VOLUME B

OUTLINE TECHNICAL SPECIFICATIONS

SECTION 00 01 10.00 48 TABLE OF CONTENTS

DIVISION 03 -CONCRETE

03 11 13.00 48 Structural Cast-In-Place Concrete Forming
03 11 19.00 48 Insulating Concrete Form (ICF) System
03 20 00.00 48 Concrete Reinforcement
03 23 00.00 48 Stressed Tendon Reinforcement
03 30 00.00 48 Cast -in-Place Concrete
03 45 00.00 48 Precast Architectural Concrete
03 45 33.00 48 Precast Structural Concrete

DIVISION 04 - MASONRY

04 20 00.00 48 Unit Masonry
04 72 00.00 48 Cast Stone

DIVISION 05 - METAL

05 12 00.00 48 Structural Steel
05 21 00.00 48 Steel Joist Framing
05 31 00.00 48 Steel Decks
05 40 00.00 48 Cold-Formed Metal Framing
05 50 00.00 48 Metal Fabrications

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

06 10 00.00 48 Rough Carpentry
06 20 00.00 48 Finish Carpentry
06 61 16.00 48 Solid Surfacing Fabrication

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 11 13.00 48 Bituminous Dampproofing
07 19 00.00 48 Water Repellent Coating
07 21 00.00 48 Building Insulation
07 22 00.00 48 Roof and Deck Insulation
07 31 00.00 48 Fiber Glass Based Asphalt Shingle Roof System
07 41 14.00 48 Hydrostatic (Water Tight) Standing Seam Metal Roofing System (HS-SSMRS)
07 42 13.00 48 Metal Wall Panels
07 52 00.00 48 Modified Bituminous Roofing System
07 53 00.00 48 Ethylene Propylene Diene Monomer Roofing
07 54 19.00 48 Thermoplastic Membrane Roofing System
07 60 00.00 48 Flashing and Sheet Metal
07 84 00.00 48 Firestopping
07 90 00.00 48 Joint Sealers

DIVISION 08 - OPENINGS

08 11 13.00 48 Steel Doors and Frames
08 11 16.00 48 Aluminum Doors and Frames
08 14 00.00 48 Wood Doors
08 31 13.00 48 Access Doors and Frames
08 33 13.00 48 Metal Coiling Counter Doors
08 33 23.00 48 Overhead Rolling Doors
08 34 59.00 48 Vault Doors and Day Gates
08 44 00.00 48 Glazed Curtain Walls
08 45 23.00 48 Insulated Translucent Fiberglass Sandwich Panel
08 51 13.00 48 Aluminum Windows

08 70 00.00 48 Door Hardware
08 80 00.00 48 Glazing
08 90 00.00 48 Louvers and Vents

DIVISION 09 - FINISHES

09 29 00.00 48 Gypsum Board
09 30 00.00 48 Ceramic Tile
09 50 00.00 48 Acoustical Ceilings
09 65 00.00 48 Resilient Flooring
09 67 00.00 48 Fluid Applied Flooring
09 68 00.00 48 Carpeting
09 72 00.00 48 Wall Coverings
09 90 00.00 48 Paints and Coatings

DIVISION 10 - SPECIALTIES

10 00 10.00 48 Miscellaneous Specialties
10 10 00.00 48 Visual Display Boards
10 12 00.00 48 Recessed Display Cases
10 14 01.00 48 Exterior Signage
10 14 02.00 48 Interior Signage
10 22 13.00 48 Plastic Toilet Partitions
10 22 13.00 48 Wire Mesh Partitions
10 22 26.00 48 Operable Partitions
10 26 00.00 48 Wall and Corner Guards
10 28 00.00 48 Toilet Accessories
10 44 00.00 48 Fire Extinguishers Cabinets and Accessories
10 50 00.00 48 Metal Lockers
10 55 00.00 48 Postal Specialties
10 56 13.00 13 Storage Shelving
10 75 00.00 48 Flag Poles

DIVISION 11 - EQUIPMENT

11 13 00.00 48 Loading Dock Equipment
11 30 00.00 48 Residential Equipment
11 52 13.00 48 Projection Screens

DIVISION 12 - FURNISHINGS

12 20 00.00 48 Window Treatment
12 48 00.00 48 Rugs and Mats

DIVISION 13 – SPECIAL CONSTRUCTION

13 34 19.00 48 Pre-Engineered Structures

DIVISION 14 – Vertical Transportation

14 24 00.00 48 Hydraulic Elevators

DIVISION 21 – FIRE SUPPRESSION

21 13 13.00 48 Wet Pipe Sprinkler Systems, Fire Protection
21 21 03.00 48 Wet Chemical Extinguishment System
21 30 00.00 48 Fire Pumps

DIVISION 22 – PLUMBING

22 11 23.00 48 Plumbing Pumps
22 13 00.00 48 Sanitary, Waste, Vent, and Storm Specialties
22 15 00.00 48 General Service Compressed Air Equipment
22 34 00.00 48 Domestic Water Heaters
22 42 00.00 48 Plumbing Fixtures

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING

23 05 29.00 48 Hangers and Supports
23 05 48.00 48 Vibration Isolation
23 05 53.00 48 Identification for HVAC Piping and Equipment
23 05 93.00 48 Testing, Adjusting, and Balancing
23 07 00.00 48 Mechanical Insulation
23 09 00.00 48 HVAC Instrumentation and Controls
23 21 13.00 48 Piping
23 21 14.00 48 Valves
23 21 23.00 48 Pumps
23 31 13.00 48 Metal Ductwork
23 33 00.00 48 Ductwork Accessories
23 34 00.00 48 Fans
23 35 16.00 48 Overhead Vehicle Tailpipe Exhaust Systems
23 36 00.00 48 Air Terminal Units
23 37 00.00 48 Air Outlets and Inlets
23 38 13.00 48 Range Hood
23 40 00.00 48 Air Cleaning Devices
23 51 00.00 48 Breeching and Stacks
23 52 00.00 48 Heating Boilers and Accessories
23 54 16.00 48 Direct-Fired Makeup Air Units
23 64 10.00 48 Packaged Air-Cooled Scroll Chillers
23 64 26.00 48 Packaged Air-Cooled Rotary Screw Chillers
23 73 00.00 48 Air Handling Units
23 81 26.00 48 Split System Air Conditioning Units
23 81 43.00 48 Air-To-Air Heat Pumps
23 82 00.00 48 Terminal Heating Units
23 82 19.00 48 Fan Coil Units
23 83 00.00 48 Radiant Floor Heating System
23 84 16.00 48 Dehumidifier Units

DIVISION 26 – ELECTRICAL

26 05 00.00 48 Common Work Results for Electrical
26 05 19.00 48 Low-Voltage Electrical Power Conductors and Cables
26 05 26.00 48 Grounding and Bonding for Electrical Systems
26 05 29.00 48 Hangers and Supports for Electrical Systems
26 05 33.00 48 Raceway and Boxes for Electrical Systems
26 05 53.00 48 Identification for Electrical Systems
26 06 00.00 48 Electrical Utility Services
26 08 00.00 48 Equipment Inspection and Testing
26 22 00.00 48 Low-Voltage Transformers
26 24 00.00 48 Switchboards, Panelboards, and Control Centers
26 27 13.00 48 Electricity Metering
26 27 26.00 48 Wiring Devices
26 28 16.00 48 Enclosed Switches and Circuit Breakers
26 29 00.00 48 Enclosed Controllers
26 41 13.00 48 Lightning Protection

26 51 00.00 48 Interior Lighting
26 56 00.00 48 Exterior Lighting
26 60 13.00 48 Low-Voltage Motors

DIVISION 27 – COMMUNICATIONS

27 51 16.00 48 Public Address System

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 20 01.00 48 Electronic Security System
28 31 76.00 48 Fire Alarm and Mass Notification Systems

DIVISION 31 - EARTHWORK

31 00 00.06 48 Earthwork
31 11 00.00 48 Clearing and Grubbing
31 31 16.13 48 Chemical Termite Control

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 01 19.00 48 Field Molded Sealants for Sealing Joints in Rigid Pavement
32 05 33.00 48 Landscaping
32 11 20.00 48 Base Course for Rigid and Subbases for Flexible Paving
32 12 16.00 48 Hot Mix Asphalt (HMA) for Roads
32 13 13.06 48 Portland Cement Concrete Pavement for Road and Site Facilities
32 17 23.00 48 Pavement Markings
32 32 23.00 48 Segmental Concrete Block Retaining Wall
32 84 24.00 48 Landscape Irrigation

DIVISION 33 – UTILITIES

33 11 00.00 48 Water Utility Distribution Piping
33 11 01.00 48 Advanced Water Meter Specification
33 30 00.00 48 Sanitary Sewerage
33 40 00.00 48 Storm Drainage Utilities
33 46 13.00 48 Foundation Drainage System
33 46 16.00 48 Sub-drainage Piping
33 51 15.00 48 Natural Gas / Liquid Petroleum Gas Distribution
33 51 16.00 48 Advanced Natural Gas Meter Specification
33 70 02.00 48 Electric Distribution System

DIVISION 41 – MATERIALS PROCESSING AND HANDLING EQUIPMENT

41 22 00.00 48 Hoists and Cranes

---END OF TABLE OF CONTENTS---

08 70 00.00 48 Door Hardware
08 80 00.00 48 Glazing
08 90 00.00 48 Louvers and Vents

DIVISION 09 - FINISHES

09 29 00.00 48 Gypsum Board
09 30 00.00 48 Ceramic Tile
09 50 00.00 48 Acoustical Ceilings
09 65 00.00 48 Resilient Flooring
09 67 00.00 48 Fluid Applied Flooring
09 68 00.00 48 Carpeting
09 72 00.00 48 Wall Coverings
09 90 00.00 48 Paints and Coatings

DIVISION 10 - SPECIALTIES

10 00 10.00 48 Miscellaneous Specialties
10 10 00.00 48 Visual Display Boards
10 12 00.00 48 Recessed Display Cases
10 14 01.00 48 Exterior Signage
10 14 02.00 48 Interior Signage
10 22 13.00 48 Plastic Toilet Partitions
10 22 13.00 48 Wire Mesh Partitions
10 22 26.00 48 Operable Partitions
10 26 00.00 48 Wall and Corner Guards
10 28 00.00 48 Toilet Accessories
10 44 00.00 48 Fire Extinguishers Cabinets and Accessories
10 50 00.00 48 Metal Lockers
10 55 00.00 48 Postal Specialties
10 56 13.00 13 Storage Shelving
10 75 00.00 48 Flag Poles

DIVISION 11 - EQUIPMENT

11 13 00.00 48 Loading Dock Equipment
11 30 00.00 48 Residential Equipment
11 52 13.00 48 Projection Screens

DIVISION 12 - FURNISHINGS

12 20 00.00 48 Window Treatment
12 48 00.00 48 Rugs and Mats

DIVISION 13 – SPECIAL CONSTRUCTION

13 34 19.00 48 Pre-Engineered Structures

DIVISION 14 – Vertical Transportation

14 24 00.00 48 Hydraulic Elevators

DIVISION 21 – FIRE SUPPRESSION

21 13 13.00 48 Wet Pipe Sprinkler Systems, Fire Protection
21 21 03.00 48 Wet Chemical Extinguishment System
21 30 00.00 48 Fire Pumps

DIVISION 22 – PLUMBING

22 11 23.00 48 Plumbing Pumps
22 13 00.00 48 Sanitary, Waste, Vent, and Storm Specialties
22 15 00.00 48 General Service Compressed Air Equipment
22 34 00.00 48 Domestic Water Heaters
22 42 00.00 48 Plumbing Fixtures

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING

23 05 29.00 48 Hangers and Supports
23 05 48.00 48 Vibration Isolation
23 05 53.00 48 Identification for HVAC Piping and Equipment
23 05 93.00 48 Testing, Adjusting, and Balancing
23 07 00.00 48 Mechanical Insulation
23 09 00.00 48 HVAC Instrumentation and Controls
23 21 13.00 48 Piping
23 21 14.00 48 Valves
23 21 23.00 48 Pumps
23 31 13.00 48 Metal Ductwork
23 33 00.00 48 Ductwork Accessories
23 34 00.00 48 Fans
23 35 16.00 48 Overhead Vehicle Tailpipe Exhaust Systems
23 36 00.00 48 Air Terminal Units
23 37 00.00 48 Air Outlets and Inlets
23 38 13.00 48 Range Hood
23 40 00.00 48 Air Cleaning Devices
23 51 00.00 48 Breeching and Stacks
23 52 00.00 48 Heating Boilers and Accessories
23 54 16.00 48 Direct-Fired Makeup Air Units
23 64 10.00 48 Packaged Air-Cooled Scroll Chillers
23 64 26.00 48 Packaged Air-Cooled Rotary Screw Chillers
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23 81 26.00 48 Split System Air Conditioning Units
23 81 43.00 48 Air-To-Air Heat Pumps
23 82 00.00 48 Terminal Heating Units
23 82 19.00 48 Fan Coil Units
23 83 00.00 48 Radiant Floor Heating System
23 84 16.00 48 Dehumidifier Units

DIVISION 26 – ELECTRICAL

26 05 00.00 48 Common Work Results for Electrical
26 05 19.00 48 Low-Voltage Electrical Power Conductors and Cables
26 05 26.00 48 Grounding and Bonding for Electrical Systems
26 05 29.00 48 Hangers and Supports for Electrical Systems
26 05 33.00 48 Raceway and Boxes for Electrical Systems
26 05 53.00 48 Identification for Electrical Systems
26 06 00.00 48 Electrical Utility Services
26 08 00.00 48 Equipment Inspection and Testing
26 22 00.00 48 Low-Voltage Transformers
26 24 00.00 48 Switchboards, Panelboards, and Control Centers
26 27 13.00 48 Electricity Metering
26 27 26.00 48 Wiring Devices
26 28 16.00 48 Enclosed Switches and Circuit Breakers
26 29 00.00 48 Enclosed Controllers
26 41 13.00 48 Lightning Protection

26 51 00.00 48 Interior Lighting
26 56 00.00 48 Exterior Lighting
26 60 13.00 48 Low-Voltage Motors

DIVISION 27 – COMMUNICATIONS

27 51 16.00 48 Public Address System

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 20 01.00 48 Electronic Security System
28 31 76.00 48 Fire Alarm and Mass Notification Systems

DIVISION 31 - EARTHWORK

31 00 00.06 48 Earthwork
31 11 00.00 48 Clearing and Grubbing
31 31 16.13 48 Chemical Termite Control

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 01 19.00 48 Field Molded Sealants for Sealing Joints in Rigid Pavement
32 05 33.00 48 Landscaping
32 11 20.00 48 Base Course for Rigid and Subbases for Flexible Paving
32 12 16.00 48 Hot Mix Asphalt (HMA) for Roads
32 13 13.06 48 Portland Cement Concrete Pavement for Road and Site Facilities
32 17 23.00 48 Pavement Markings
32 32 23.00 48 Segmental Concrete Block Retaining Wall
32 84 24.00 48 Landscape Irrigation

DIVISION 33 – UTILITIES

33 11 00.00 48 Water Utility Distribution Piping
33 11 01.00 48 Advanced Water Meter Specification
33 30 00.00 48 Sanitary Sewerage
33 40 00.00 48 Storm Drainage Utilities
33 46 13.00 48 Foundation Drainage System
33 46 16.00 48 Sub-drainage Piping
33 51 15.00 48 Natural Gas / Liquid Petroleum Gas Distribution
33 51 16.00 48 Advanced Natural Gas Meter Specification
33 70 02.00 48 Electric Distribution System

DIVISION 41 – MATERIALS PROCESSING AND HANDLING EQUIPMENT

41 22 00.00 48 Hoists and Cranes

---END OF TABLE OF CONTENTS---

SECTION 03 11 13.00 48 STRUCTURAL CAST-IN-PLACE CONCRETE FORMING

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ACI INTERNATIONAL (ACI)

ACI 117	Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 301	Specifications for Structural Concrete
ACI 347R	Guide to Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C578	Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001	Principles and Criteria for Forest Stewardship

NATIONAL INSTITUTE O F STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	DOC Voluntary Product, Structural Plywood

General: 1. DESIGN REQUIREMENTS: The design, engineering, and construction of the formwork shall be the responsibility of the Contractor. Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in the Construction Documents. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

2. SUBMITTALS: The following shall be submitted to the Engineer of Record for approval in accordance with Section 01 33 00.00 48 SUBMITTAL PROCEDURES:
   a. Shop drawings: Drawings showing details of formwork, including dimensions of fiber voids, joints, supports, studding and shoring, and sequence of form and shoring removal shall be submitted at least 30 days either before fabrication on site or before delivery of prefabricated forms. If reshoring is permitted, submit the method, including the location, order and time of erection and removal.
   b. Product data: Design analysis and calculations for form design and methodology used in the design shall be submitted at least 30 days either before fabrication on site or before delivery of prefabricated forms.
   c. Test reports: The Contractor shall submit field inspection reports for concrete forms and embedded items. If forms are to be removed in less than 24 hours on formwork not supporting the weight of concrete, the evaluation and results of the control cylinder tests shall be submitted to and approved before the forms are removed.
   d. Certificates; Certificates attesting the fiber voids conform to the specified requirements.

3. STORAGE AND HANDLING: Form materials shall be stored above ground level in a dry location. Form materials shall be kept dry until installed and overlaid with concrete.

Products: 1. FORM MATERIALS
   a. Forms for Class A and B surfaces shall be plywood panels conforming to PS-1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the

smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels. Forms for round columns shall be the prefabricated seamless type. Forms for Class C and D surfaces shall be as accepted by the Engineer and/or Architect of record.

b. Retain-In-Place Metal Forms: Retain-in-place metal forms for concrete slabs and roofs shall be as specified in Section 05 30 00.00 48 STEEL DECK.
c. Pan-Form Units: Pan-form units for one-way or two-way concrete joist and slab construction shall be factory-fabricated units of the approximate section indicated. Units shall consist of stell or molded fiberglass concrete form pans. Closure units shall be furnished as required.
d. Form Ties: Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 1/4 inch nor more than 1 inch deep and not more than 1 inch in diameter. Removable tie rods shall be not more than 1-1/2 inches in diameter. Plastic snap ties may be used in locations where the surface will not be exposed to view.
e. Form Releasing Agents: Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.
f. Fiber Voids: Fiber voids shall be the product of a reputable manufacturer regularly engaged in the commercial production of fiber voids. The voids shall be constructed of double faced, corrugated fiberboard. The corrugated fiberboard shall be fabricated of wet strength paper liners, impregnated with paraffin, and laminated with moisture resistant adhesive, and shall have a board strength of 275 psi. Voids which are impregnated with paraffin after construction, in lieu of being constructed with paraffin impregnated fiberboard, are acceptable. Voids shall be designed to support not less than 1000 psf. To prevent separation during concrete placement fiber voids shall be assembled with steel or plastic banding or by adequate stapling or gluing as recommended by the manufacturer. Fiber voids placed under concrete slabs and that are at least 8 inches in depth may be heavy duty "waffle box" type, constructed of paraffin impregnated corrugated fiberboard.
g. FIBER VOID RETAINERS:
    1) 2.2.1 Polystyrene Rigid Insulation: Polystyrene rigid insulation shall conform to ASTM C 578, Type V, VI, or VII, square edged. Size shall be 1-1/2 inches thick by 16 inches in height by 3 feet in length, unless otherwise indicated by the Engineer of Record.
    2) 2.2.2 Precast Concrete: Precast concrete units shall have a compressive strength of not less than 2500 psi, reinforced with 6 inch by 6 inch by W1.4 WWF wire mesh, and 12 inches (height) by 3 feet (length) by 1-5/8 inches (thickness) in size unless otherwise indicated.

--- End of Section ---

SECTION 03 11 19.00 48 INSULATING CONCRETE FORM (ICF) SYSTEM

Scope: 1. Insulating Concrete Form (ICF) System

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ACI INTERNATIONAL (ACI)

ACI 117	Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 301	Specifications for Structural Concrete
ACI 305R	Guide to Hot Weather Concreting
ACI 306.1	Standard Specification for Cold Weather Concreting
ACI 318	Building Code Requirements for Structural Concrete and Commentary
ACI 347	Guide to Formwork for Concrete

ASTM INTERNATIONAL (ASTM)

ASTM C177	Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
ASTM C203	Standard Test Method for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
ASTM C518	Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C578	Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM D1621	Compressive Properties of Rigid Cellular Plastics
ASTM D1622	Apparent Density of Rigid Cellular Plastics
ASTM D1761	Standard Test Methods for Mechanical Fasteners in Wood
ASTM D7611	Standard Practice for Coding Plastic Manufactured Articles for Resin Identification
ASTM E119	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E2634	Standard Specification for Flat Wall Insulating Concrete Form (ICF) Systems
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E90	Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

INTERNATIONAL CODE COUNCIL (ICC)

Acceptance Criteria AC353: Stay-In-Place Foam Insulating Concrete (ICF) Systems for Solid Concrete Walls.

System Description:

1. The ICF System shall include expanded polystyrene (EPS) concrete forming units used to construct a monolithic reinforced concrete wall. The forms shall remain in place, providing a concrete wall that shall be finished with conventional interior and exterior wall coverings. Form unit types and sizes shall be as determined by the ICF manufacturer to provide the walls indicated in the drawings.

Submittals: 1. Shop Drawings: Provide plan and elevation drawings showing details of all ICF wall sections, including dimensions of openings, construction joints, bracing supports, studding and shoring, and sequence of shoring removal. ICF shop drawings shall indicate coordination with other

trades to show, penetrations, steel embeds, etc. Drawings shall indicate that all trades have verified interface of work with ICF walls.

2. Product Data
   a. ICF Wall System Design; Design analysis and calculations for ICF design and methodology used in the design.
   b. ICF Form Materials; Manufacturer's data including literature describing form materials and accessories.
3. Samples Mock-Up Installation of ICF
4. Test Reports ICC ES Evaluation Report
5. Certificates: ICF Form Materials Submit 3rd party agency certification stating that products supplied for the ICF System meet the requirements of ASTM E2634.
   a. Qualification of ICF Manufacturer
   b. Qualification of ICF Technical Advisor
   c. Qualification of ICF Installation Company
   d. Training Certificates for CQCSM & Superintendent
6. Manufacturer's Instructions: ICF Installation; Provide manufacturer's standard printed instructions for the installation of the ICF wall system.
7. Operation and Maintenance Data: Plastic Identification

Quality Control:

1. Qualification of ICF Manufacturer: The ICF system shall be the product of a manufacturer who has been successfully developing shop drawings and producing ICF products for a period of not less than 5 years and who has experience on at least 5 projects similar to this project in size, scope, and complexity. Manufacturer shall have an ICC ES Evaluation Report or a certification showing conformance to ASTM E2634 as evidence that the Insulating Concrete Forming (ICF) units are compliant.
2. Qualification of ICF Technical Advisor: The Contractor shall engage the on-site, full time services of a Factory-Trained Installer or ICF technical advisor for the duration of the work under this Section. The ICF technical advisor shall have received instructional training in the installation of the ICF system forms and shall have supervised an installation crew on site for at least 3 years and at minimum 5 projects. At least one project shall have been similar to this project having a minimum of 40,000 gross sq/ft of ICF wall area and no less than 10,000 gross SF of ICF wall area with a height of 25 feet or taller from foundation to top of ICF wall. Submit the technical advisor's resume to include the listing of past projects meeting the above criteria with current contact names and phone numbers. The instructional training shall have been taken within the last 5 years and shall have been administered by the ICF manufacturer used for this project. The ICF Technical Advisor shall be approved by the ICF Manufacturer.
3. Qualification of ICF Installation Company: The ICF installation company shall have demonstrated successful performance on 5 relevant projects, each with a minimum of 40,000 gross sq/ft of ICF wall area and no less than 10,000gross SF of ICF wall area with a height of 25 feet or taller from foundation to top of ICF wall. All relevant projects shall have been substantially completed within 8 years prior this project's issue date. Submit the company's resume to include the listing of past projects meeting the above criteria with current contact names and phone numbers. Failure to provide and fulfill these criteria will result in immediate rejection of the entire installation company.
4. Training Certificates for CQCSM & Superintendent: Prior to ICF installation, the CQCSM and the project superintendent shall be trained by the ICF manufacturer or the ICF Technical Advisor on the product's installation in accordance with the manufacturer's published installation instructions, and manufacturer recommendations not covered in the published installation instructions. Submit appropriate training certificates. If either person is replaced, the replacement shall also be trained.
5. ICF Installation Company Workforce Requirement: The submitted and approved ICF installation company shall provide at all times during installation of the ICF, a labor force for the installation of the ICF consisting of a minimum of 25% of that force being dutifully employed directly by the ICF installation company. Further Sub-contracting of ICF installation labor shall at no time exceed 75% of the installation labor during the entire ICF construction period.
6. Special Inspector: The special inspector shall perform special inspections in accordance with

Section 01 45 35 SPECIAL INSPECTIONS. The special inspector shall also inspect the work to initial the pre-pour and post pour inspection checklists.

7. Pre-Installation Meetings: Prior to commencement of ICF installation and associated work, the contractor shall conduct a meeting at the project site with the Contracting Officer, ICF manufacturer's representative, ICF Technical Advisor, ICF installation company, and trades responsible for installing concrete. The meeting shall include review of approved submittals for coordination of various trades such as that for windows, doors, bucks, [integral steel frame,] concrete supply, and structural steel. The Installation Quality Control Plan, pre-pour checklist (Attachment A), and post pour checklist (Attachment B) shall also be reviewed.
   a Contractor shall give the Contracting Officer's Representative and the Structural Engineer of Record a 7-day notice (minimum) prior to the placement of concrete within the ICF Wall System.
8. Mock-Ups: Complete Mock-Up Installation of ICF prior to start of ICF installation with full-size erected assemblies with features to include at least one window, a sleeve penetration, and a structural steel embed/face plate. Mock-up shall establish the materials and construction techniques and quality used for the project, providing visual effect, tolerances, alignment, bracing, etc as required and approved by the COR. [This mock-up shall be integrated with the masonry wall sample required in Section 04 20 00.00 48 Unit Masonry.] Materials and construction methods used for the mock-up shall be those proposed for actual construction in the shop drawings, meeting the following requirements:
   a. Locate mock-up installation in the location as approved by the Contracting Officer.
   b. Demonstrate the required concrete thickness, insulation and workmanship.
   c. Demonstrate window openings with sill, head, jambs, and proposed bucks[and integrated steel frame systems].
   d. Demonstrate electrical sleeve penetration and sealant used at interface with ICF formwork.
   e. Obtain Contracting Officer's written approval of mock-up before starting fabrication of ICF work.
   f. Maintain mock-up installation during construction as a standard for judging the completed work by protecting mock-up from weather and construction activities. When directed, demolish and remove the mock-up from the site. Mock-up shall not be used as part of any finished construction.

Products:1. ICF Form Materials shall be provided in accordance with the manufacturer, other specifications herein, and the following:
   a. ICF Wall System Design: Form capacity testing shall be provided by manufacturer or formwork shall be provided in accordance with the methodology of ACI 347 for anticipated loads, lateral pressures, and stresses, and capable of withstanding the pressures resulting from placement and vibration of concrete. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03 30 00.00 48 CAST-IN-PLACE CONCRETE.
   b. ICF Performance Requirements The Insulating Concrete Forms (ICF) wall system shall provide minimum [100 mm 4 inches] [150 mm 6 inches] [200 mm 8 inches] [250 mm 10 inches] [300 mm 12 inches] forming cavity width. Provide cross ties in the ICF wall system at 200 mm 8 in o.c. maximum. ICF system shall have fastening strips 25 mm with 1 inch minimum flange width for the full vertical or horizontal span of the wall on each side to fasten exterior and interior wall finishes. Space fastening strips at a maximum of 40616 inches on center. Wall system shall provide accurate positioning of concrete reinforcing bars within the form cavity conforming to ACI 318. Material in contact with the ICF form must be compatible with the expanded polystyrene. Form materials shall not cause a thermal bridging effect.
   c. ICF Design Criteria ICF units shall provide a minimum rigid insulation R-value as specific in Section 01 02 00.00 48 STATEMENT OF WORK [The ICF with concrete installed shall have a minimum rating of Sound Transmission Class (STC) [50][___] sound attenuation performance as tested in accordance with Test Method ASTM E90.] [Required fire resistive-rated construction shown on the drawings of the ICF wall including forms, cross tie material, and concrete shall be in accordance with Test Methods ASTM E119.]
   d. The Insulating Concrete Forms System shall conform to the following requirements:

1) Density: ASTM D1622, 1.35 lb/ft^3
2) Thermal Resistance (R-Value) ASTM C177, 4.0 F.ft^2.h/Btu per in minimum
3) Compressive Strength: ASTM D1621, 15.0psi
4) Flexural Strength: ASTM C203, 35.0 psi (minimum)
5) Flame Spread: ASTM E84, 25 (maximum)
6) Smoke Developed: ASTM E84450 (maximum).

2. ICF Form Materials shall be as follows:
   a. Expanded Polystyrene (EPS): Expanded Polystyrene shall conform to ASTM C578. Provide Type II EPS panels. EPS shall provide maximum vapor permeation of 3.5 perm-in. EPS thickness on each side shall be [ ][as shown on the drawings]. An alternate EPS thickness may be used if approved, and the contractor shall be responsible for coordinating the alternate dimensions throughout the project.
   b. Cross Ties and Fastening Strips: Cross ties shall be high density polypropylene or galvanized welded steel with minimum 11-gauge thick wire welded in multiple locations by the ICF manufacturer. Each tie shall be further reinforced on both sides with a welded 1-inch wide minimum, 22-gauge galvanized steel attachment furring strip or stud, or equivalent high density polypropylene furring strip or stud, providing strength for the secure attachment of wall coverings. The furring strips or studs are recessed up to [1 1/2-inch][ ] below the surface of the EPS and are identified by lines on the forms. Furring strips or studs shall be spaced 8 inches on center, maximum. In the completed wall system, each attachment stud shall be rigidly anchored to the concrete by the galvanized welded steel tie or equivalent high density polypropylene tie.
3. ICF Accessories
   a. Bracing, Scaffolding, and Wall Alignment: Provide information showing Insulating Concrete Forms Wall Alignment system shoring, and sequence of shoring to be used during ICF installation. Support ICF system prior to the attachment of permanent structural elements to protect the ICF components from damage during construction.
   b. Door and Window Bucks
      1) [Use manufacturer's standard bucks to frame door and window openings without creating thermal bridging. Door and window frame construction shall not result in exposed bucks as indicated in the drawing details.]
      2) [Provide an integral steel frame (ISF) buck system to serve as bracing ICF for openings that remains in place to receive aluminum frame door and window units, steel window units, and steel doors, where shown on the drawings, after ICF wall construction is complete.
      3) ICF shall include thermal breaks to eliminate thermal bridging. ICF shall be designed by the ICF manufacturer to be poured-in-place with the ICF walls to perform as the bucking assembly for aluminum doors and windows or as the framing assembly for steel doors and steel window frames. Integral frames for windows shall be compatible with the window assembly and the window assembly's load requirements for the window's connection into the integral frame.]
   c. Waterproofing: Waterproofing material for below grade application shall be compatible with EPS system or shall be integral to the EPS material.
   d. Fasteners: Fasteners of interior and exterior wall finishes to ICF wall system shall conform to ASTM D1761. Fasteners shall be corrosion-resistant and have sufficient length to penetrate the flanges of the fastening strips.
   e. Concrete: Comply with Section 03 30 00.00 48 CAST-IN-PLACE CONCRETE

ATTACHMENT A

ICF Pre-Pour Checklist

The following checklist shall be initialed and signed/dated, in order, by the following:

- ICF Installation Company (ICF Sub),
- Contractor's Quality Control System Manager (CQCSM),
- Special Inspector (per UFGS Section 01 45 35),
- USACE Representative.

Concrete pours shall not begin until each item is initialed AND each person has signed this checklist.

Checklist Item:	ICF Sub	CQC SM	Sp Insp	USACE Rep
a. Have ICF walls been installed according to drawing dimensions and verified field survey marks	____	____	____	____
b. Has ICF alignment system and shoring been installed per accepted plan and manufactures recommendations	____	____	____	____
c. Has wall rebar been installed per construction drawings and specifications in all locations?	____	____	____	____
b. Has lintel reinforcement been installed per construction drawings and specifications?	____	____	____	____
e. Are all openings installed and in correct location?	____	____	____	____
f. Are all rough openings level, plumb and of correct dimensions per construction documents?	____	____	____	____
g. Has proper anchorage for buck material been used?	____	____	____	____
h. Have construction joint forms and reinforcement been installed per agreed details?	____	____	____	____
i. Have all service penetration sleeves been installed?	____	____	____	____
j. Have all T junctions, pilasters or columns been shored or braced adequately?	____	____	____	____
k. Have all beam pockets, steel embeds or face plates been installed and locations verified?	____	____	____	____
l. Have all string lines for wall line verification been installed around perimeter of building?	____	____	____	____
m. Have walls been straightened?	____	____	____	____
n. Have all corners and openings been verified for level and plumbness?	____	____	____	____
o. If applicable, has the Cold/Hot Weather Concreting Plan been accepted and followed?	____	____	____	____

p. If no protection was provided, have measures been taken to remove all snow and ice from the forms?

____ ____ ____ ____

q. Confirm vibrators for internal concrete consolidation are correct size and length and are operational?

____ ____ ____ ____

r. Are there back up materials in case of blowout? (i.e. blow-out kits and screw gun available)

____ ____ ____ ____

s. Ensure concrete ordered and delivered to site conforms to pre-approved mix design as specified.

____ ____ ____ ____

t. Has the quantity of concrete been properly calculated and checked against the build?

____ ____ ____ ____

u. Have concrete deliveries and interval timing for trucks been coordinated with concrete supplier?

____ ____ ____ ____

v. Ensure concrete pump operator reviews site condition prior to day of pour and concrete placement plan. ____ ____ ____ ____

w. Ensure concrete pump discharge line has been configured with proper reducers and flexible placement hose. ____ ____ ____ ____

x. Ensure ICF Subcontractor has appropriate number of personnel onsite to manage concrete placement and has assigned crew members to manage post placement wall alignment and plumb checks.

____ ____ ____ ____

_____ _____

ICF Installation Company Rep Date

_____ _____

Project CQCSM Date

_____ _____

Special Inspector Date

_____ _____

Government Representative Date

ATTACHMENT B

ICF Post Pour Checklist

The following checklist shall be initialed, in order, by the following.

- ICF Installation Company (ICF Sub),
- Contractor's Quality Control System Manager (CQCSM),
- Special Inspector (per UFGS Section 01 45 35),
- USACE Representative.

Work covering or enclosing the ICF System on either side of the walls shall only occur after each item is initialed AND each person has signed this checklist.

Checklist Item:	ICF Sub	CQC SM	Sp Insp	USACE Rep
a. Have all walls been properly consolidated?	____	____	____	____
b. Ensure properly consolidated at all beam pockets, steel embed or face plates.	____	____	____	____
c. Ensure properly consolidated at locations of possible rebar congestions, i.e. lintels, pilasters, columns, etc.	____	____	____	____
d. Check wall areas for possible voids by probe testing to depth gauge at possible rebar congestion locations.	____	____	____	____
e. Have the walls been preliminarily straightened to plumb?	____	____	____	____
f. For final pour, has the top of wall been screeded level?	____	____	____	____
g. For wall continuing up, is all cold joint reinforcement in place with proper lap splice and top of concrete left rough?	____	____	____	____
h. Ensure final fine adjustment of all walls been completed using installed string lines tape measure and laser level.	_____	____	____	____
i. Ensure all opening dimensions have been maintained, headers and sills are level and jambs are plumb.	____	____	____	____
j. Ensure all wall areas are within planer tolerances.	____	____	____	____
k. Confirm all structural embeds, face plates and beam pockets install correctly and location/ elevation verified by surveyor.	____	____	____	____
l. Cold weather pouring – has top of wall been protected from freezing i.e. Thermal blanket, etc.	____	____	____	____
m. Has alignment system been cleaned of all excess concrete?	____	____	____	____
n. Has all excess concrete been clear from job site area?	____	____	____	____

_____ _____

ICF Installation Company Rep Date

_____ _____

Project CQCSM Date

_____ _____

Special Inspector Date

_____ _____

Government Representative Date

---End of Section---

SECTION 03 20 00.00 48 CONCRETE REINFORCEMENT

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ACI INTERNATIONAL (ACI)

ACI 117	Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 318	Building Code Requirements for Structural Concrete and Commentary
ACI 318M	Metric Building Code Requirements for Structural Concrete and Commentary
ACI SP-66	ACI Detailing Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	Structural Welding Code – Reinforcing Steel

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A1064/A1064M	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A53/A53M	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A184/A184M	Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A185/A185M	Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement
ASTM A496/A496M	Steel Wire, Deformed, for Concrete
ASTM A497/A497M	Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A615/A615M	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A675/A675M	Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A706/A706M	Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767/A767M	Zinc-Coated (Galvanized) Steel Bars in Concrete Reinforcement
ASTM A775/A775M	Epoxy-Coated Steel Reinforcment Bars
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A820/A820M	Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
ASTM A884/A884M	Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM C1116	Fiber-Reinforced Concrete

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	Manual of Standard Practice
CRSI RB4.1	Supports for Reinforcement Used in Concrete

General: 1. SUBMITTALS: The following shall be submitted to the Engineer of Record for approval in accordance with Section 01 33 00.00 48 SUBMITTAL PROCEDURES:

a. Shop Drawings: Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

b. Certificates:

1) Reinforcing Steel; Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

2) Welder certificates, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

2. WELDING: Welders shall be qualified in accordance with AWS D1.4/D1.4M. Qualification test shall be performed at the worksite and the Contractor shall notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4.

3. DELIVERY AND STORAGE: Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

Products:

1. DOWELS: Round dowels shall conform to to ASTM A675/A675M, Grade 80. Steel pipe conforming to ASTM A53/A53M, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar. Proprietary steel dowel systems may be used with the approval of the Structural Engineer of Record and acceptance of the Contracting Officer.

2. FABRICATED BAR MATS: Fabricated bar mats shall conform to ASTM A184/A184M.

3. REINFORCING STEEL: Reinforcing steel shall be deformed bars conforming to ASTM A615/A615M or ASTM A706/A706M, grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A1064/A1064M. In highly corrosive environments or when directed by the Engineer, reinforcing steel shall conform to ASTM A767/A767M as appropriate.

4. WELDED WIRE FABRIC: Welded wire fabric shall conform to ASTM A185/A185M.. When directed by the EngineerEngineerfor special applications, welded wire fabric shall conform to ASTM A884/A884M. Welded wire fabric shall be transported and delivered in flat sheets.

5. WIRE TIES: Wire ties shall be 16 ga. or heavier black annealed steel wire.

6. SUPPORTS: Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI 10MSP and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

7. Welds: Weld reinforcement in accordance with AWS D1.4 and AWS D12.1. Welding shall be limited to A706 reinforcing only.

8. SYNTHETIC FIBER REINFORCEMENT: Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of 2 inches.

--- End of Section ---

SECTION 03 23 00.00 48 STRESSED TENDON REINFORCING

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ACI INTERNATIONAL (ACI)

ACI 318	Building Code Requirements for Structural Concrete and Commentary
ACI 318M	Metric Building Code Requirements for Structural Concrete and Commentary
ACI SP-66	ACI Detailing Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A416/A416M	Standard Specification for Low-Relaxation, Seven-Wire for Prestressed Concrete
ASTM A421/A421M	Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete
ASTM A722/A722M	Standard Specifications for Uncoated High-Strength Steel Bar for Prestressing Concrete
ASTM C109/C109M	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube specimens)

POST-TENSIONING INSTITUTE (PTI)

PTI M10.3	Field Procedures Manual for Unbonded Single Strand Tendons
PTI M50.3	Guide Specification for Grouted Post-Tensioning
PTI M55.1	Specification for Grouting of Post-Tensioned Structures
PTI-CRT-20 G1-1015	Manual for Certification of Plants Producing Unbonded Single Strand Tendons

General:

1. SUBMITTALS: The following shall be submitted to the Engineer of Record for approval in accordance with Section 01 33 00.00 48 SUBMITTAL PROCEDURES:
   a. Shop Drawings; Installation drawings for tendons and accessories shall be submitted and approved prior to commencing the work.
   b. Product Data
      1) Materials Disposition Records; Records which identify the incorporation of approved materials into the work shall be submitted before completion of the contract.
   c. Test Reports
      1) Stressing Tendons and Accessories; Certified materials test reports shall be submitted for all required materials tests, note the specific standards followed in the performance of tests, show that materials comply with the applicable specifications, be submitted for each material shipment and be identified with specific lots prior to use of materials in the work.

2. DELIVERY, STORAGE AND HANDLING OF MATERIALS: Materials shall be suitably wrapped, packaged or covered at the factory to prevent being affected by dirt, water and rust. Materials shall be protected against abrasion or damage during shipment and handling. Materials stored at the site shall be placed above ground on elevated covered platforms.

Products:

1. MATERIALS: Stressing tendons and accessories shall conform to the requirements of ACI 318 except as specified.
   a. Stressing Tendons: Stressing tendons shall be clean and free of loose rust, scale and pitting. Unbonded tendons shall be permanently protected from corrosion with an approved applied coating.

1) Seven-Wire Stress-Relieved Strand and Strand Assemblies: Seven-wire stress-relieved strand shall conform to ASTM A416/A416M.
2) High-Strength Steel Bars: High-strength steel bars shall conform to ASTM A722/A722M, Type I or II, meeting all supplementary requirements.
3) Accessories:
   i. Ducts: Provide tendon ducts of galvanized sheet steel or plastic, capable of transmitting forces from grout to the surrounding concrete, flexible enough to conform to the tendon profile and strong enough to maintain their shape without deforming, sagging, or collapsing during concrete placement and vibration. The inside diameter of the ducts must be large enough to provide an internal area at least two and a half times the gross area of multiple wire, bar or strand assemblies and must be at least 1/2-inch larger than the diameter of a single wire, bar or strand placed in the ducts. Design ducts for watertight connections with all fittings.
   ii. Anchorage and couplers: Anchorages and couplers must be metal of proven corrosion resistance and compatible with the stressing tendons, capable of developing 95 percent of the actual breaking strength of the strands. Anchorages must be the button-head, wedge, nut and thread, grip nut, thread-bar, threaded plate or other approved type and must be provided with bearing plates bars, rings, bells or other positive-attaching anchor fittings. Provide couplers with housings long enough to permit the necessary movements and fittings which allow complete grouting of all components. Bar couplers must meet the requirements of ASTM A722/A722M and develop 100 percent of the minimum bar ultimate tensile strength.
   iii. Grout: Grout for grouting post-tensioned tendons must be a Class C in accordance with PTI M55.1. The minimum 7-day compressive strength of 2-inch grout cubes, molded, cured and tested in accordance with ASTM C109/C109M must be 3000 psi.

2. TESTS, INSPECTIONS, AND VERIFICATIONS: The Contractor shall have required material tests performed by an approved laboratory to demonstrate that the materials are in conformance with the specifications. These tests shall be at the Contractor's expense.

--- End of Section ---

SECTION 03 30 00.00 48 CAST-IN-PLACE CONCRETE

Scope: 1. Provide cast-in-place concrete for general building construction, including, without limitation:
a. Footings and foundations.
b. Slab on grade.
c. Concrete fill for metal floor and roof decks.
d. Base course for exterior paving.
e. Door frames at maintenance bays
f. Requirements (materials, mixes, finishes) apply to concrete work specified in other sections, such as sidewalk paving and fill for metal pan stair treads.
g. Concrete wall panels

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ACI INTERNATIONAL (ACI)

ACI 117	Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 121R	Guide for Concrete Construction Quality Systems in Conformance with ISO 9001
ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 211.2	Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 213R	Guide for Structural Lightweight Aggregate Concrete
ACI 214R	Evaluation of Strength Test Results of Concrete
ACI 301	Specifications for Structural Concrete
ACI 302.1R	Guide for Concrete Floor and Slab Construction
ACI 301M	Metric Specifications for Structural Concrete
ACI 304.2R	Guide to Placing Concrete by Pumping Methods
ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305.1	Specifications for Hot Weather Concreting
ACI 305R	Guide to for Hot Weather Concreting
ACI 306.1	Specifications for Cold Weather Concreting
ACI 306R	Guide to for Cold Weather Concreting
ACI 308.1	Specification for Curing Concrete
ACI 318	Building Code Requirements for Structural Concrete and Commentary
ACI 318M	Building Code Requirements for Structural Concrete and Commentary
ACI SP-2	ACI Manual of Concrete Inspection
ACI SP-15	Field Reference Manual: Standard Specifications for Structural Concrete ACI 301 with Selected ACI References
ACI/MCP-1	Manual of Concrete Practice Part 1: ACI 104-71R-97 to 223-98
ACI/MCP-2	Manual of Concrete Practice Part 2: ACI 224R-01 to ACI 313R-97
ACI/MCP-3	Manual of Concrete Practice Part 3: ACI 315-99 to ACI 343R-95
ACI/MCP-4	Manual of Concrete Practice Part 4: ACI 345R-05 to 355.2R-04

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C1017/C1017M	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1064/C1064M	Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

ASTM C1077/C1107M	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1107/C1107M	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1116/C1116M	Standard Specification for Fiber-Reinforced Concrete
ASTM C1157/C1157M	Standard Performance Specification for Hydraulic Cement
ASTM C1240	Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C131/C131M	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136/C136M	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C143/C143M	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	Standard Specification for Portland Cement
ASTM C156	Water Retention by Concrete Curing Materials
ASTM C1567	Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C171	Sheet Materials for Curing Concrete
ASTM C172/C172M	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C1778	Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete
ASTM C192/C192M	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231/C231M	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C311/C311M	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C33/C33M	Standard Specification for Concrete Aggregates
ASTM C330/C330M	Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C39/C39M	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C494/C494M	Standard Specification for Chemical Admixtures for Concrete
ASTM C496/C496M	Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C552	Standard Specification for Cellular Glass Thermal Insulation
ASTM C567/C567M	Determining Density of Structural Lightweight Concrete
ASTM C578	Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C591	Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

ASTM C595/C595M	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C685/C685M	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C78/C78M	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C873/C873M	Standard Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds
ASTM C881/C881M	Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C920	Elastomeric Joint Sealants
ASTM C932	Surface-Applied Bonding Compounds for Exterior Plastering
ASTM C937	Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C94/C94M	Standard Specification for Ready-Mixed Concrete
ASTM C989/C989M	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C990	Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexbile Joint Sealants
ASTM D1557	Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D1751	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	Preformed Sponge Rubber Cork andRecycled PVC Expansion
ASTM D2103	Polyethylene Film and Sheeting
ASTM D2628	Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D3042	Standard Test Method for Insoluble Residue in Carbonate Aggregates
ASTM D4397	Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D5759	Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavements
ASTM D7116	Joint Sealants, Hot Applied, Jet Fuel Resistant Types, for Portland Cement Concrete
ASTM D75/D75M	Standard Practice for Sampling Aggregates
ASTM E1155	Standard Test Method for Determining Floor Flatness and Levelness Numbers
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
ASTM E1745	Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
ASTM E96/E96M	Standard Test Methods for Water Vapor Transmission of Materials
ASTM E329	Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM E648	Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	Manual of Standard Practice

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	Concrete Plant Standards
NRMCA QC 3	Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities
NRMCA TMMB 100	Truck Mixer Agitator and Front Discharge Concrete Carrier Standards

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513	Corps of Engineers Specifications for Rubber Waterstops
COE CRD-C 572	Corps of Engineers Specifications for Polyvinylechloride Waterstops

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS MMM-A-001993	Adhesive, Epoxy, Flexible, Filled (For Binding, Sealing, and Grouting)
FS SS-S-1614	Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Tar Concrete Pavements
FS SS-S-200	Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement
FS UU-B-790	Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellant and Fire Resistant)

General:

1. SUBMITTALS: The following shall be submitted to the Engineer of Record (unless noted otherwise) for approval in accordance with Section 01 33 00.10 06 SUBMITTAL PROCEDURES FOR DESIGN/BUILD:
   a. Shop Drawings
      1) Mixture Proportions; Submit the results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength of concrete, at least 60 days prior to commencing concrete placing operations. Base aggregate weights on the saturated surface dry condition. Accompany the statement with test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions may be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.
      2) Lightweight Aggregate Concrete; Written recommendations from lightweight aggregate supplier on batching and mixing cycles.
   b. Samples
      1) Surface Retarder; Sample of surface retarder material with manufacturer's instructions for application in conjunction with air-water cutting.
   c. Test Reports
      1) Testing and Inspection for Contractor Quality Control; Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, slag cement, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.
   d. Certificates
      1) Qualifications; Written documentation for Contractor Quality Control personnel.

2. QUALIFICATIONS:

a. Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) Certified Workmen in one of the following grades or shall have written evidence of having completed similar qualification programs:
   1) Concrete Field Testing Technician, Grade I
   2) Concrete Laboratory Testing Technician, Grade I or II
   3) Concrete Construction Inspector, Level II
b. Concrete Transportation Construction Inspector or Reinforced Concrete Special Inspector, Jointly certified by American Concrete Institute (ACI), Building Official and Code Administrators International (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International (SBCCI).
c. The foreman or lead journeyman of the flatwork finishing crew shall have similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation.

3. FIELD TEST PANELS:
   a. Field test concrete wall panels shall be constructed prior to beginning of work using the materials and procedures proposed for use on the job, to demonstrate the results to be attained. The quality and appearance of each panel shall be subject to the approval of the Architect and the acceptanceacceptance of the Contracting Officer, and, if not judged satisfactory, additional panels shall be constructed until such acceptancecceptance is attained. Formed or finished surfaces in the completed structure shall match the quality and appearance of the accepted field example.

4. SPECIAL REQUIREMENTS: Not Used.

5. GENERAL REQUIREMENTS: Conform to ACI 301 except as herein modified. All materials are to be certified by the Manufacturer or sampled, pretested and approved before use.
   a. Tolerances: Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.
   b. Strength Requirements and w/c Ratio
      1) Strength Requirements: Specified compressive strength (f'c) shall be as required by the structural design. Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement. Compressive strength shall be determined in accordance with ASTM C39/C39M. Flexural strength shall be determined in accordance with ASTM C78/C78M.
         A. Evaluation of Concrete Compressive Strength. Compressive strength specimens 6 by 12 inch cylinders shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C31/C31M and tested in accordance with ASTM C39/C39M 4 inch diameter cylinders may be used if accepted by the Engineer of Record and if sampling and testing conforms to the appropriate ASTM standards. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls below the specified strength f'c by more than 500 psi. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.
         B. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 500 psi or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is

considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C42/C42M. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Engineer of Record to least impair the strength of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. The Contractor shall perform the coring and repair the holes.

C. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Government in accordance with the requirements of ACI 318. Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Government. All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and must be accepted by the Governement, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.

D. Evaluation of Concrete Flexural Strength. Flexural strength specimens (beams) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C31/C31M and tested in accordance with ASTM C78. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified flexural strength and no individual test result falls below the specified flexural strength by more than 50 psi. A "test" is defined as the average of two companion beams. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the slab is considered potentially deficient.

2) Water-Cement Ratio

A. Maximum water-cement ratio (w/c) for normal weight concrete shall be as follows:

WATER-CEMENT RATIO, BY WEIGHT	REQUIRED COMPRESSIVE STRENGTH OF STRUCTURE OR PORTION OF STRUCTURE
0.45	5000 psi
0.50	4000 psi
0.55	3000 psi

These water-cement ratios may cause higher strengths than that required above for compressive or flexural strength. The maximum water cement ratio required will be the equivalent water cement ratio as determined by conversion from the weight ratio of water to cement plus pozzolan, silica fume, and slag cement by the weight equivalency method as described in ACI 211.1. In the case where silica fume or slag cement is used, the weight of the silica fume and slag cement shall be included in the equations of ACI 211.1 for the term P which is used to denote the weight of pozzolan. Interpolation may be used for other compressive strengths, and higher strengths are acceptable with attention to similar water-cement ratios.

c. Air Entrainment: Except as otherwise specified for lightweight concrete, all normal weight concrete exposed to weather shall be air entrained as required by the structural design. Concrete with specified strength over 5000 psi may have 1.0 percent less air than specified. Specified air content shall be attained at point of placement into the forms. Air content for normal weight concrete shall be determined in accordance with ASTM C231/C231M. Lightweight concrete in the floor framing parts of the structure shall be air-entrained with a total air content of 4.5 to 7.5 percent, except that if the nominal maximum size coarse aggregate is 3/8 inch or less, the air content shall be 5.5 to 8.5 percent. Air content for lightweight concrete shall be determined in accordance with ASTM C173/C173M.

d. Slump: Slump of the concrete, as delivered to the point of placement into the forms, shall be within the structural design requirements. Slump shall be determined in accordance with ASTM C143/C143M.
e. Concrete Temperature: The temperature of the concrete as delivered shall not exceed 90 degrees F. When the ambient temperature during placing is 40 degrees F or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 55 and 75 degrees F.
f. Size of Coarse Aggregate: The largest feasible nominal maximum size aggregate (NMSA) specified in paragraph AGGREGATES shall be used in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.
g. Special Properties and Products: Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.
h. Lightweight Aggregate Structural Concrete: Lightweight aggregate structural concrete shall conform to the requirements specified for normal weight concrete except as specified herein. Compressive strength shall be determined by test specimens that have been air dried at 50 percent relative humidity for the last 21 days. Air-dry unit weight shall be not over 115 pcf at 28 days as determined by ASTM C567/C567M. However, fresh unit weight shall be used for acceptance during concreting, using a correlation factor between the two types of unit weight as determined during mixture design studies. Lightweight aggregate structural concrete floor fill shall have an air-dry unit weight not exceeding 115 pcf.
i. Technical Service for Specialized Concrete: The services of a factory trained technical representative shall be obtained to oversee proportioning, batching, mixing, placing, consolidating, and finishing of specialized structural concrete. The technical representative shall be on the job full time until the Contracting Officer is satisfied that field controls indicate concrete of specified quality is furnished and that the Contractor's crews are capable of continued satisfactory work. The technical representative shall be available for consultation with and advising Government forces.

6. MIXTURE PROPORTIONS: Covered in Products paragraph 16 of this section.

7. STORAGE OF MATERIALS: Cement and other cementitious materials shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer is left undisturbed. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

8. GOVERNMENT ASSURANCE INSPECTION AND TESTING: Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Government can and will inspect construction as considered appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any of his CQC responsibilities.
   a. Materials: The Government maysample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the

point of batching in accordance with ASTM D75/D75M. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

b. Fresh Concrete: Fresh concrete will be sampled as delivered in accordance with ASTM C172/C172M and tested in accordance with these specifications, as considered necessary.
c. Hardened Concrete: Tests on hardened concrete maymay be performed by the Government when such tests are considered necessary.
d. Inspection: Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

9. CONTRACTOR QUALITY CONTROL/VERIFICATION: Perform work in conformance with Division 01- GENERAL REQUIREMENTS and ACI 301.
   a. The Contractor shall maintain a documented Quality Control (QC) Program during the cast-in-place concreting operations covered by this section of specs. The QC Program shall include the following:
      1) Coordination, scheduling and monitoring of all sampling, testing and inspections required herein (whether the service is a part of the Contractor's QC Program or part of the Owner/Architect Acceptance/Verification operation).
      2) Evaluation and selection of qualified producers/suppliers/subcontractors and their conformance to the requirements of the Contract Documents.
      3) Preparation of appropriate procurement documents with adequate reference to the requirements of the Contract Documents.
      4) Scheduling and conducting installation and in-progress job conferences.
      5) Preparation, review, and submittal of CIP reinforced concrete shop drawings.
      6) Prequalification of proposed concrete materials and establishment of mix designs. Review and approve mix designs before submittals for approval.
      7) Conduct Quality Control tests and inspections herein designated as being the responsibility of the Contractor.
      8) Periodic monitoring and verification of producer/supplier/subcontractor quality control procedures.
      9) Provide verification of conformance for all materials furnished. The Contractor shall designate a responsible qualified person to receive ready-mixed concrete at the job site to verify each truck load for appropriate quality for the portion of the work being placed.
      10) Make preplacement of concrete inspections: lines and grades, formwork, reinforcing steel, embedments, blockouts and embedded items.
      11) Review formwork design, construction, shoring and reshoring procedures and assure conformance with design parameters and loading conditions.
      12) Placement supervision: Pouring conditions, field tests of concrete, conveyance, placement and consolidation, finishing and curing.
   b. Quality Verification Testing:
      1) Testing services required for construction Quality Verification shall be as follows:
         A. Pre qualification of proposed materials including: Course and Fine Aggregated, Cement, Water, Admixtures, Reinforcing and Prestressing Steel and establishment or review of concrete mix designs (ACI 301 Section 4.2, Proportioning).
         B. NRMCA Certification or equivalent inspection of batch plant(s) and truck mixers before and during construction.
         C. Other testing services needed as required to assure required Concrete Quality.
   c. Quality Verification Inspections: Inspection of the cast-in-place, reinforced concrete as required by applicable local building code and by ACI 318, Building Code Chapter 1. The Independent Inspection Agency specified in Division 01 will perform the inspections of cast-in-place reinforced concrete.
      1) Inspection to conform to the "ACI Manual of Concrete Inspection" and shall consist of the following services by the Project Special Inspector:
         A. Make intensive observations and investigations during construction of the CIP reinforced concrete portions of the project to promote conformity to the intent of the

Contract Documents. These services shall be performed during form construction, placement of reinforcement, mix design; and mixing, conveying, testing, placing, finishing, curing and protection of all concrete work specified herein.
(1) Review and approve batching and mixing facilities and operation.
(2) Review and approve concrete mix designs.
(3) Monitor and evaluate Testing Laboratory procedures in the testing of materials and verification of quality control in the production and delivery of concrete to the project.
(4) Observe forms and placement of reinforcing steel, embedded items, joints, etc. and verify same to be according to plans and specifications.
(5) Review concrete conveying and placing methods and equipment.
(6) Observe concrete placing, consolidation, finishing, curing, protection, repair, and/or patching.
(7) Keep a record of all inspections of the progress of the work, and of any pertinent facts relevant to this portion of the work.

B. Project Inspector's duties are not to be confused nor will they replace any of the Contractor's supervisory functions; nor will engineering inspection in any way relieve the Contractor of his complete responsibility of these supervisory functions. General Contractor is solely responsible for the direction and supervision of the entire construction operation, the performance of materials and labor, safety of working conditions, and the ultimate quality of the structure. The Project Inspector's responsibility is to make detailed observations while the work is in progress to provide a large measure of assurance to the Contracting Officer and the Contractor that the concrete work is conforming to the intent of the Contract Documents. His/her role in no way serves as guarantor of the Contractor's work.

10. TESTING LABORATORY SERVICES: Comply with general requirements of Division 01 and ACI 301, Section 1.6. The testing laboratory shall provide the following:
    a. Review the Contractor's prequalification tests, and certifications for CIP Concrete Materials and evaluate for conformance to Contract Document requirements and advise the Engineer and Contracting Officer.(ACI 301, Section 1.6).
    b. Procure random samples of the concrete as it is discharged from the mixer/truck at the jobsite and just prior to being deposited in the forms and conduct strength tests as specified in ACI 301, Section 1.6.
    c. In addition to the requirements and duties in ACI 301, Section 1.6, the testing lab shall provide the following:
        1) Review and evaluate Concrete Mix Designs submitted by the Contractor before submittal for A/E Review.
        2) Review Manufacturer's reports and/or certification for each shipment of cement and reinforcing steel and/or conduct spot checks and laboratory tests of the materials as received for compliance with specifications.
        3) Inspect concrete batching, mixing, and delivery operations periodically or as directed.
        4) Sample (and test when directed) cement and aggregates and verify approved admixtures. Store samples in a protected place until authorize to dispose of them.
        5) Submit to the Concrete Producer, Contractor, Engineer and Contracting Officer during construction, the results of concrete tests. As a minimum include the following information:
            A. Weight of concrete - ASTM C138.
            B. Slump - ASTM C143
            C. Air content of freshly-mixed concrete by the pressure method, ASTM C231 or the volumetric method, ASTM C173 or ASTM C567 for lightweight concrete.
            D. Concrete temperature (at placement time).
            E. Air temperature (at placement time)
            F. Strength determined in accordance with ASTM C39.
        6) 6) Other testing or inspection as required by the Contracting Officer or Engineer.

d. Periodic field and concrete plant inspections made by a competent representative of the Testing Laboratory during structural concreting operations including audit and spot check of the Producer's and/or Contractor's quality control procedures to assure proper and adequate control. When it appears that any material furnished fails to fulfill specification requirements, the Testing Laboratory is to report such deficiency immediately to the Contracting Officer, Engineer and Contractor and appropriately record it in his/her report.
e. Concrete reinforcement verification and/or testing: Receive and evaluate mill test certifications for conformance with contract document requirements. Perform quality tests if in the absence of identifiable mill test certifications the quality is in doubt at the cost of the Contractor.

Products: 1. CEMENTITIOUS MATERIALS: Cementitious Materials shall be portland cement, ASTM C150 - Type I or II unless otherwise approved by the Engineer of Record. Use of cementitious materials in concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementitious material.
a. The Contractor shall assume responsibility for verification of the quality and soundness of cement. Cement is to be of one type and from the same mill; it is to be of uniform color for all concrete with exposed architectural concrete finishes.
b. Where the identity of the cement can be maintained, the Manufacturer's Mill Test Reports may be accepted as certification of pretesting of cement to be used. Where the delivery methods make it impractical to pretest and/or maintain proper identity of the tested cement, pretesting may be waived; in which case, samples are to be taken of all shipments of cement used and retained by the Testing Lab for a period of one year. Such samples are to be tested when directed to verify conformance.

2. AGGREGATES: Test and evaluate fine and coarse aggregates for alkali-aggregate reactivity in accordance with ASTM C1260. Evaluate the fine and coarse aggregates separately and in combination, which matches the proposed mix design proportioning. All results of the separate and combination testing must have a measured expansion less than 0.10 (0.08) percent at 16 days after casting. Should the test data indicate an expansion of 0.10 (0.08) percent or greater, reject the aggregate(s) or perform additional testing using ASTM C1260 and ASTM C1567. Perform the additional testing using ASTM C1260 and ASTM C1567 using the low alkali portland cement in combination with slag cement, or Class F fly ash. Use slag cement in the range of 40 to 50 percent of the total cementitious material by mass. Use Class F fly ash in the range of 25 to 40 percent of the total cementitious material by mass.
a. Normal-weight concrete - ASTM C33
b. All concrete exposed to the weather shall conform to the limits of deleterious substances and physical properties of Table 3, ASTM C33.
c. Local aggregates: Local aggregates not complying with ASTM C33 but which have been shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to the A/E.
d. Abrasive aggregates non-slip finishes: Provide nonslip surfacing material consisting of 55 percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogeneous material sufficiently porous to provide a good bond with portland cement paste; or factory-graded emery aggregate consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. Use well graded aggregate from particles retained on the No. 30 sieve to particles passing the No. 8 sieve.
e. Lightweight Aggregate: Lightweight fine and coarse aggregate shall conform to the quality and gradation requirements of ASTM C330/C330M. Lightweight aggregate shall be prewetted in accordance with the Manufacturer's instructions unless otherwise specified. For pumped concrete, prewetting shall be sufficient to ensure that slump loss through the pump line does not exceed 4 inches.

3. CHEMICAL ADMIXTURES: Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing. The following admixtures are permitted or

are required as specified herein and are to be used in strict accordance with the Manufacturer's specifications or recommendations. Admixtures containing calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions are not permitted.

a. Air-Entraining Admixture: ASTM C260/C260M shall consistently entrain the air content in the specified ranges under field conditions and achieve the specified air content in all permanently exposed exterior concrete.
b. Accelerating Admixture: ASTM C494/C494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used and all Accelerating Admixtures shall have long-term test results showing non-rusting on metal deck and reinforcing steel..
c. Water-Reducing or Retarding Admixture: Water-reducing admixture: ASTM C494/C494M, Type A, containing not more chloride ions than allowed in paragraph 3 above. Water-reducing/retarding admixtures: ASTM C494/C494M, Type D containing not more than 1% chloride ions..
d. High-Range Water Reducer: ASTM C494/C494M, Type F or G, super plasticizers containing 0.05% maximum chloride ions may be used with low slump (3 inch maximum) concrete to produce flowable concrete (up to 8 inch slump) with early strength gain and 28-day strengths equal to reference concrete. HRWR admixture may be used providing not more than 60 minutes is allowed from addition of admixture to final placement of concrete. HRWR admixture shall be used to adjust the workability of onsite concrete as needed.
    1) Where more than 30 minutes is required between the addition of admixtures to final placement of the concrete, a combination of water-reducing, set controlling admixtures (ASTM C494/C494M, Types A, D, & E) may be used.
e. FLY ASH: Conform fly ash to ASTM C618, Class F,except that the maximum allowable loss on ignition cannot exceed 3 percent. If pozzolan is used, it must never be less than 10 percent by weight of the total cementitious material. Report the chemical analysis of the fly ash in accordance with ASTM C311/C311M. Evaluate and classify fly ash in accordance with ASTM D5759. The Contractor shall comply with EPA requirements
f. SILICA FUME: Conform silica fume to ASTM C1240. Conform available alkalis to the optimal limit given in Table 2 of ASTM C1240. Silica fume may be furnished as a dry, densified material or as a slurry. Proper mixing is essential to accomplish proper distribution of the silica fume and avoid agglomerated silica fume which can react with the alkali in the cement resulting in premature and extensive concrete damage. In accordance with paragraph Technical Service for Specialized Concrete in PART 1, provide the services of a manufacturer's technical representative experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume. This representative must be present on the project prior to and during at least the first 4 days of concrete production and placement using silica fume. Use a High Range Water Reducer (HRWR) with silica fume .
g. SLAG CEMENT: ASTM C989, Grade 120.
h. CERTIFICATION: Certification of the above requirements is required from the admixture manufacturer prior to mix design review and approval by theEngineer and acceptance of the Contracting Officer. Use of admixtures, other than listed above will be permitted only when approved prior to bidding.
i. COMPATIBILITY: Supplier shall certify the compatibility of all proposed admixtures. Certification shall accompany submittal of mix design.

4. CURING AND PROTECTION MATERIALS:
    a. Impervious-Sheet: Impervious-sheet materials shall conform to ASTM C171, type optional, except, that polyethylene sheet shall not be used.
    b. Membrane-Forming Compound: Membrane-Forming curing compound shall conform to ASTM C309, Type 1-D or 2, except that only a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified. Nonpigmented compound shall contain a fugitive dye, and shall have the reflective requirements in ASTM C 309 waived.

c. Burlap and Cotton Mat: Burlap and cotton mat used for curing shall conform to AASHTO M 182.

5. WATER: Provide water complying with the requirements of ASTM C1602/C1602M. Provide potable water for mixing, free of injurious amounts of oil, acid, salt, or alkali. Submit test report showing water complies with ASTM C1602/C1602M .

6. NONSHRINK GROUT: High strength non-shrink grout: Provide nonshrink grout conforming to ASTM C1107/C1107M, and a commercial formulation suitable for the proposed application .

7. NONSLIP SURFACING MATERIAL: Nonslip surfacing material shall consist of 55 percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogeneous material sufficiently porous to provide a good bond with portland cement paste; or factory-graded emery aggregate consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. The aggregate shall be well graded from particles retained on the No. 30 sieve to particles passing the No. 8 sieve.

10. EMBEDDED ITEMS: Embedded items shall be of the size and type indicated or as needed for the application. Dovetail slots shall be galvanized steel. Hangers for suspended ceilings shall be as specified in Section 09 50 00.00 48 ACOUSTICAL CEILINGS. Inserts for shelf angles and bolt hangers shall be of malleable iron or cast or wrought steel.

11. FLOOR HARDENER: Floor hardener shall be a colorless aqueous solution containing zinc silicofluoride, magnesium silicofluoride, or sodium silicofluoride. These silicofluorides can be used individually or in combination. Proprietary hardeners may be used if approved in writing by the Engineer and accepted by the Contracting Officer.

12. PERIMETER INSULATION: Perimeter insulation shall be polystyrene conforming to ASTM C578, Type II; polyurethane conforming to ASTM C591, Type II; or cellular glass conforming to ASTM C552, Type I or IV. The Contractor shall comply with EPA requirements.

13. VAPOR BARRIER: Polyethylene sheeting, ASTM E1745 with a minimum thickness of 10 mils or other equivalent material having a vapor permeance rating not exceeding 0.04 perms as determined in accordance with ASTM E96/E96M .

14. JOINT MATERIALS: ACI 301, Chapter 5
    a. CONSTRUCTION JOINTS: ACI 301, 2.2.5
        1) Locate and install construction joints, which are not shown on drawings, so as not to impair strength and appearance of the structure, as acceptable to the A/E.
        2) Provide keyways at least 1 ½" deep in construction joints, unless shown otherwise on plans, in walls, slabs and between walls and footings.
        3) Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.
    b. EXPANSION/CONTRACTION JOINT FILLER: ACI 301, Section 2.2.1.4
        1) Install premolded expansion joint filler 1 inch thick unless otherwise indicated of the following types:
            A. Asphalt - impregnated fiberboard (ASTM D1751, for interior work)
            B. Self expanding corkboard (ASTM D1752, Type III) for exterior work.
            C. Fiberboard/Glass Fiber - (ASTM D994)
            D. Polyvinyl/polystyrene (ASTM D1752)
            E. Sponge Rubber (ASTM D1752, Type 1)
        2) Hot-poured type shall conform to Federal Specification SS-S-1401.
    c. CONTROL JOINTS IN SLAB-ON-GROUND: Construct control joints in slab-on-ground to form panels of patterns as shown (12 feet o.c. maximum). Use Zipstrip, Greenstreak or equal inserts 1/8 inch to 1/4 inch wide x 1/4 of slab depth, unless otherwise indicated. Form control joints by inserting premolded plastic, hardboard or fiberboard strip into fresh concrete

until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris. Control joints may be formed by saw cuts made as soon as possible after slab finishing as may be safely done without dislodging aggregate. Submit sawing schedule to the A/E for review.

d. ISOLATION JOINT FILLERS: Fillers shall consist of 1/8 inch width strips of neoprene; synthetic rubber, or approved substitute, extending the full depth of the slab.

e. WATER STOPS: ACI 301, Section 2.2.3.5 - Splice, seal, and install water stop for watertight joint as recommended by manufacturer and designed to allow for the anticipated movement at the joint.

1) PVC - Corps of Engineers, CRD-C572, minimum 1750 psi tensile strength, minus 115 degrees F to plus 175 degrees F working temperature range; flat profile; corrugated flaps, ribbed flaps on one side only, large center bulb, or split center bulb of the sizes and profile shown on drawings.

2) Rubber - Corps of Engineers, CRD-C513

3) Neoprene - Corps of Engineers, continuous maximum lengths; 60 Shore A hardness; 2000 psi minimum tensile strength; recessed from joint; vertical turns; lubricant/adhesive; black color.

4) Copper - Minimum 16 ounce copper; temper; maximum possible length.

15. REPAIR OF SURFACE DEFECTS: ACI 301, 5, paragraph 3.7.

16. PROPORTIONING: ACI 301, Section 4.2.3

a. Concrete types and strengths: See General and Specific Notes on structural drawings.

1) Weights: All concrete shall be normal-weight (N.W.) concrete unless otherwise designated on the structural drawings.

2) Durability:

A. All concrete exposed to potentially destructive weathering, such as freezing and thawing, or to deicer chemicals is to be air-entrained, (ACI 301 Table 4.2.2.4) water-cement ratio less than 0.45 by weight, 10 sacks cement per cubic yard minimum, 4 inch maximum slump. All concrete subject to aggressive chemical exposure in designated areas shall conform to the recommendations of ACI 201, Chapter 2.

B. Water-cement ratio: For concrete subject to freezing and thawing or deicer chemicals, the water-cement ratio shall not exceed 0.50 by weight including any water added to meet specified slump in accordance with the requirements of ASTM C94 unless otherwise noted.

3) Slump: ACI 301, 4.2.2.2

A. 4 inch maximum for consolidation by vibration

B. 5 inch maximum for consolidation by other methods

C. 8 inch maximum for flowable concrete. Concrete containing HRWR admixture (super plasticizer): 3 inch maximum before addition of HRWR.

D. Where field conditions require slump to exceed that specified above, the increase slump shall be obtained by the use of a superplasticizer only, and the Contractor shall obtain written approval from the Engineer and accepted from the Contracting Officer who may require an adjustment to the mix.

4) Selection of proportions (mix design): ACI 301, Section 4.2.3 and ACI 211.1-81.

5) Mix Designs:

A. Mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301, 4.2.3.2. The testing facility shall not be the same as used for field quality control testing and inspection unless otherwise acceptable to the Engineer and Contracting Officer.

B. Submit written testing laboratory reports to the testing laboratory for review for each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed and verified by the Testing Laboratory to be in conformance with these Contracting Officer. Include the following information for each concrete mix design:

(1) Method used to determine the proposed mix design.
(2) Gradation of fine and coarse aggregates
(3) Proportions of all ingredients including all admixtures added either at the time of batching or at the job site.
(4) Water-cement ratio
(5) Slump, ASTM C143
(6) Certification of the chloride content of individual admixtures and of the mixes as proposed.
(7) Air Content: ASTM C173 (Volumetric Method)
(8) Unit weight of concrete, ASTM C138
(9) Strength at 4, 7, and 28 days, ASTM C39
(10) Method of recording batch proportions
(11) Substantiating test reports which have been reviewed and approved by the independent testing lab.
(12) Maximum allowable field dosages of water and admixtures which meet mix design criteria and allow Contractor to achieve proper field results.

--- End of Section ---

SECTION 03 45 00.00 48- PRECAST ARCHITECTURAL CONCRETE

Scope: 1. Provide Architectural precast concrete cladding[and load-bearing] units.
a. Insulated, architectural precast concrete units.
b. Thin-brick-faced, architectural precast concrete units.
c. Stone-faced, architectural precast concrete units.

References: 1. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 211.2	Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 214R	Evaluation of Strength Test Results of Concrete
ACI 301	Specifications for Structural Concrete
ACI 301M	Metric Specifications for Structural Concrete
ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	Guide to Hot Weather Concreting
ACI 306.1	Standard Specification for Cold Weather Concreting
ACI 318	Building Code Requirements for Structural Concrete (ACI 318) and Commentary (ACI 318R)
ACI 318M	Building Code Requirements for Structural Concrete & Commentary
ACI SP-66	ACI Detailing Manual

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	Basic Hardboard

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA U1	Use Category System: User Specification for Treated Wood

ASME INTERNATIONAL (ASME)

ASME B18.21.1	Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A27/A27M	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A283/A283M	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A416/A416M	Standard Specification for Low-Relaxation, Seven-Wire for Prestressed Concrete
ASTM A449	Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A47/A47M	Standard Specification for Ferritic Malleable Iron Castings
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A615/A615M	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A666	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A706/A706M	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A996/A996M	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM B370	Standard Specification for Copper Sheet and Strip for Building Construction
ASTM C1107/C1107M	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non shrink)
ASTM C1218/C1218M	Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
ASTM C1240	Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C143/C143M	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150/C150M	Standard Specification for Portland Cement
ASTM C1602/C1602M	Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C172/C172M	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C185	Standard Test Method for Air Content of Hydraulic Cement Mortar
ASTM C231/C231M	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C31/C31M	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C311/C311M	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete

ASTM C33/C33M	Standard Specification for Concrete Aggregates
ASTM C39/C39M	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C494/C494M	Standard Specification for Chemical Admixtures for Concrete
ASTM C578	Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C591	Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C650	Standard Test Method for Resistance of Ceramic Tile to Chemical Substances
ASTM C666/C666M	Resistance of Concrete to Rapid Freezing and Thawing
ASTM C67/C67M	Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C78/C78M	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C94/C94M	Standard Specification for Ready-Mixed Concrete
ASTM C979/C979M	Standard Specification for Pigments for Integrally Colored Concrete
ASTM C989/C989M	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D1056	Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1149	Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D5759	Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM D635	Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM D746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM E488/E488M	Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-117	Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products
PCI MNL-122	Architectural Precast Concrete

General:

1. Submittals:
   a. Shop Drawings:
      1) Precast Drawings
   b. Product Data: For each type of product.
      1) Cast in Embedded Items and connectors
      2) Connection Devices
      3) Admixtures
      4) Gasket
      5) Thin Brick Veneer
      6) Bearing Pads
      7) Insulation
   c. Samples:
      1) Concrete Wall Panel Surface Finish

2) Mock-up
3) Brick Color Chips
4) Form Liner
5) Full Size Sample Wall Panel

d. Design Data
1) Design Calculations
2) Contractor Furnished Mix Design
3) Concrete Mix Design for Repair of Surface Defects
4) Thermal Calculations

e. Test Reports:
1) Strength Tests
2) Slump
3) Air Content
4) Test for Concrete Materials
5) Water
6) Testing Precast Units for Strength

d. Certificates
1) Manufacturers Qualifications
2) Fabricator Quality Certifications
3) Erector Certifications

e. Manufacturers Instructions:
1) Installation
2) Cleaning
3) Thin-brick units and accessories.

f. Closeout Submittals
1) Concrete Batch Ticket Information

2. Requirements: Precast concrete units must be designed and fabricated by an experienced and certified precast concrete manufacturer. The manufacturer needs to have been regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings for at least 3 years. The Contractor must submit a statement detailing the Manufacturer's Qualifications. Coordinate precast work with the work of other trades.

3. Design:
a. Standards and Loads: Precast unit design must conform to ASCE 7, ACI 318 and PCI MNL-122. Indicate design loads for precast concrete on the drawings. A differential temperature of 192 degrees F, between interior and exterior faces of the units, must be considered in the design. Stresses due to restrained volume change caused by shrinkage and temperature differential, handling, transportation and erection must be accounted for in the design.
b. Connections: Connection of units to other members, or to other units must be of the type and configuration indicated. The design and sizing of connections for all design loads will be completed by the Contractor.
c. Concrete Proportion: Base the selection of proportions for concrete on the methodology presented in ACI 211.1 for normal weight concrete and ACI 211.2 for lightweight concrete. Develop the concrete proportion using the same type and brand of cement, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for the project. Do not use calcium chloride in precast concrete and admixtures containing chloride ions, nitrates, or other substances that are corrosive will not be used in prestressed concrete.
d. Design Calculations: Calculations for design of members, connections and embedments not shown must be made by a registered professional engineer experienced in the design of precast architectural concrete. Maximum Allowable Deflection of wall panels: L/360 span for wind load. Calculation will include the analysis of member for lifting stresses and the sizing of the lifting inserts. Submit calculations for review and approval prior to fabrication, signed and sealed by the registered design professional who prepared the design.
e. Thermal Calculations: Submit thermal calculations prepared and sealed by a registered professional engineer for review complying with ASHRAE 90.1 - IP, for the steady state thermal

resistance for the precast concrete wall panels. Thermal calculations must demonstrate the thermal conductivity of all components, the spacing of all connectors, the percent area of the wall that is solid concrete, and the thermal resistance of all components.

4. Delivery Storage and Handling: Deliver packaged materials, except for wall panels, to the project site in the original, unbroken packages or containers, each bearing a label clearly identifying manufacturer's name, brand name, weight or volume, and other pertinent information. Store in a weathertight and dry place until ready for use.
5. Protect precast units temporarily stored at the manufacturer's plant from damage in accordance with PCI MNL-117 and PCI MNL-122. Immediately prior to shipment to the jobsite, all precast concrete units must be inspected for quality to insure all precast units conform to the requirements specified. Inspection for quality will include, but will not be limited to, the following elements: color, texture, dimensional tolerances, chipping, cracking, staining, warping and honeycombing. Replace or repair all defective precast concrete units as approved.
6. [At the option of the Contracting Officer, precast units may be inspected.] [Precast units must be inspected by the QC representative prior to being transported to the job site.] The Contractor is to give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.
7. Fabricator Quality Certifications: Plants must be certified by the PCI Plant Certification Program for Group A, Category A1, or Architectural Precast Association (APA) certification or National Precast Concrete Association (NPCA). At the Contracting Officer's option, PCI Plant quality control program records must be available for review. When plants are not currently enrolled in one of the three certification programs listed above then they must provide a product quality control system in accordance with PCI MNL-117 and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory.
8. Erector Certification: Erector with erecting organization and all erecting crews certified and designated by PCI's Certificate of Compliance to erect Category A (Architectural Systems) for non-load-bearing members.
9. Quality Assurance:
   a. Precast Drawings: Submit precast drawings with the following information:
      1) Precast dimensions, cross-section, and edge details; location, size, and type of reinforcement, including reinforcement necessary for safe handling and erection of precast units and other embedded items. Comply with ACI SP-66.
      2) Layout, dimensions, and identification of each precast unit, corresponding to installation sequence.
      3) Setting drawings, instructions, and directions for installation of concrete inserts.
      4) Location and details of anchorage devices and lifting devices embedded in panels, and connection details to building framing system.
      5) Location of embedded brick work including joint locations, joint widths, brick coursing, brick coursing alignment across panel joints and reveal and false-joint locations and dimensions
      6) Concrete Wall Panel Surface Finish Sample: Submit a concrete wall panel sample 12 inches by 12 inches by approximately 1 1/2 inches in thickness, to illustrate quality, color, and texture of both exposed-to-view surface finish and finish of panel surfaces that will be concealed by other construction. Obtain approval prior to submission of sample panels.
      7) After approval of the surface, Contractor must provide one full size sample Wall Panel. Approved sample may be used in construction when properly identified.
   b. Required Records: ASTM C94/C94M. Submit mandatory batch ticket information for each load of ready-mixed concrete.
10. Tolerances: Dimensions of the finished panel, at the time of erection in the structure, must conform to the tolerances for precast, non-prestressed elements in PCI MNL-117, unless otherwise specified by the Architect.

---END OF SECTION---

SECTION 03 45 33.00 48 PRECAST STRUCTURAL CONCRETE

Scope: 1. Provide precast prestressed structural concrete units, reinforced and pretensioned, for building structure:

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LRFDCONS Bridge Construction Specifications
AASHTO M 251 Standard Specification for Plain and Laminated Elastomeric Bridge Bearings
AASHTO T 259 Standard Method of Test for Resistance of Concrete to Chloride Ion Penetration

ACI INTERNATIONAL (ACI)

ACI 318/ Building Code Requirements for Structural Concrete and Commentary

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A27/A27M Standard Specification for Steel Castings, Carbon, for General Application
ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A325M Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)ASTM A36/A36M Carbon Structural Steel
ASTM A36/A36M Standard Specification for Carbon Structural Steel
ASTM A416/A416M Standard Specification for Low-Relaxation, Seven-Wire for Prestressed Concrete
ASTM A421/A421M Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete
ASTM A47/A47M Standard Specification for Ferritic Malleable Iron Castings
ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M Standard Specification for Carbon and Alloy Steel Nuts (Metric)ASTM A615/A615M Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM A615/A615M	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706/A706M	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A722/A722M	Standard Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete
ASTM A767/A767M	Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A775/A775M	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A934/A934M	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A996/A996M	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM C1107/C1107M	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1202	Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
ASTM C1218/C1218M	Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
ASTM C1240	Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C150/C150M	Standard Specification for Portland Cement
ASTM C1567	Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C260/C260M	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C295/C295M	Petrographic Examination of Aggregates for Concrete
ASTM C311/C311M	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C33/C33M	Standard Specification for Concrete Aggregates
ASTM C330/C330M	Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C494/C494M	Standard Specification for Chemical Admixtures for Concrete
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C94/C94M	Standard Specification for Ready-Mixed Concrete
ASTM C989/C989M	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D5759	Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM F436	Hardened Steel Washers
ASTM F436M	Hardened Steel Washers (Metric)
ASTM F844	Washers, Steel, Plain (Flat), Unhardened for General Use

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	Structural Welding Code - Steel
AWS D1.4	Structural Welding Code - Reinforcing Steel

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products
PCI MNL-120	PCI Design Handbook - Precast and Prestressed Concrete
PCI MNL-124	PCI design for Fire Resistance of Precast Prestressed Concrete
PCI MNL-135	Tolerance Manual for Precast and Prestressed Concrete Consturction

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-C-882	Cloth, Duck, Cotton or Cotton-Polyester Blend, Synthetic Rubber, Impregnated, and Laminated, Oil Resistant

UNDERWRITERS' LABORATORIES INC. (UL)

UL Fire Resistance	Fire Resistance Directory

General: 1. SUBMITTALS: The following shall be submitted to the Engineer of Record (unless noted otherwise) for approval in accordance with Section 01 33 00.00 48 SUBMITTAL PROCEDURES:

a. Shop Drawings and Calculations

1) Submit drawings and design calculations indicating complete information for the fabrication, handling, and erection of the precast prestressed member. Include a cover page with the design calculations, signed and sealed by the registered design professional who prepared the design. Drawings must not be reproductions of contract drawings. Design calculations, drawings of precast members, and drawings of precast prestressed concrete members (including connections) must be made by a registered professional engineer experienced in the design of precast prestressed concrete members, and submitted for approval prior to fabrication. The drawings must indicate, as a minimum, the following information:

a. Plans, elevations and other drawing views showing the following:

(1) Member piece marks locating and defining products furnished by the manufacturer.

(2) Headers for openings.

(3) Location and size of openings that cut prestressing strands or require the location of prestressing strands to miss field cut openings.

(4) Relationships to adjacent material.

(5) Joints and openings between members and between members and other construction.

(6) Location of field installed anchors.

(7) Erection sequences and handling requirements

(8) Areas receiving toppings and magnitude of topping thickness. Identify areas where topping is an integral part of the structural capacity of the precast members.

(9) Lifting and erection inserts

b. Elevations, sections and other details for each member showing the following:

(1) Connections between members and connections between members and other construction.

(2) Connections for work of other trades and cast-in items and their relation to other trades.

(3) Dimensioned size and shape for each member with quantities, position and other details of reinforcing steel, anchors, inserts and other embedded items.

(4) Lifting, erection and other handling devices and inserts.

(5) Surface finishes of each member.

(6) Estimated cambers

c. Magnitude, schedule and sequence of tensioning and detensioning prestressing strands.

d. Strength properties for concrete, steel and other materials.

e. Methods for storage and transportation.

f. Description of loose, cast-in and field hardware.

g. All dead, live, handling, erection and other applicable loads used in the design.

h. Signature and seal of the registered design professional who prepared the design.

2) Finish: The proposed finish for each type of member shall be submitted prior to the initiation of manufacture.

3) Insulation: The insulation value and thermal performance shall be clearly indicated on the shop drawings.

b. Samples: Before casting precast members, one sample precast concrete panel not less than 24 by 24 by 5 inches deep shall be submitted for each finish type with proposed surface texture, including surface sealer. After approval, the sample panels shall be retained at the job site to serve as the standard of quality for texture, surface finish, and concrete color.Test Reports

1) Materials; Certified test reports of required material tests shall be submitted prior to the use of the materials in the work. Reports shall be furnished for each shipment and shall be identified with specific lots.

2) Concrete; The results of concrete strength testing by the contractor shall be submitted not more than 5 days after the tests are completed.

2. SYSTEM DESCRIPTION

a. Design Requirements: Size components to withstand design loads stated in the structural drawings. Maximum Allowable Deflection of wall panels: L/360 span for wind load. Design components to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.

1) Precast-Prestressed Members and Connections: Design of members and connections shall be in accordance with ACI 318/318R, ACI 301 and PCI MNL-120.

2) Loads: Loadings for members and connections shall include all dead load, live load, applicable lateral loads such as wind and earthquake, applicable construction loads such as handling, erection loads, and other applicable loads.

3) Design Calculations: Design calculations for members and connections not shown in the contract drawings shall be made by a registered professional engineer experienced in the design of precast-prestressed concrete.

4. DELIVERY, STORAGE, AND HANDLING: Mark each member with date of production and final position in structure.

a. Transportation

1) Transporting Members: In transporting members by truck, railroad car, or barge, provision shall be made for supporting the members as described above, except battens can be continuous over more than one stack of units, with adequate bracing to ensure their maintaining the vertical position and damping of dangerous vibrations. Trucks with double bolsters are satisfactory provided the members are fully seated on the outer bolsters at not more than 3 feet or the depth of the member from the end and the inner bolster is not more than 8 feet from the end of the member or the designated pickup point. Adequate padding material shall be provided between tie chains or cables to preclude chipping of concrete.

2) Lateral Deflection or Vibration: Any noticeable indication of lateral deflection or vibration during transportation shall be corrected by rigid bracing between members or by means of lateral trussing.

b. Storage

1) Storage Areas for prestressed members shall be stabilized, and suitable foundations shall be provided, so differential settlement or twisting of members will not occur.

2) Stacked members shall be separated and supported by battens placed across the full width of each bearing point. Battens shall be arranged in vertical planes at a distance not greater than the depth of the member from designated pickup points. Battens shall not be continuous over more than one stack of precast units. Stacking of members shall be such that lifting devices will be accessible and undamaged. The upper members of a stacked tier shall not be used as storage areas for shorter members or equipment.

c. Handling of Members

1) The location of pickup points for handling of the members and details of the pickup devices shall be shown in shop drawings. Members shall be handled only by means of approved devices at designated locations. Members shall be maintained in an upright position at all times and picked up and supported as shown in approved shop drawings. Lifting hooks or other erection hardware shall not be located in exposed or finished surfaces.

6. Qualifications: Fabricator: PCI MNL-116. Plants must be certified by the PCI Plant Certification Program for the appropriate Category work. At the Contracting Officer's option, PCI Plant quality control program records must be available for review. Where panels are manufactured by specialists in plants not currently enrolled in the PCI "Quality Control Program," provide a product quality control system in accordance with PCI MNL-116 and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory. Submit test results to the Contracting Officer. Erector: Erector with erecting organization and all erecting crews certified and designated by PCI's Certificate of Compliance to erect Category S1 (Simple Structural Systems). A precast erector that is not certified by PCI must retain a PCI-Certified Field Auditor, at the erector's expense, to conduct a field audit of a project in the same category as this project prior to start of precast concrete erection and must submit the Erector's Post Audit Declaration to be considered qualified. Welder: Provide AWS D1.1/D1.1M qualified welders who are currently certified at contract award date and have maintained their certificates over the past year..

7. Regulatory Requirements: Provide precast prestressed members in conformance with ACI 318 and PCI MNL-120.

8. Pre-Installation Conference: Convene one week prior to commencing work of this section. Discuss anchor and weld plate locations, sleeve locations, and cautions regarding cutting or core drilling.

9. Coordination: Coordinate work under provisions of Division 1. Coordinate the work of framing components not precast but directly associated with the Work of this section. Coordinate field cut openings with affected section. Coordinate location of hanger tabs and devices for mechanical and electrical work.

Products:

1. MATERIALS: Materials shall comply with the ACI 318 and ACI 301. Non-shrink Grout: Non-metallic, minimum compressive strength of 10,000 psi at 28 days. Cement Grout: Minimum compressive strength of 3000 psi at 28 days.
   a. Steel Reinforcement: Steel reinforcement shall be in accordance with ASTM A615, grade 60,000 psi deformed steel bars.
   b. Steel Tendons: Steel tendons shall be in accordance with ASTM A416, grade 270 K, of sufficient strength commensurate with member design.
   c. Accessories: Connecting and Supporting Devices: ASTM A36 carbon steel; plates, angles, items connected to steel framing members, and inserts. Hanger Tabs: Galvanized steel, designed to fit into grouted key joints, capable of supporting 500 lb. dead load, predrilled to receive hanger. Bearing Pads: High density plastic, 1/8 inch thick, smooth on one side, Vulcanized elastomeric compound molded to size, Neoprene (Chloroprene) or Tetrafluoroethylene (TFE). Sill Seal: Compressible glass fiber strips.

2. CONCRETE MIXTURE PROPORTIONS
   a. Concrete: Concrete shall be composed of cementitious material, water, fine and coarse aggregate, and admixtures. The cementitious material shall be portland. The admixtures shall be an air-entraining agent and may include a water-reducing admixture when its formulation and use are approved.
   b. Proportions: The concrete mixture proportions shall meet the specifications stated in the general notes in the structural plans. Mixtures shall be proportioned in accordance with ACI 211.1. The trial mixtures shall be formulated using the same materials as those to be used in the units supplied under this specification, and the selected proportions shall be submitted for approval with the results of cylinder strengths at 28 days.

3. FORMS AND ACCESSORIES

   a. Forms: Metal, rigid and dimensionally stable dressed lumber, or other approved materials that will provide continuous and true concrete surfaces within fabrication tolerances indicated; non-reactive with concrete and suitable for producing required finishes.

   b. Chamfer and Reveal Strips: Wood, metal, PVC, or rubber strips,.

   c. Form Liners: Units of face design, texture, arrangement, and configuration as indicated and to match those used to produce approved Sample Panels. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface or joint treatments of concrete.
      1) Brick Form Liners: Single use plastic liners for use with thin brick units to produce joint type and bond configuration as follows:

   d. Butt Type Corner Details: At tilt-up panels that occur at corners the form liners must go “around - the - corner” to create a finished thin brick wall surface with corner thin brick. Panel joints will occur as the adjoining panel abuts the corner panel at 90 degrees. Brick bond configuration to match the typical panel design requirements.

4. THIN BRICK UNITS AND ACCESSORIES:
   a. Thin Brick Units: ASTM C 1088, Grade Exterior, Type TBX, not less than 1/2 inch thick with size tolerances as follows:
      1) Brick < than 8” - +0 to -1/16”.
      2) Brick 8” to 12” - +0 to -3/132”.
      3) Face Size: Utility - 3-5/8 inches high by 11-5/8 inches long.
      4) Water Absorption: Maximum 5 percent; ASTM C 67.
      5) Efflorescence: Tested according to ASTM C 67 and rated "not effloresced."
      6) Waxed Surface: Thin brick units to be sufficiently waxed on surfaces to be exposed to prevent adhesion of concrete.
      7) Back Surface Texture: Ribbed, keybacked, or dovetailed.
   b. Acceptable Manufacturers for thin brick units:
      1) Metro Brick as manufactured by Ironrock Capitol, Canton, Ohio; Tel: 888-325-3945. www.metrobrick.com
      2) Endicott Clay Products Company, Fairbury, Nebraska; Tel: 402-729-3315.
      3) Summitville Tile Company, Summitville, Ohio; Tel: 330-223-1511
      4) Approved equal

5. EVALUATION AND ACCEPTANCE
   a. At the option of the Contracting Officer, precast prestressed units must be inspected by the QC Representative prior to being transported to the job site. The Contractor must give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.
   b. Defects

1) Minor Defects: All honeycombed areas, chipped corners, air pockets over 1/4 inch in diameter, and other minor defects involve less than 36 square inches of concrete must be repaired. Form offsets of fins over 1/8 inch must be ground smooth. All unsound concrete must be removed from defective areas prior to repairing. All surfaces permanently exposed to view must be repaired by a blend of portland cement and white cement properly proportioned so that the final color when cured will be the same as adjacent concrete. Precast [prestressed]members containing hairline cracks which are visible and are less than 0.01 inches in width, may be accepted, except that cracks larger than 0.005 inches in width for surfaces exposed to the weather must be repaired.
2) Major Defects: Major defects are those which involve more than 36 square inches of concrete or expose stressing tendons or reinforcing steel. If one or more major defects appear in a member, it will be rejected. Cracks of a width of more than 0.01 inch will be cause for rejection of the member.
3) No broken or chipped brick units area allowed in Thin Brick precast walls. Any repairs shall be of the same quality and appearance of the surrounding wall and sample panel.

--- End of Section ---

SECTION 04 20 00.00 48 UNIT MASONRY

Scope: 1. Provide unit masonry for walls and partitions:
a. Cavity wall construction.
b. Concrete masonry bearing walls and non-bearing partitions.
c. Architectural concrete masonry units.
d. Prefaced concrete masonry units

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ACI INTERNATIONAL (ACI)

ACI 216.1	Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies
ACI 318	Building Code Requirements for Structural Concrete and Commentary
ACI 318M	Metric Building Code Requirements for Structural Concrete and Commentary
ACI 530/530.1	Building Code Requirements for Masonry Structures; Containing Building Code Requirements for Masonry Structures, Specifications for Masonry Structures and Companion Commentaries
ACI SP-66	ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1064/1064M	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete.
ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A185/A185M	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A615/A615M	Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
ASTM A641/A641M	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A951/A951M	Standard Specification for Steel Wire for Masonry Joint Reinforcement
ASTM A996/A996M	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM B370	Standard Specification for Copper Sheet and Strip for Building Construction
ASTM C27	Standard Classification for Fireclay and High-Alumina Refractory Brick
ASTM C55	Standard Specification for Concrete Building Brick
ASTM C578	Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C62	Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C67/C67M	Standard Test Method for Sampling and Testing Brick and Structural Clay Tile

ASTM C73	Standard Specification for Calcium Silicate Brick (Sand-Lime Brick)
ASTM C90	Standard Specification for Loadbearing Concrete Masonry Units
ASTM C91	Standard Specification for Masonry Cement
ASTM C94/C94M	Standard Specification for Ready-Mix Concrete
ASTM C1019	Standard Test Method for Sampling and Testing Grout
ASTM C1072	Standard Test Methods for Measurement of Masonry Flexural Bond Strength
ASTM C1142	Standard Specification for Extended Life Mortar for Unit Masonry
ASTM C126	Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units
ASTM C1289	Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C129	Standard Specification for Nonloadbearing Concrete Masonry Units
ASTM C1314	Standard Test Method for Compressive Strength of Masonry Prisms
ASTM C1384	Standard Specification for Admixtures for Masonry Mortars
ASTM C140	Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C1611/C1611M	Standard Test Method for Slump Flow of Self-Consolidating Concrete
ASTM C207	Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C216	Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C270	Standard Specification for Mortar for Unit Masonry
ASTM C315	Standard Specification for Clay Flue Liners and Chimney Pots
ASTM C476	Standard Specification for Grout for Masonry
ASTM C494/C494M	Standard Specification for Chemical Admixtures for Concrete
ASTM C586	Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks as concrete Aggregates (Rock Cylinder Method)ASTM C593 Standard Specification for Fly Ash and Other Pozzolans for Use with Lime for Soil Stabilization
ASTM C616/C616M	Standard Specification for Quartz Based Dimension Stone
ASTM C641	Standard Test Method for Iron Staining Materials in Lightweight Concrete Aggregates
ASTM C652	Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale)
ASTM C744	Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C780	Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D2000	Standard Classification for Rubber Products in Automotive Applications
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D2287	Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E119	Standard Rest Methods for Fire Tests of Building Construction and Materials
ASTM E514	Standard Test Method for Water Penetration and Leakage Through Masonry

THE MASONRY SOCIETY (TMS)

TMS MSJC	Masonry Standard Joint Committee's (MSJC) Book-Building Code Requirements and Specification for Masonry Structures Containing TMS 402/ACI 530/ASCE 5, TMS 602/ACI 530.1/ASCE 6, and Companion Commentaries.

System Description:

1. Design Requirements
   a. Unit Strength Method: Compute compressive strength of masonry system "Unit Strength Method," in accordance with TMS MSJC.
      1. Submit calculations and certifications of unit and mortar strength.
   b. Seismic Requirement: In addition to design requirements of ICC IBC, the total minimum reinforcing percentage for structural walls shall be 0.20 percent and non-structural walls shall be 0.15 percent. The maximum spacing of reinforcing bars shall be 24 inches for vertical bars and 48 inches for horizontal bars in structural walls and 48 inches for vertical bars and 80 inches for horizontal bars in non-structural walls. Bond beams are required at the top of footings, at the bottom and top of openings at roof and floor levels, and at the top of parapet walls.
   c. Special Inspection: Perform special inspections and testing for seismic-resisting systems and components in accordance with Section 01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.
   d. Masonry Strength: Determine masonry strength in accordance with ACI 530 and TMS MSJC; submit test reports in accordance with ACI 530 and TMS MSJC. The cost of testing shall be paid by the Contractor.
   e. Additional Requirements: Maintain at least one spare vibrator on site at all times; provide bracing and scaffolding necessary for masonry work. Design bracing the resist wind pressure as required by local code.

General:

1. Submittals: The following shall be submitted to the Engineer of Record (unless noted otherwise) for approval in accordance with Section 01 33 00.00 06 SUBMITTAL PROCEDURES FOR DESIGN/BUILD:
   a. Shop Drawings: Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; and wall openings. Bar splice locations shall be shown. Drawings shall be provided showing the location and layout of glass block units. If the Contractor opts to furnish inch-pound CMU products, drawings showing elevation of walls exposed to view and indicating the location of all cut CMU products shall be submitted for approval. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66.
   b. Product Data
      1) Manufacturer's descriptive data for the following:
         A. Clay or Shale Brick
         B. Concrete Brick
         C. Prefaced Concrete Masonry Units
         D. Insulation
         E. Cement
      2) Cold Weather Installation; Cold weather construction procedures.

c. Samples
   1) Color samples of three stretcher or other typical units and one unit for each type of special shape. Units shall show the full range of color and texture.
      A. Prefaced Concrete Masonry Units
      B. Clay or Shale Brick
   2) Anchors, ties, and bar positioners
   3) Expansion-joint materials
   4) Joint reinforcement
   5) Insulation
   6) Portable Panel; One panel of clay or shale brick, 2 by 2 feet containing approximately 24 brick facings to establish range of color and texture.
d. Design Data:
   1) Pre-mixed Mortar
   2) Unit Strength Method: Pre-mixed mortar composition. Calculations and certifications of masonry unit and mortar strength.
e. Test Reports
   1) Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.
      A. Efflorescence Test
      B. Field Testing of Mortar
      C. Field Testing of Grout
      D. Prism tests
      E. Masonry Cement
      F. Fire-rated CMU
   2) Special Inspection; Copies of masonry inspector reports.
f. Certificates
   1) Certificates of compliance stating that the materials meet the specified requirements.
      A. Clay or Shale Brick
      B. Concrete Brick
      C. Concrete Masonry Units (CMU)
      D. Prefaced Concrete Masonry Units
      E. Control Joint Keys
      F. Anchors, Ties, and Bar Positioners
      G. Expansion-Joint Materials
      H. Joint Reinforcement
      I. Reinforcing Steel Bars and Rods
      J. Masonry Cement
      K. Mortar Coloring
      L. Insulation
      M. Precast Concrete Items
      N. Mortar Admixtures
      O. Grout Admixtures
      P. Siloxane Sealer
   2) Insulation; Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.
   3) Salvaged Brick; Documentation certifying products are from salvaged/recovered sources. Indicate relative dollar value of salvaged content products to total dollar value of products included in project.

2. Quality Assurance
   a. Appearance: Blend all bricks to produce a uniform appearance when installed. An observable “banding” or “layering” of colors or textures caused by improperly mixed brick is unacceptable.
   b. Contamination: When using bricks containing contaminated soil, supplier shall certify that the hazardous waste is neutralized by the manufacturing process and that no additional pollutants will be released, or that the product is free from hazardous contaminants.

c. Sample Masonry Panels: After material samples are approved and prior to starting masonry work, sample masonry panels shall be constructed for each type and color of masonry required. At least 48 hours prior to constructing the sample panel or panels, the Contractor shall submit written notification to the Contracting Officer's Representative. Sample panels shall not be built in, or as part of the structure, but shall be located where directed.
   1) Configuration: Panels shall be L-shaped or otherwise configured to represent all of the wall elements. Panels shall be of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. The minimum size of a straight panel or a leg of an L-shaped panel shall be 8 feet long by 6 feet high.
   2) Composition: Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work shall be demonstrated during the construction of the panels. Installation or application procedures for anchors, wall ties, glass block units, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weep holes shall be shown in the sample panels. The panels shall contain a masonry bonded corner that includes a bond beam corner. Panels shall show bituminous dampproofing. Panels that represent reinforced masonry shall contain a 2 by 2 foot opening placed at least 2 feet above the panel base and 2 feet away from all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.
   3) Construction Method: Where anchored veneer walls are required, the Contractor shall demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Temporary provisions shall be demonstrated to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, the Contractor shall demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. If sealer is specified to be applied to the masonry units, sealer shall be applied to the sample panels. Panels shall be built on a properly designed concrete foundation.
   4) Usage: The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

3. Special Inspection: A qualified masonry inspector accepted by the Engineer and Contracting Officer shall perform inspection of the masonry work. Minimum qualifications for the masonry inspector shall be 5 years of reinforced masonry inspection experience or acceptance by a State, municipality, or other governmental body having a program of examining and certifying inspectors for reinforced masonry construction. The masonry inspector shall be present during preparation of masonry prisms, sampling and placing of masonry units, placement of reinforcement (including placement of dowels in footings and foundation walls), inspection of grout space, immediately prior to closing of cleanouts, and during grouting operations. The masonry inspector shall assure Contractor compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction.

Products:

1. General Requirements: The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's acceptance.
2. Clay Or Shale Brick: Color range and texture of clay or shale brick shall be as specified and shall conform to the approved sample. Grade SW shall be used for brick in contact with earth or grade and for all exterior work. Brick shall be tested for efflorescence in accordance with ASTM C67. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall.
   a. Solid Clay or Shale Brick: Solid clay or shale brick shall conform to ASTM C216, Type FBX, Grade SW.
   b. Hollow Clay or Shale Brick: Hollow clay or shale brick shall conform to ASTM C652. Where the vertical reinforcement is shown in hollow brick, the minimum cell dimension shall be 2-1/2 inches and the units shall be designed to provide precise vertical alignment of the cells.
   c. Sand-Lime Brick: ASTM C73, Grade SW, approximately 3 5/8 inches thick, 2 ¼ inches high, and 8 inches long (nominal) or nominal modular, with smooth surfaces and natural color.
   d. Refractory Brick: ASTM C27, low-duty type.
   e. Closure or Utility Brick: ASTM C216, Grade SW, Type FBS, 3 5/8 inches thick, 3 5/9 inches high and 8 inches long (closure) or nominally 4 inches thick, 4 inches high, and 12 inches long utility. Closure/utility bricks may be used at the option of the Contractor, provided that changes necessitated by the use of such brick shall be the responsibility of the Contractor.
   f. Salvaged Brick: Use of salvaged brick shall be only as accepted by the Government and only after material samples are submitted along with samples of any and all new brick to be used on the project. If used, use lead-free salvaged bricks and other masonry units in place of new bricks or masonry units as indicated. Bricks salvaged from foundrys or industrial buildings shall be washed with appropriate metal-dust removing cleaner. When using salvaged brick, select exterior face bricks from salvaged exterior face bricks. Bricks shall meet standards of new bricks otherwise used in application, and shall be cleaned of all mortar prior to use. Place exterior face towards the exterior.
3. CONCRETE BRICK: Concrete brick shall conform to ASTM C55, Type I, Grade N. Concrete brick may be used where necessary for filling out in concrete masonry unit construction.
4. CONCRETE MASONRY UNITS (CMU): Hollow and solid concrete masonry units shall conform to ASTM C90. Cement shall have a low alkali content and be of one brand.
   a. Aggregates: Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.
   b. Kinds and Shapes: Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 1 inch. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.
      1) Architectural Units:
         A. Rockface Units: shall have patterned face shell. Face shell pattern shall be rockface. Units shall be integrally colored during manufacture. Color shall be as selected by the Architect. Patterned face shell shall be properly aligned in the completed wall.
         B. Burnished Units: shall have burnished face shell. Color shall be as selected by the Architect. Moisture resistant sealer as recommended by the manufacturer for exterior application.
   c. Fire-Rated CMU: For indicated fire-rated construction, provide concrete masonry units of minimum equivalent thickness for the fire rating indicated and the corresponding type of aggregates indicated in TABLE I. Units containing more than one of the aggregates listed

in TABLE I will be rated by linear interpolation based on the percent by dry-rodded volume of each aggregate used in manufacturing the units..

TABLE I: FIRE-RATED CONCRETE MASONRY UNITS

Aggregate Type	Minimum Equivalent thickness for fire Resistance Rating (inch)		
	4 hours	3 hours	2 hours
Calcareous or siliceous gravel (other than limestone)	6.2	5.3	4.2
Limestone, cinders, or air-cooled slag	5.9	5.0	4.0
Expanded clay, expanded shale, or expanded slate	5.1	4.4	3.6
Expanded slag or pumice	4.7	4.0	3.2

Note: Determine equivalent thickness in accordance with <RID>ACI 216.1</RID>. Where walls are to receive plaster or be faced with brick, or otherwise form an assembly; include the thickness of plaster or brick or other material in the assembly in determining the equivalent thickness. Submit calculation results.

5. Prefaced Concrete Masonry Units: Prefaced concrete masonry units shall conform to ASTM C 744 using masonry units conforming to ASTM C 90. The facing shall turn over the edges and ends of the unit at least 3/8 inch in the direction of the thickness of the unit to form a lip at least 1/16 inch thick. Variation in color and texture shall not exceed that of the approved samples. All shapes and sizes shall be provided for a complete installation. Base units shall be coved to meet finished floor surfaces where ceramic tile floor occurs.
6. Precast Concrete Items: Trim, lintels, sills, copings, splashblocks and door sills shall be factory-made units from a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, concrete shall be 4000 psi minimum conforming to Section 03 30 00.00 48 CAST-IN-PLACE CONCRETE using 1/2 inch to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 3/4 inch shall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 psi for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Cast-concrete members weighing over 80 pounds shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. Units shall have beds and joints at right angles to the face, with sharp true arises and shall be cast with drip grooves on the underside where units overhang walls. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.
   a. Lintels: Precast lintels, unless otherwise shown, shall be of a thickness equal to the wall and reinforced with two No. 4 bars for the full length. Provide top and bottom bars for lintels over 36 inches in length. Provide at least 8 inches bearing at each end. Top of lintels shall be labeled "TOP" or otherwise identified and each lintel shall be clearly marked to show location in the structure.
   b. Sills and Copings: Sills and copings shall be cast with washes. Sills for windows having mullions shall be cast in sections with head joints at mullions and a 1/4 inch allowance for mortar joints. The ends of sills, except a 3/4 inch wide margin at exposed surfaces, shall be roughened for bond. Treads of door sills shall have rounded nosings.
   c. Splash Blocks: Splash blocks shall be as detailed. Reinforcement shall be the manufacturer's standard.

d. Flue Linings and Thimbles: ASTM C315, free from fractures. Sizes and shapes shall be as indicated.

7. Stone Items: Stone for trim, sills, lintels, and copings shall be limestone (ASTM C586), standstone (ASTM C616), or granite (ASTM C616), and shall be cut to the design shown. Sandstone shall be standard grade, buff, gray, or buff brown, with a smooth finish free from clay pits and tool marks. Granite shall be a commercial grade of medium or moderately coarse grain, and a light or medium gray or light pink color, with a smooth machine finish on washes, 4-cut finish on treads, and 6-cut or equivalent machine finish on other exposed surfaces. Limestone shall be standard buff limestone with a smooth machine finish free from tool marks. Lintels, except when supported by a steel member, shall be 4 inches or more thick from face to back edge and of the depth required to support the masonry over the opening. Stone shall have beds and joints at right angles to the face, with sharp, true arises. Copings and sills shall be provided with washes, and where overhanging the walls, shall have drips cut on the underside.
8. Mortar for Structural Masonry: ASTM C270, Type S, N, or N as indicated on the Structural drawings. Strength (f'm) as indicated. Test in accordance with ASTM C780. Use Type II Portland cement. Do not use admixtures containing chlorides. When structural reinforcement is incorporated, maximum air-content shall be 12 percent in cement-lime mortar. Masonry cement shall not be used for reinforced masonry construction. Use up to 40 percent Class F fly ash with Type IP cement in cement-lime mortar. Fly ash shall comply with ASTM C593.
9. Mortar: Mortar shall be Type S, N, or M as indicated on the Structural drawings (with strength as indicated on structural drawings) in accordance with the proportion specification of ASTM C270, or following the specifications of ACI 530 and TMS MSJC if so designated by the structural Engineer. When masonry cement ASTM C91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C1072. Mortar for prefaced concrete masonry unit wainscots shall contain aggregates with 100 percent passing the 2.36 mm No. 8 sieve and 95 percent passing the No. 16 sieve. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source. Pre-mixed mortar shall conform to ASTM C1142
   a. Mortar Admixtures: In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C1384.
   b. Mortar Coloring:. Mortar coloring shall not exceed 3 percent of the weight of cement for carbon black and ten percent of the weight of cement for all other pigments. Mortar coloring shall be chemically inert, of finely ground limeproof pigment, and furnished in accurately pre-measured and packaged units that can be added to a measured amount of cement.
   c. Hydrated Lime and Alternates: Hydrated lime shall conform to ASTM C207.
   d. Portland Cement: Conform to ASTM C150.
   e. Pre-mixed Mortar: Conform to ASTM C1142.
   f. Sand and Water: Conform to ASTM C144.
10. Water-Repellant Admixture: Polymeric type formulated to reduce porosity and water transmission. Construct panels of masonry units conforming to ASTM C744 and mortar which contain the water-repellant admixture. When tested in accordance with ASTM C1072, such panels shall have flexural strength not less than that specified or indicated. When tested in accordance with ASTM E514, panels shall exhibit no water visible on back of test panel and no leaks through the panel after 24 hours, and not more than 25 percent of wall area shall be damp after 72 hours.
11. Grout: Grout shall conform to ASTM C 476. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 10 inches. Minimum grout strength shall be 2000 psi in 28 days. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-mixed grout shall conform to ASTM C94/C94M.

a. Grout Admixtures: Water-reducing admixtures that conform to ASTM C494/C494M Type F or G and viscosity-modifying admixtures that conform to ASTM C494/C494M Type S are permitted for use in grout. Other admixtures require approval by the Contracting Officer. In cold weather, a non-chloride based accelerating admixture may be used subject to approval by the Contracting Officer; use accelerating admixture that is non-corrosive and conforms to ASTM C494/C494M, Type C.
b. Grout Barriers: Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

12. Anchors, Ties, And Bar Positioners: Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A1064/A1064M. Wire ties or anchors in exterior walls shall conform to ASTM A153/153M. Joint reinforcement in interior walls, and in exterior or interior walls exposed to moist environment shall conform to ASTM A641/A641M; coordinate with paragraph JOINT REINFORCEMENT below. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.
    a. Wire Mesh Ties: Wire mesh for tying 4 inch thick concrete masonry unit partitions to other intersecting masonry partitions shall be 1/2 inch mesh of minimum 16 gauge steel wire. Minimum lengths shall be not less than 12 inches.
    b. Wall Ties: Wall ties shall be rectangular-shaped or Z-shaped fabricated of 3/16 inch diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 4 inches wide. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 3/16 inch diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 1/2 inch eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 1/16 inch. The pintle and eye elements shall be formed so that both can be in the same plane.
    c. Dovetail Anchors: Dovetail anchors shall be of the flexible wire type, 3/16 inch diameter zinc-coated steel wire, triangular shaped, and attached to a 12 gauge or heavier steel dovetail section. These anchors shall be used for anchorage of veneer wythes or composite-wall facings extending over the face of concrete columns, beams, or walls. Cells within vertical planes of these anchors shall be filled solid with grout for full height of walls or partitions, or solid units may be used. Dovetail slots are specified in Section 03 30 00.00 48 CAST-IN-PLACE CONCRETE.
    d. Adjustable Anchors: Adjustable anchors shall be 3/16 inch diameter steel wire, triangular-shaped. Anchors attached to steel shall be 5/16 inch diameter steel bars placed to provide 1/16 inch play between flexible anchors and structural steel members. Spacers shall be welded to rods and columns. Equivalent welded-on steel anchor rods or shapes standard with the flexible-anchor manufacturer may be furnished when approved. Welds shall be cleaned and given one coat of zinc-rich touch up paint.
    e. Bar Positioners: Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.
13. Joint Reinforcement: Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A951/951M, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A153/A153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be single layer of ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 3 m 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

14. Reinforcing Steel Bars And Rods: Reinforcing steel bars and rods shall conform to ASTM A615/A615M, or ASTM A996/A996M. Tack welding of bars other than ASTM A996 shall not be allowed.
15. Control Joint Keys: Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D2000 M2AA-805 with a minimum durometer hardness of 80 or polyvinyl chloride conforming to ASTM D2287 Type PVC 654-4 with a minimum durometer hardness of 85. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 30 degrees F after five hours exposure.
16. Expansion-Joint Materials: Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07 90 00.00 48 JOINT SEALERS.
17. Insulation
    a. Rigid Board-Type Insulation: Rigid board-type insulation shall be extruded polystyrene, polyurethane, or polyisocyanurate. Polystyrene shall conform to ASTM C578. Polyisocyanurate shall conform to ASTM C 1289, Type I, Class 1 or 2, faced with aluminum foil on both sides of the foam. The insulation shall be a standard product and shall be marked with not less than the manufacturer's trademark or name, the specification number, the permeance and R-values.
        1) Insulation Thickness and Air Space: The cavity space shall allow for a maximum insulation thickness of 2 inches and a minimum air space of 3/4 inch.
18. Insulation Adhesive: Insulation adhesive shall be specifically prepared to adhere the insulation to the masonry and, where applicable, to the thru-wall flashing. The adhesive shall not deleteriously affect the insulation, and shall have a record of satisfactory and proven performance for the conditions under which to be used.Flashing: Flashing shall be as specified in Section 07 62 00.00 48 FLASHING AND SHEET METAL.
19. Weep Hole Ventilators: Weephole ventilators shall be prefabricated aluminum, plastic or wood blocking sized to form the proper size opening in head joints. Provide aluminum and plastic inserts with grill or screen-type openings designed to allow the passage if moisture from cavities and to prevent. Ventilators shall be sized to match modular construction with a standard 3/8 inch mortar joint.
20. Siloxane Sealer is specified in Section 07 19 00.00 48 WATER REPELLANT COATINGS.
21. Sand and Water: Sand shall conform to ASTM C144. Water shall be clean, potable, and free from substances which could adversely affect the mortar.

---End of Section---

SECTION 04 71 00.00 48 CAST STONE

Scope:

1. Provide cast stone shown on Architectural drawings and as described in this specification.
   a. Trim, lintels, sills, copings, door sills and other miscellaneous items as indicated.

References:

1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section

ACI INTERNATIONAL (ACI)

ACI 318	Building Code Requirements for Structural Concrete and Commentary

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185 -	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
ASTM A 615/A 615M	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete reinforcement
ASTM C 33	Standard Specification for Concrete Aggregates
ASTM C 150	Standard Specification for Portland Cement
ASTM C 173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volume Method.
ASTM C 231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Standard Specification for Air-Entrained Admixtures for Concrete.
ASTM C 270	Standard Specification for Mortar for Unit Masonry.
ASTM C 494/C 494M	Standard Specification for Chemical Admixtures for Concrete.
ASTM C 618	Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
ASTM C 979	Standard Specification for Coloring Pigments for Integrally Pigmented Concrete.
ASTM C 989	Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete.
ASTM C 1194	Standard Test Method for Compressive Strength of Architectural Cast Stone.
ASTM C 1195	Standard Test Method for Absorption of Architectural Cast Stone.
ASTM C 1364	Standard Specification for Architectural Cast Stone.
ASTM D 2244	Standard Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

CAST STONE INSTITUTE

Cast Stone Institute Technical Manual (Current Edition)

Definitions:

1. Cast Stone – a refined architectural concrete building unit intended to simulate natural cut stone
   a. Dry Cast Concrete Products - manufactured from zero slump concrete
      1) Vibrant Dry Tamp (VDT) casting method: Vibratory ramming of earth moist, zero-slump concrete against a rigid mold until it is densely compacted
   b. Wet Cast Concrete Products - manufactured from measurable slump concrete
      1) Wet Cast Method: manufactured from measurable slump concrete and vibrated into a mold until it becomes densely consolidated

Submittals:

1. Preconstruction Submittal: Manufacturer's Qualifications.
2. Manufacturer's Shop Drawings; Submit manufacturer's shop drawings including profiles, cross section, reinforcement, exposed faces, arrangement of joints (optional for standard or semi-custom installations), anchoring methods, anchors (if required), annotation of stone types and their location.

Quality Assurance:

1. Manufacturer's Qualifications:
   a. Manufacturer shall have sufficient plant facilities to produce the shapes, quantities and size of cast stone required in accordance with the project schedule.
   b. Manufacturer shall submit a written list of projects similar in scope and at least three (3) years of age, along with owner, architect and contractor references.
2. Standards: Comply with the requirements of the Cast Stone Institute Technical Manual and the project specifications. Where a conflict may occur, the contract documents shall prevail.
3. Mock-up: Provide full size unit(s) for use in construction of sample wall. The approved mock-up shall become the standard for appearance and workmanship for the project.

Products:

1. Comply with ASTM C 1364.
2. Physical Properties:
   a. Compressive Strength - ASTM C 1194: 6,500 psi minimum for products at 28 days.
   b. Absorption - ASTM C 1195: 6% maximum by the cold water method.
   c. Air Content - ASTM C 173 or ASTM C 231, for wet cast product shall be 4-6% for units used in a freeze-thaw environment.
3. Raw Materials:
   a. Portland cement - Type I or Type III, white and/or grey, ASTM C 150
   b. Coarse aggregates - Granite, quartz or limestone, ASTM C 33, except for gradation, and are optional for the VDT casting method.
   c. Fine aggregates - Manufactured or natural sands, ASTM C 33, except for gradation.
   d. Colors - Inorganic iron oxide pigments, ASTM C 979, except carbon black pigments shall not be used.
4. Admixtures - Comply with the following:
   a. ASTM C 260 for air-entraining admixtures.
   b. ASTM C 494 for water reducing, retarding or accelerating admixtures.
   c. Other admixtures: integral water repellents and other chemicals for which no ASTM standard exists, shall be previously established as suitable for use in concrete by proven field performance or through laboratory testing.
   d. ASTM C 618 mineral admixtures of dark and variable colors shall not be used in surfaces intended to be exposed to view.
   e. ASTM C 989 granulated blast furnace slag may be used to improve physical properties. Tests are required to verify these features.
   f. Water – Potable
5. Reinforcing bars:
   a. ASTM A 615/A 615M. Grade 40 or 60 steel galvanized or epoxy coated when cover is less than 1.5 in.
   b. Welded Wire Fabric: ASTM A 185 where applicable for wet cast units.

6. All anchors, dowels and other anchoring devices and shims shall be standard building stone anchors commercially available in a non-corrosive material such as zinc plated, galvanized steel, brass, or stainless steel Type 302 or 304.
7. Job Site Testing:
   a. One (1) sample from production units may be selected at random from the filed for each 500 cubic feet delivered to the job site.
   b. Three (3) field cut cube specimens from each of these samples shall have an average minimum compressive strength of not less than 80% of design strength or as allowed by ACI 318.
   c. Three (3) field cut cube specimens from each of these samples shall have an average maximum cold-water absorption of 6%.
   d. Field specimens shall be tested in accordance with ASTM C 1194 and ASTM C 1195.

Color and Finish:

1. All surfaces intended to be exposed to view shall have a fine-grained texture similar to natural stone, with no air voids in excess of 1/32 in and the density of such voids shall be less than 3 occurrences per any 1-square inch and not obvious under direct daylight illumination at a 5-feet distance.
2. Units shall exhibit a texture approximately equal to the approved sample when viewed under direct daylight illumination at a 10-feet distance.
3. ASTM D 2244 permissible variation in color between units of comparable age subjected to similar weathering exposure.
   a. Total color difference - not greater than 6 units.
   b. Total hue difference - not greater than 2 units.
4. .Minor chipping resulting from shipment and delivery shall not be grounds for rejection. Minor chips shall not be obvious under direct daylight illumination from a 20-foot distance.

Reinforcing:

1. Reinforce the units as required by the drawings and for safe handling and structural stress.
2. Minimum reinforcing shall be 0.25 percent of the cross section area, panels, soffits and similar stones greater than 12 inches wide shall be reinforced along their length and width.
3. Welded wire fabric reinforcing shall not be used in dry cast products.

Curing:

1. Cure units in a warm curing chamber at 95 percent relative humidity for approximately 18 hours, or yard cure for 350 degree-days (i.e. 7 days @ 50 degrees F or 5 days @ 70 degrees F prior to shipping.
2. Remove cement film from exposed surfaces prior to packaging for shipment.

Manufacturing Tolerances:

1. Cross section dimensions shall not deviate by more than plus or minus 1/8 inch from approved dimensions.
2. Length of units shall not deviate by more than length/360 or plus or minus 1/8 inch, whichever is greater, not to exceed plus or minus 1/4 inch. Maximum length of any unit shall not exceed 15 times the average thickness of such unit unless otherwise agreed by the manufacturer.
3. Warp, bow or twist of units shall not exceed length/360 or plus or minus 1/8 inch, whichever is greater
4. Location of dowel holes, anchor slots, flashing grooves, false joints and similar features - On formed sides of units, 1/8 inch, on unformed sides of unit, 3/8 inch maximum deviation.

Production Quality Control:

1. Test compressive strength and absorption from specimens selected at random from plant production.
2. Samples shall be taken from every 500 cubic feet of product produced.
3. Perform tests in accordance with ASTM C 1194 and ASTM C 1195.

4. New and existing mix designs shall be tested for strength and absorption compliance prior to producing units.

Setting Tolerances:

1. 1. Comply with Cast Stone Institute Technical Manual
2. Set stones 1/8 inch or less, within the plane of adjacent units.
3. Joints, plus 1/16 inch, minus 1/8 inch

Jointing:

1. Joint Size:
   a. At stone/brick joints 3/8 inch .
   b. At stone/stone joints in vertical position 1/4-inch (3/8 inch optional)
   c. Stone/stone joints exposed on top 3/8 inch .
2. Joint materials
   a. Mortar, Type N, ASTM C 270.
   b. Use a full bed of mortar at all bed joints.
   c. Flush vertical joints full with mortar.
   d. Leave all joints with exposed tops or under relieving angles open for sealant.
   e. Leave head joints in copings and projecting components open for sealant.

---End of Section---

SECTION 05 12 00.00 48 STRUCTURAL STEEL

Scope: 1. Provide structural steel for building construction including sub-framing units which are part of the general framing system. Include anchors, bases, bearing plates, bracing, lintels when part of structural framing, and detail fittings.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OPFFICIALS (AASHTO)

AASHTO LRFD	Bridge Design Specifications

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 207	Certification Standard for Steel Fabrication and Erection, and Manufacturing of Metal Components
AISC 303	Code of Standard Practice for Steel Buildings and Bridges
AISC 325	Steel Construction Manual
AISC 326	Detailing for Steel Construction
AISC 341	Seismic Provisions for Structural Steel Buildings
AISC 348	Structural Joints Using ASTM A325 and A490 Bolts
AISC 360	Specifications for Structural Steel Buildings
AISC 420	Certification Standard for Shop Application of Complex Protective Coating Systems
AISC DESIGN GUIDE 10	Erection Bracing of Low-Rise Structural Steel Frames

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189	ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel (ANSI/ASNT CP-105-2006)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A108	Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A1085/A1085M	Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143/A143M	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A193/A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A276/A276M	Standard Specification for Stainless Steel Bars and Shapes
ASTM A29/A29M	Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A500/A500M	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts

ASTM A563M	Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A6/A6M	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A668/A668M	Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	Standard Specification for Structural Steel Shapes
ASTM B695	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C1107/C1107M	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C827	Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
ASTM F1136	Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F2329/2329M	Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
ASTM F2833	Standard Specification for Corrosion Protective Fastener Coatings with Zinc Rich Base Coat and Aluminum Organic/Inorganic Type
ASTM F3125/F3125M	Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions
ASTM F436/F436M	Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
ASTM F844	Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F959/F959M	Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	Structural Welding Code – Steel
AWS D1.8/D1.8M	Structural Welding Code – Seismic Supplement
AWS QC1	Specification for AWS Certification of Welding Inspectors

ASME INTERNATIONAL (ASME)

ASME B46.1	Surface Texture, Surface Roughness, Waviness, and Lay

CRANE MANUFACTURES ASSOCIATION OF AMERICA (CMAA)

CMAA 70	Specification for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	Shop, Field, and Maintenance Painting
SSPC Paint 20	Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)
SSPC Paint 29	Zinc Dust Sacrificial Primer, Performance-Based
SSPC SP 3	Power Tool Cleaning

SSPC SP 6/NACE No.3 Commercial Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 Structural Engineering

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR Part 1926, Subpart R Quality Control System, Requirements for a Testing and Inspection Laboratory.

General:

1. GENERAL REQUIREMENTS: Structural steel fabrication and erection shall be performed by an organization experienced in structural steel work of equivalent magnitude. The Contractor shall be responsible for correctness of detailing, fabrication, and for the correct fitting of structural members. Connections, for any part of the structure not shown on the contract drawings, designed and detailed in accordance with pertinent provisions of AISC Manual. Substitution of sections or modification of connection details will not be accepted unless approved by the Engineer of Record. AISC Manual shall govern the work. Welding shall be in accordance with AWS D1.1 or paragraph WELDING. High-strength bolting shall be in accordance with AISC Manual.
   a. Steel fabricator shall design connections not detailed on the contract drawings under direct supervision of a Professional Structural Engineer experienced in the design of this work and licensed in the state where the Project is located. Design shall follow recognized industry standards and shall conform to AISC 303, Option 3.
   b. General Requirements: Conform to general requirements for Quality Control and Assurance covered in Division 01 and specific requirements as outlined in the following AISC documents:
      1) "Code of Standard Practice for Steel Buildings and Bridges", AISC-S303, Section 8 - Quality Control.
      2) "Specifications for Steel Buildings, with Commentary, AISC Manual, AISC-360, Ch. M, Fabrications, Erection and Quality Control and supplements thereto as issued. Maintain a copy of each document on site.
   c. Quality Assurance: Both the Fabricator and Erector shall maintain a Quality Assurance program conforming to AISC-S303 Code of Standard Practice, Section 8, and AISC Specification for Structural Steel Buildings, Section M5, to assure that all of the work is performed in accordance with the contract documents. It shall be the responsibility of the Contractor to maintain control of the quality of the materials and workmanship, and conformance to the project Specifications. Materials and fabrication procedures are subject to inspections and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
   d. Welding (Shop and Field): Fabrication/erection inspection and testing of weldments shall be provided by the Contractor in accordance with AWS D1.1, Section 6. The fabrication/erection inspector(s) shall be AWS Certified Welding Inspector(s) in accordance with the provisions of AWS QCI, Standard for Qualifications and Certification of Welding Inspectors. Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welder or welding operator is more than 6 months old, the welding operator's qualification certificate must be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months. Each welder working on the project shall mark his identification symbol at each weldment completed whether in shop or field.

2. SUBMITTALS: The following shall be submitted to the Engineer of Record (unless noted otherwise) for approval in accordance with Section 01 33 00.00 48 - SUBMITTAL PROCEDURES:
   a. Shop Drawings
      1) Structural Steel System and Structural Connections; Shop and erection details including members (with their connections) not shown on the contract drawings. Welds shall be indicated by standard welding symbols in accordance with AWS A2.4.
   b. Product Data
      1) Erection; Prior to erection, erection plan of the structural steel framing describing all necessary temporary supports, including the sequence of installation and removal.
      2) Welding; Electrodes and rods.
   c. Samples
      1) Random samples of bolts, nuts, and washers as delivered to the job site if requested, taken in the presence of the Quality Control Inspector and provided to the Quality Control Inspector for testing to establish compliance with specified requirements.
         i. High Strength Bolts and Nuts
         ii. Carbon Steel Bolts and Nuts
         iii. Nuts Dimensional Style
         iv. Washers
   d. Certificates
      1) Mill Test Reports; Certified copies of mill test reports for structural steel, structural bolts, nuts, washers and other related structural steel items, including attesting that the structural steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified, prior to the installation.
      2) Welder Qualifications; Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.1.
      3) Welding Inspector; Welding Inspector qualifications.
      4) Fabrication; A copy of the AISC certificate indicating that the fabrication plant and erector meet the specified structural quality certification.

3. PRODUCT HANDLING AND STORAGE
   a. Delivery of materials to be installed under other sections:
      1) Anchor bolts and other anchorage devices, which are embedded in cast-in-place concrete or masonry construction, shall be delivered to the project site in time to be installed before the start of cast-in-place concrete operations or masonry work.
      2) Provide setting drawings, templates, and directions for the installation of the anchor bolts and other devices.
   b. Storage of Materials:
      1) Structural steel members which are stored at the project site shall be above ground on platforms, skids, or other supports.
      2) Steel shall be protected from corrosion.
      3) Other materials shall be stored in a weather tight and dry place until ready for use in the work.
      4) Packaged materials shall be stored in their original, unbroken packages or containers.

4. WELDING INSPECTOR: Welding Inspector qualifications shall be in accordance with AWS D1.1.

5. QUALIFICATIONS: The structural steel fabricating plant and the steel erector shall have the personnel, organization, experience, procedures, knowledge, equipment, capacity, and commitment to produce and erect fabricated steel of the structural steel work involved in this project.
   a. The Fabricator shall have specialized in performing the work of this section with a minimum of 5 years documented experience.
   b. The Erector shall have specialized in performing the work of this section with minimum 5 years documented experience.

c. Fabricator shall be certified under the AISC "Quality Certification Program" or equivalent verification for the following category: I. Conventional Steel Buildings.

6. VERIFICATION TESTING AND INSPECTION: Perform field tests, and provide labor, equipment, and incidentals required for testing, except that electric power for field tests will be furnished as set forth in Division 1. Notify the Contracting Officer in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of the inspection
   a. Welds:
      1) Visual Inspection - AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. A Certified Welding Inspector must perform visual inspection on 100 percent of all welds. Document this inspection in the Visual Weld Inspection Log. Submit certificates indicating that certified welding inspectors meet the requirements of AWS QC1. Inspect proper preparation, size, gaging location, and acceptability of all welds; identification marking; operation and current characteristics of welding sets in use.
      2) Nondestructive Testing - Nondestructive testing must be in accordance with AWS D1.1/D1.1M and AWS D1.8/D1.8M. Ultrasonic testing must be performed in accordance with Table 6.2 or 6.3 of AWS D1.1/D1.1M. Test locations must be selected by the Contracting Officer. All personnel performing NDT must be certified in accordance with ANSI/ASNT CP-189 in the method of testing being performed. Submit certificates showing compliance with ANSI/ASNT CP-189 for all NDT technicians. If more than 20 percent of welds made by a welder contain defects identified by testing, then all groove welds made by that welder must be tested by ultrasonic testing, and all fillet welds made by that welder must be inspected by magnetic particle testing (MT) or dye penetrant testing (PT) as approved by the Contracting Officer. When groove welds made by an individual welder are required to be tested, magnetic particle or dye penetrant testing may be used only in areas inaccessible to ultrasonic testing. Retest all repaired areas. Submit weld inspection reports.
   b. Direct Tension Indicator Washers:
      1) Direct Tension Indicator Washer Compression - Test direct tension indicator washers in place to verify that they have been compressed sufficiently to provide the 0.015 inch gap, as required by ASTM F959/F959M. Submit direct tension indicator washer inspection reports.
      2) Direct Tension Indicator Gaps - In addition to the above testing, an independent testing agency as approved by the Contracting Officer, must test in place the direct tension indicator gaps on 20 percent of the installed direct tension indicator washers to verify that the ASTM F959/F959M direct tension indicator gaps have been achieved. If more than 10 percent of the direct tension indicators tested have not been compressed sufficiently to provide the average gaps required by ASTM F959/F959M test all in place direct tension indicator washers to verify that the ASTM F959/F959M direct tension indicator gaps have been achieved. Test locations must be selected by the Contracting Officer.
   c. High-Strength Bolts:
      1) Testing Bolt, Nut, and Washer Assemblies - Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 360, depending on bolt size and grade. The bolt tension must be developed by tightening the nut. A representative of the manufacturer or supplier must be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements. Submit bolt testing reports.
      2) Inspection - Inspection procedures must be in accordance with AISC 360. Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly

prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

3) Testing - The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. Provide the required access for the Government to perform the tests. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations must be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, must be tested at the Contractor's expense. Retest new bolts after installation at the Contractor's expense.

d. Testing for Embrittlement: ASTM A143/A143M for steel products hot-dip galvanized after fabrication. Submit embrittlement test reports.

e. Inspection and Testing of Steel Stud Welding: Perform verification inspection and testing of steel stud welding conforming to the requirements of AWS D1.1/D1.1M, Stud Welding Clause. The Contracting Officer will serve as the verification inspector. Bend test studs that do not show a full 360 degree weld flash or have been repaired by welding as required by AWS D1.1/D1.1M, Stud Welding Clause. Studs that crack under testing in the weld, base metal or shank will be rejected and replaced by the Contractor at no additional cost.

7. RESPONSIBILITIES

a The Contractor/Fabricator is responsible for properly implementing the design drawings, properly furnishing materials and workmanship, maintaining the specified fabrication and erection tolerances, and for fit and erectability of the structure. It is the Contractor’s sole responsibility for reviewing the means and methods of construction or related job safety issues.

b. Substitutions of member sizes due to non-availability of materials shall be of equivalent strength and rigidity to that specified, shall be compatible with the design and shall be approved by the Structural Engineer of Record after being specifically called to his/her attention in writing.

8. FIELD MEASUREMENTS: Verify that field measurements are as shown on drawings or as approved on shop drawings.

Products: 1. STRUCTURAL STEEL: Wide flange and WT shapes, ASTM A992/A992M. Angles, Channels and Plates, ASTM A36/A36M.

2. STRUCTURAL STEEL TUBING: Structural tubing shall conform to ASTM A 500/A500M or ASTMA1085/A1085M.

3. STEEL PIPE: Steel pipe shall conform to ASTM A53/A53M.

4. BOLTS, NUTS, AND WASHERS: Submit the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

a. Common Grade Bolts

1) Bolts: ASTM A307, Grade A. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2) Nuts: ASTM A563, Grade A, heavy hex style.

3) Washers: ASTM F844.

b. High-Strength Bolts: High strength bolts and nuts must be shipped together in the same shipping container. Fasteners indicated to be galvanized shall be tested by the supplier to show that the galvanized nut with the supplied lubricant provided may be rotated from the

snug tight condition well in excess of the rotation required for pretentioned installation without stripping. The supplier shall supply nuts that have been lubricated and tested with the supplied bolts.

1) Bolts: ASTM F3125/F3125M, Grade A325M A325 or A490M A490, Heavy Hex Head Style.
2) Nuts: ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.
3) Direct Tension Indicator Washers - ASTM F959/F959M. Submit product data for direct tension indicator washers.
4) Washers: ASTM F436/F436M, plain carbon steel.

c. Tension Control Bolts -ASTM F3125/F3125M, Grade F1852 or F2280, Type 1, twistoff style assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon steel nuts, and hardened carbon steel washers. Submit product data for tension control bolts.

d. Foundation Anchorage

1) Anchor Rods: ASTM F1554 Gr 36, 55, or 105, Class 1A or 2A.
2) Anchor Nuts: ASTM A563, Grade A, hex style.
3) Anchor Washers: ASTM F844.
4) Anchor Plate Washers: ASTM A36/A36M.

5. STRUCTURAL STEEL ACCESSORIES

a. Welding Electrodes and Rods: AWS D1.1/D1.1M and AWS D1.8/D1.8M. Submit product data for welding electrodes and rods.

b. Non-Shrink Grout: ASTM C1107/C1107M, with no ASTM C827/C827M shrinkage. Grout must be nonmetallic. Submit product data for non-shrink grout.

c. Welded Shear Stud Connectors: ASTM A29/A29M, Grades 1010 through 1020. AWS D1.1/D1.1M, Table 7.1, Type B.

6. SOURCE QUALITY CONTROL AND TESTS

a. Provide Certified Mill Test Reports (CMTR) for all structural steel sections.

b. Provide manufacturer's Certificate of Conformance for all bolts, nuts, washers, rods, weld materials, stud shear connectors, grout and other materials provided under this section.

--- End of Section ---

SECTION 05 21 00.00 48 STEEL JOIST FRAMING

Scope: 1. Provide steel joist girders and/or the following steel joists for floor and roof construction:
a. Open web steel joists: K-series and KCS series.
b. Longspan steel joists: LH-series.
c. Deep longspan steel joists: DLH-series.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

STEEL JOIST INSTITUTE (SJI)

SJI COMPOSITE JOISTS Standard Specifications for Composite Steel Joist Catalog
SJI LOAD TABLES Current Edition Catalog of Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders

SJI MANUAL Open Web Steel Joist Construction

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 Structural Welding Code - Steel

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A36/A36M Carbon Structural Steel

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC International Building Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1 Shop, Field, and Maintenance Painting of Steel
SSPC Paint 15 Steel Joist Shop Primer
SSPC SP 2 Hand Tool Cleaning

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926 Safety and Health Regulations for Construction
29 CFR 1926.756 Steel Erection; Beams and Columns
29 CFR 1926.757 Steel Erection; Open Web Steel Joists

General: 1. SUBMITTALS: The following shall be submitted to the Engineer of Record (unless noted otherwise) for approval in accordance with Section 01 33 00.00 48 SUBMITTAL PROCEDURES:
a. Shop Drawings
1) Steel Joists; Detail drawings shall include fabrication and erection details, specifications for shop painting, and identification markings of joists and joist girders.
b. Certificates
1) Steel Joists: Statement from steel joist manufacturer, that work was performed in accordance with approved construction documents and with SJI standard specifications, in accordance with ICC IBC.
2) Fabricator: Certification that the fabricator is a Steel Joist Institute Member Fabricator.
3) Weld Test Data and Certificates: Prior to construction commencement, submit certification for welder qualification, in compliance with AWS D1.1/D1.1M, welding operation, and tacker, stating the type of welding and positions qualified for, the code

and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests.

2. GENERAL REQUIREMENTS: Designate steel joists and joist girders on the contract drawings in accordance with the standard designations of the Steel Joist Institute. Joists of other standard designations or joists with properties other than those shown may be substituted for the joists designated provided the structural properties are equal to or greater than those of the joists shown and provided all other specified requirements are met.
All joist girder framing must conform to 29 CRF 1926.757. Secure all joist bridging and anchoring in place prior to the application of any construction loads. Distribute temporary loads so that joist capacity is not exceeded. Do not apply loads to bridging.

3. DELIVERY AND STORAGE: Materials shall be delivered to the site in undamaged condition and stored off the ground in a well drained location, protected from damage, and easily accessible for inspection and handling.

Products:

1. OPEN WEB STEEL JOISTS: Open web steel joists shall conform to SJI Specs & Tables, K-Series or KCS-Series. Joists shall be designed to support the loads given in the standard load tables of SJI Specs & Tables.

2. LONGSPAN STEEL JOISTS: Longspan steel joists and deep longspan steel joists shall conform to SJI Specs & Tables, LH-Series and DLH-Series. Joists designated LH and DLH shall be designed to support the loads given in the applicable standard load tables of SJI Specs & Tables.

3. JOIST GIRDERS: Joist girders shall conform to SJI Specs & Tables.

4. ACCESSORIES AND FITTINGS: Provide bridging of material, size, and type required by SJI LOAD TABLES for type of joist, chord size, spacing and span. Furnish additional erection bridging if required for stability. Fabricate steel bearing plats from ASTM A36/A36M steel of size and thickness indicated.

5. SHOP PAINTING: SSPC Paint 15. Shop prime joists, except as modified herein, in accordance with SSPC PA 1. Clean joists in accordance with SSPC SP 2 before priming. Do not prime joists to receive sprayed-on fireproofing. If flash rusting occurs, re-clean the surface prior to application of primer. For joists and joist girders which require finish painting under Section 09 90 00.00 48 PAINTS AND COATINGS, the primer paint must be compatible with the finish paint.

--- End of Section ---

SECTION 05 30 00.00 48 STEEL DECKS

Scope: 1. Provide structural roof and floor decking:
   a. Standard roof deck units.
   b. Acoustical roof deck units.
   c. Standard metal floor decking.
   d. Cellular metal floor decking.
   e. Composite metal floor decking.
   f. Combination composite and cellular decking.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI D100	Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A1008/A1008M	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A792/A792M	Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM C423	Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM D1056	Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1149	Standard Test Method for Rubber Deterioration – Surface Ozone Cracking in a Chamber
ASTM D746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel
AWS D1.3/D1.3M	Structural Welding Code - Sheet Steel

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/
FM DS 1-28R	Data Sheet: Roof Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20	Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)

STEEL DECK INSTITUTE (SDI)

ANSI/SDI C	Standard for Composite Steel Floor Deck - Slabs
ANSI/SDI NC	Standard for Non-Composite Steel Floor Deck
ANSI/SDI QA/QC	Standard for Quality Control and Quality Assurance for Installation of Steel Deck
ANSI/SDI RD	Standard for Steel Roof Deck
SDI DDM04	Diaphragm Design Manual; 4th Edition
SDI DDP	Deck Damage and Penetrations
SDI MOC3	Manual of Construction with Steel Deck (3rd Edition)

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20	Paint Specification No.20 Zinc-Rich Primers (Type I - "Inorganic" and Type II - "Organic")

UNDERWRITERS LABORATORIES (UL)

UL 209	UL Standard for Safety Cellular Metal Floor Raceways and Fittings
UL 580	UL Standard for Safety Tests for Uplift Resistance of Roof Assemblies
UL Fire Resistance	Fire Resistance Directory

General:

1. SUBMITTALS: The following shall be submitted to the Engineer of Record (unless noted otherwise) for approval in accordance with Section 01 33 00.00 48 SUBMITTAL PROCEDURES:
   a. Shop Drawings
      1) Drawings shall include type, configuration, structural properties, location, and necessary details of deck units, accessories, and supporting members; size and location of holes to be cut and reinforcement to be provided; location and sequence of welded or fastener connections; and the manufacturer's erection instructions.
         A. Deck Units
         B. Accessories
         C. Attachments
         D. Holes and Openings
   b. Product Data
      1) Deck Units; Design computations for the structural properties of the deck units or SDI certification that the units are designed in accordance with SDI specifications.
      2) Attachments; Prior to welding operations, copies of qualified procedures and lists of names and identification symbols of qualified welders and welding operators.
   c. Certificates
      1) Manufacturer's certificates attesting that the decking material meets the specified requirements. Manufacturer's certificate attesting that the operators are authorized to use the low-velocity piston tool.
         A. Deck Units
         B. Attachments

2. DELIVERY, STORAGE, AND HANDLING: Deck units shall be delivered to the site in a dry and undamaged condition, stored off the ground with one end elevated, and stored under a weather tight cover permitting good air circulation. Finish of deck units shall be maintained at all times by using touch-up paint whenever necessary to prevent the formation of rust.

Products:

1. DECK UNITS: Panels of maximum possible lengths shall be used to minimize end laps. Deck units shall be fabricated in lengths to span 3 or more supports with flush, telescoped, or nested 2 inch (minimum) laps at ends, and interlocking, or nested side laps, unless otherwise indicated. Deck with cross-sectional configuration differing from the units indicated may be used, provided that the properties of the proposed units, determined in accordance with AISI Cold-Formed Manual, are equal to or greater than the properties of the units indicated and that the material will fit the space provided without requiring revisions to adjacent materials or systems. Fabricate metal decking in accordance with SDI Design Manual for Composite Decks, Form Decks, Roof Decks to accommodate maximum working stress of 20,000 psi and maximum span deflection of L/240.
   a. Roof Deck: Conform to ASTM A792/A792M or ASTM A1008/A1008M for deck used in conjunction with insulation and built-up roofing. Fabricate roof deck units of the steel design thickness required by the design drawings and zinc-coated in conformance with ASTM A653/A653M, Z275 G90 coating class or aluminum-zinc coated in accordance with ASTM A792/A792M Coating Designation AZM165 AZ55. Furnish sample of Metal Roof Deck Units used to illustrate actual cross section dimensions and configurations.
   b. Acoustical Roof Deck: Provide a Noise Reduction Coefficient (NRC) rating of not less than 0.70, when tested in accordance with ASTM C423. Provide sound absorbing materials with either glass fiber in roll or premolded form for acoustical steel deck (noncellular) or glass fiber rigid strip for acoustical steel deck (cellular) in accordance with manufacturer's standards.
   c. Form Deck: Conform to ASTM A653/A653M or ASTM A1008/A1008M for deck used as formwork for concrete. Fabricate form deck of the steel design thickness required by the design drawings. Zinc-coat in conformance with ASTM A653/A653M, Z180 G60 or G90 coating class.
   d. Composite Deck: Conform to ASTM A653/A653M or ASTM A1008/A1008M for composite deck assembly. Fabricate deck used as the tension reinforcing in composite deck of the steel design thickness required by the design drawings. Zinc-coat in conformance with ASTM A653/A653M, G60 or G90 coating class.
   e. Sump Pans: Sump pans shall be provided for roof drains and shall be minimum 0.075 inch thick steel, flat bottom type, sloped sides, recessed ½ inch below roof deck surface and watertight. Sump pans shall be shaped to meet roof slope by the supplier or by a sheet metal specialist. Bearing flanges of sump pans shall overlap steel deck a minimum of 3 inches. Opening in bottom of pan shall be shaped, sized, and reinforced to receive roof drain.
   f. Shear Connectors: Provide shear connectors in accordance with AWS D1.1/D1.1M headed stud Type B. Submit stud manufacture's certification that the studs delivered conform to the material requirements. Submit stud manufacture's test reports for the last completed in-plant quality control mechanical tests.

2. TOUCH-UP PAINT: Provide a high zinc-dust content paint for regalvanizing welds in galvanized steel conforming to ASTM A780/A780M. Provide touch-up paint for shop-painted units of the same type used for the shop painting, and touch-up paint for zinc-coated units of an approved galvanizing repair paint with a high-zinc dust content. Touch-up welds with paint conforming to SSPC Paint 20 in accordance with ASTM A780/A780M. Maintain finish of deck units and accessories by using touch-up paint whenever necessary to prevent the formation of rust.
3. ADJUSTING PLATES: Provide adjusting plates, or segments of deck units, of same thickness and configuration as deck units in locations too narrow to accommodate full size units. Provide factory cut plates of predetermined size where possible.

4. CLOSURE PLATES: Shall be 20 ga. thick sheet steel; of required profiles and size.
   a. Closure Plates for Roof Deck: Voids above interior walls shall be closed with sheet metal where shown. Open deck cells at parapets, end walls, eaves, and openings through roofs shall be closed with sheet metal. Sheet metal shall be same thickness as deck units.
   b. Closure Plates for Floor Deck: The concrete shall be supported and retained at each floor level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to

support the wet concrete. Metal closures shall be provided for all openings in floor steel deck 1/4 inch and over. Fabricate metal closure plates for closing deck to columns, angle beams, etc., of not less than 18 ga. thick material galvanized. Form to close deck flutes and lap on the deck approximately 2 inches minimum.

1) Cover Plates to Close Panels: Cover plates to close panel edge and end conditions and where panels change direction or abut. Butt joints in floor steel deck may receive a tape joint cover. Fabricate metal cover plates for end-abutting floor deck units of not less than same thickness as decking. Form to match contour of deck units and approximately 6 inches wide.
2) Column Closures to Close Openings: Column closures to close openings between steel deck and structural steel columns.
3) Sheet Metal: Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.
4) Closure strips for floor deck: Fabricate metal closure strips for openings between decking and other construction of not less than 18 ga. thick minimum sheet steel. Form to provide tight-fitting closure at open ends of flutes and sides of decking.

5. ACCESSORIES: The manufacturer's standard accessories shall be furnished as necessary to complete the deck installation. Metal accessories shall be of the same material as the deck and have minimum design thickness as follows: saddles, 0.0474 inch; welding washers, 0.0598 inch; cant strip, 0.0295 inch; other metal accessories, 0.0358 inch; unless otherwise indicated. Accessories shall include but not be limited to saddles, welding washers, cant strips, butt cover plates, under lapping sleeves, and ridge and valley plates. Sheet metal accessories shall be ASTM A526 commercial quality galvanized.

6. Bearing Plates and Angles: ASTM A36 steel

7. Welding Materials: AWS D1.1

--- End of Section ---

SECTION 05 40 00.00 48 COLD-FORMED METAL FRAMING

Scope: 1. Provide lightgage metal framing:
   a. Load bearing steel studs, joists, purlins and rafters.
   b. Non-load bearing steel studs.
   c. C-shaped joists.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318/318R	Building Code Requirements for Structural Concrete and Commentary

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100	North American Specification for the Design of Cold-Formed Steel Structural Members
AISI S110	Standard for Seismic Design of Cold-Formed Steel Structural Systems - Special Bolted Moment Frames
AISI S200	North American Standard for Cold-Formed Steel Framing - General Provision
AISI S201	North American Standard for Cold-Formed Steel Framing - Product Data
AISI S202	Code of Standard Practice for Cold-formed Steel Structural Framing
AISI S211	North American Standard for Cold-Formed Steel Framing - Wall Stud Design
AISI S212	North American Standard for Cold-Formed Steel Framing - Header Design
AISI S213	North American Standard for Cold-Formed Steel Framing - Lateral Design
AISI S214	North American Standard for Cold-Formed Steel Framing – Truss Design

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A1013/A1013M	Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members
ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
ASTM A370	Mechanical Testing of Steel Products
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM C1007	Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories
ASTM C1513	Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM C955	Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
ASTM E119	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E329	Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E488/E488M	Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F1941	Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Inch Screw Threads (UN/UNR))
ASTM F2329/F2329M	Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel
AWS D1.3/D1.3M	Structural Welding Code - Sheet Steel

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	International Building Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	Structural Engineering

General:

1. SUBMITTALS: The following shall be submitted to the Engineer of Record (unless noted otherwise) for approval in accordance with Section 01 33 00.00 48 SUBMITTAL PROCEDURES:
   a. Shop Drawings
      1) Framing Components
         A. Cross sections, plans, and/or elevations showing component types and locations for each framing application; including shop coatings and material thicknesses for each framing component.
         B. Connection details showing fastener type, quantity, location, and other information to assure proper installation.
         C. Drawings depicting panel configuration, dimensions, components, locations, and construction sequence if the Contractor elects to install prefabricated/prefinished frames.
         D. For cold-formed metal framing; drawings, connection details, and design calculations to be signed and sealed by a professional engineer registered in the state where the project is located.
   b. Certificates
      1) Mill Certificates; Mill certificates or test reports from independent testing agency, qualified in accordance with ASTM E329, showing that the steel sheet used in the manufacture of each cold-formed component complies with the minimum yield strengths and uncoated steel thickness specified. Test reports shall be based on the results of three coupon tests in accordance with ASTM A370.

2) Welds; Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.3.
3) Product Data; Provide data on standard framing members; describe materials and finish, product criteria and limitations. ASTM A370.
4) Product Test Reports; From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:
   A. Post-installed anchors.
   B. Mechanical fasteners.
   C. Vertical deflection clips.
   D. Miscellaneous structural clips and accessories.

2. DELIVERY, HANDLING AND STORAGE: Materials shall be delivered and handled preventing bending or other damage, and avoiding contact with soil or other contaminating materials. Finish of the framing members shall be maintained at all times, using an approved high zinc dust content, galvanizing repair paint whenever necessary to prevent the formation of rust.

3. System Description: Size components to withstand design loads as indicated on contract drawings. Design wall and/or roof or floor system to provide for 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. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

4. Quality Assurance: QUALITY ASSURANCE
   a. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a registered professional engineer.
   b. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E329 for testing indicated.
   c. Product Tests: Mill certificates or data from a qualified independent testing agency[, or in-house testing with calibrated test equipment] indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
   d. Welding Qualifications: Qualify procedures and personnel according to the following:
      (1) AWS D1.1/D1.1M, "Structural Welding Code - Steel".
      (2) AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel".
   e. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E119 by, and displaying a classification label from, a testing and inspecting agency acceptable to authorities having jurisdiction.
   f. AISI Specifications and Standards: Comply with:
      (1) AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members".
      (2) AISI S110, "Standard for Seismic Design of Cold-Formed Steel Structural Systems - Special Bolted Moment Frames".
      (3) AISI S200, "North American Standard for Cold-Formed Steel Framing - General Provision".
      (4) AISI S201, "North American Standard for Cold-Formed Steel Framing - Product Data".
      (5) AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing".
      (6) AISI S211, "North American Standard for Cold-Formed Steel Framing - Wall Stud Design".
      (7) AISI S212, "North American Standard for Cold-Formed Steel Framing - Header Design".
      (8) AISI S213, "North American Standard for Cold-Formed Steel Framing - Lateral Design".
      (9) AISI S214, "North American Standard for Cold-Formed Steel Framing - Truss Design".

Products:

1. STEEL STUDS, TRACKS, BRACING, BRIDGING, AND ACCESSORIES: Framing components shall comply with ASTM C955 and the following:
   a. Material shall be corrosion-resistant steel complying with ASTM A 653/A 653M, 33,000 psi or higher, having a minimum yield of 33,000 psi and a G 60 minimum zinc coating.
   b. Studs, joists, rafters and purlins: sheet steel, cold-rolled, punched web for studs only if allowed or indicated by Engineer, knurled faces, size and gauge as required by design.
   c. Track: sheet steel, cold-rolled; channel shaped; same width as studs, tight fit; solid web, size and gauge as required by design.
   d. Framing Materials: roll from new sheet steel; re-rolled steel not acceptable.
   e. Struts: ASTM A570 or A525 sheet steel, cold-rolled, size and gauge as required by design.
   f. Load-bearing framing: Framing members shall have the structural properties indicated. Where physical structural properties are not indicated, they shall be as necessary to withstand all imposed loads.

2. MARKINGS: Studs and track shall have product markings on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 4 feet on center and shall be legible and easily read. The product marking shall include the following:
   a. An ICC number
   b. Manufacturer's identification.
   c. Minimum delivered uncoated steel thickness.
   d. Protective coating designator.
   e. Minimum yield strength.

3. CONNECTIONS: Screws are ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping steel screws of the type and size indicated. Provide low-profile head beneath sheathing and manufacturer's standard elsewhere. Electroplated to a minimum of 5 micron zinc coating per ASTM F1941 or hot-dipped galvanized per ASTM A123/A123M or ASTM A153/A153M. Bolts are ASTM A307 coated by hot-dip process per ASTM F2329/F2329M or zinc-coated by mechanical-deposition process per ASTM B695, Class 55. Welding in conformance with AWS D1.1 and AWS D1.3.

4. Accessories: Bracing and Bridging: Formed sheet steel, channel shape, size and gauge as required by design. Plates, Gussets, Clips and Angles: Formed sheet steel, size and gauge as required by design. Touch-Up Primer: SSPC paint 20, type I, inorganic, zinc rich.

5. Fabrication: Fabricate assemblies of formed sections of sizes and profiles required; with framing members fitted, reinforced, and braced to suit design requirements. Fit and assemble in largest practical sections for delivery to site, ready for installation.

6. Finishes: Zinc coated (galvanized) by the hot-dip process, G-60 minimum, G-90 as required.

7. MAXIMUM DEFLECTIONS: Maximum deflections permissible are as follows:
   a. Exterior Studs:

Deflection Criteria	Exterior Finish
L/240 or L/360	Synthetic Plaster, Metal Panels
L/360	Cement Plaster, Wood Veneer
L/600	Brick Veneer, Stone Panels

   Wall deflections shall be computed on the basis that studs withstand all lateral forces independent of any composite action from sheathing materials. Studs abutting windows or louvers shall also be designed not to exceed 1/4 inch maximum deflection.

   b. Floor Joists:

L/360 - Live load only
L/240 - Total load

c. Roof Rafters:
L/240 - Live load only

--- End of Section ---

SECTION 05 50 00.00 48 METAL FABRICATIONS

Scope: 1. Provide miscellaneous metal items fabricated from heavy gage ferrous metals and not provided with structural steel system:
a. Steel pipe handrails and railings.
b. Wall ladders.
c. Ships ladders.
d. Pan stairs and landings.
e. Grating stairs and landings.
f. Checkered Plate Stairs and Landings
g. Loose angle lintels.
h. Structural steel door frames.
i. Bollards, concrete filled.
j. Roof opening steel frames.
k. Welded wire fabric
l. Floor grating and frames
m. Partitions, Diamond mesh type
n. Steel door frames
o. Trench covers, frames, and liners
p. Operable partition supports
q. Overhead coiling door frame
r. Aluminum ramps
s. Corner guards
t. Trash Guard
u. Miscellaneous framing and supports.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

ALUMINUM ASSOCIATION (AA)

AA DAF45	Designation System for Aluminum Finishes

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.3	Safety Requirements for Powder Actuated Fastening Systems

ASME INTERNATIONAL (ASME)

ASME B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B18.21.1	Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.6.2	Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series

ASME B18.6.3	Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3	Ladders - Fixed - Safety Requirements

ASTM INTERNATIONAL (ASTM)

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
ASTM A123/A 123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A 153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A27/A27M	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A283/A 283M	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A36/A 36M	Standard Specification for Carbon Structural Steel
ASTM A467/A 467M	Standard Specification Machine Coil and Chain
ASTM A47/A 47M	Standard Specification for Ferritic Malleable Iron Castings
ASTM A475	Standard Specification for Zinc-Coated Steel Wire Strand
ASTM A48/A 48M	Standard Specification for Gray Iron Castings
ASTM A500/A500M	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A 53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A653/A 653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A786/A786M	Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A924/A 924M	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B108/ B108M	Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B210	Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
ASTM B211	Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire
ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B26/B 26M	Standard Specification for Aluminum-Alloy Sand Castings
ASTM B633	Standard Specification for Electrodeposited Coatings of Zinc On Iron And Steel

ASTM C1107	Standard Specification for Packaged Dry, Hydraulic -Cement Grout (Non Shrink)
ASTM C1513	Standard Specification for Steel Tapping Screws for Cold Formed Steel Framing Connections
ASTM D1187	Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM D2047	Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine
ASTM E488	Standard Test Method for Strength of Anchors in Concrete and Masonry Elements
ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code – Steel
AWS D1.2/1.2M	Structural Welding Code – Aluminum
AWS D1.6	Structural Welding Code – Stainless Steel

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	Alkyd Anti-Corrosive Metal Primer

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	Metal Bar Grating Manual
NAAMM MBG 532	Heavy Duty Metal Bar Grating Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	Power Tool Cleaning
SSPC SP 6/NACE No.3	Commercial Blast Cleaning

Submittals:

1. Shop Drawings: Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items:
   a. Steel pipe handrails and railings.
   b. Wall ladders.
   c. Ships ladders.
   d. Pan stairs and landings.
   e. Grating stairs and landings.
   f. Checkered Plate Stairs and Landings
   g. Loose angle lintels.
   h. Structural steel door frames.
   i. Bollards, concrete filled.
   j. Roof opening steel frames.
   k. Welded wire fabric
   l. Floor grating and frames
   m. Partitions, Diamond mesh type
   n. Steel door frames

o. Trench covers, frames, and liners
p. Operable partition supports
q. Overhead coiling door frame
r. Aluminum ramps
s. Corner guards
t. Trash Guard
u. Miscellaneous framing and supports

Products:

1. Materials:
   a. Steel plates, shapes, and bars: ASTM A36/A 36M.
   b. Sheet steel: ASTM A1011/A1011M.
   c. Stainless steel Bars and Shapes: ASTM A276, Grade 302/304.
   d. Checkered Steel Floor Plates: ASTM A786/A786M.
   e. Steel tubing: ASTM A53, schedule 40.
   f. Bolts, nuts and washers: ASME B18.2.2 or ASTM A 307.
   g. Grout: ASTM C1107.
   h. Concrete inserts: ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel.
   i. Steel Tubing: ASTM A500, Grade B
   j. Plates: ASTM A283/A283 M
   k. Pipe: ASTM A53, Grade B, Sched 40
   l. Extruded Aluminum: ASTM B221, Alloy 6063, Temper T6
   m. Sheet Aluminum: ASTM B209, Alloy 6063, Temper T6
   n. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210, Alloy 6063, Temper T6
   o. Aluminum-Alloy Bars: ASTM B211, Alloy 6063, Temper T6
   p. Bolts and Nuts: ASTM A307 and ASTM A563
   q. Screws: ASME B18.2.1, B18.6.2, B18.6.3 and ASTM C1513.
   r. Expansion Anchors: ASTM B633, capable to sustain, without failure, a load capacity equal to 6 times the load imposed when installed in unit masonry and 4 times when installed in concrete as determined by testing per ASTM E488
   s. Welding Materials: AWS D1.1, D1.2 or D1.3 of the type required for materials being welded.
   t. Concrete for Landings and Treads: Portland cement Type I, 4000 psi 28 day strength, 3 to 5 in slump.
   u. Landing Concrete Reinforcement: Mesh type galvanized.
2. Galvanized ferrous metal items at exterior and where exposed to weather; 1 coat primer (shop-applied) elsewhere.
   a. Galvanizing: ASTM A123.
   b. Primer Paint: Fabricator's standard gray primer, 2.0 mils thickness.
   c. Galvanizing repair compound.

Fabrication:

1. Corner Guards and Shields: Corner guards and shields for jambs and sills of openings and edges of platforms shall be steel shapes and plates anchored in masonry or concrete with welded steel straps or end weld stud anchors. Corner guards for use with glazed or ceramic tile finish on walls shall be formed of 0.0625 inches thick corrosion-resisting steel with polished or satin finish, shall extend 5 feet above the top of cove base or to the top of the wainscot, whichever is less, and shall be securely anchored to the supporting wall. Corner guards on exterior shall be galvanized. Corner guards for Kitchens shall be stainless steel.
2. Pipe Guards (Bollards): Pipe guards shall be heavy duty steel pipe conforming to ASTM A53/A 53M, Type E or S, weight STD, black finish. Anchor posts in concrete and fill solidly with minimum compressive strength 2500 PSI concrete.
3. Floor Gratings and Frames: Carbon steel and Aluminum grating shall be designed in accordance with NAAMM MBG 531 to meet the indicated load requirements. Edges shall be banded with bars ¼ inch less in height than bearing bars for grating sizes above 3/4 inch. Banding bars shall be flush with the top of bearing grating. Frames shall be of welded steel construction finished to

match the grating. Steel floor gratings and frames shall be galvanized after fabrication. Aluminum grating shall be alloy 6063-T6 conforming to ASTM B221. Grating shall conform to NAAMM metal Bar Grating Manual designated ANSI/NAAMM MBG 531. Grating Type shall be Rectangular Bar SG Series. Provide aluminum saddle clips for grating hold down.

4. Floor Plates: Floor plates shall be 6 mm thick, raised pattern steel galvanized.
5. Handrails: Handrails shall be designed to meet loads in accordance with the applicable building code, OSHA and ADA, minimum. Steel handrails, including inserts in concrete, shall be steel pipe conforming to ASTM A53/A 53M or structural tubing conforming to ASTM A500, Grade A or B of equivalent strength. Steel railings shall be 1 ½ inches nominal size. Railings shall be hot-dip galvanized and shop painted primed. Pipe collars shall be hot-dip galvanized steel. Joint posts, rail, and corners shall be fabricated by one of the following methods:
   a. Flush type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with hexagonal recessed-head set screws.
   b. Mitered and welded joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight fitting interior sleeve not less than 6 inches long.
   c. Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.
   d. Removable sections, toe-boards, and brackets shall be provided as indicated.
6. Ladders: Ladders shall be galvanized steel or aluminum, fixed rail type in accordance with ANSI A14.3.
7. Miscellaneous: Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.
8. Partitions, Diamond Mesh Type: Partitions shall be constructed of metal fabric attached to structural steel framing members. Fabric shall be 10 gauge steel wires woven into 1 ½ inch diamond mesh with wire secured through weaving channels. Framing members shall be channels 1 ½ inch by 3/8 inch minimum size. Channel frames shall be mortised and tenoned at intersections. Steel frames, posts, and intermediate members shall be of the sizes and shapes indicated. Cast-iron floor shoes and caps shall have set screw adjustment. Doors and grilles shall be provided as indicated, complete with hardware and accessories including sliding mechanisms, locks, guard plates, sill shelves and brackets, and fixed pin butts. Doors and grilles shall have cover plates as indicated. Dutch doors shall have a lock for each leaf. A continuous rubber bumper shall be provided at bottom of grille frame. Locks shall be bronze, cylinder, mortise type. Keying shall be coordinated with Section 08 71 00 DOOR HARDWARE. Ferrous metal portions of partitions and accessories shall be galvanized.
9. Steel Door Frames: Steel door frames built from structural shapes shall be neatly mitered and securely welded at the corners with all welds ground smooth. Jambs shall be provided with 2 by 1/4 by 12 inch bent, adjustable metal anchors spaced not over 2 feet 6 inch on centers. Provision shall be made to stiffen the top member for all spans over3 foot. Continuous door stops shall be made of 1-1/2 by 5/8 inch bars.
10. Trench Covers, Frames, And Liners: Trench grating shall be ductile iron load capacity Class C, heavy duty. Trench frames and anchors shall be all welded steel construction designed to match cover. Grating opening widths shall not exceed 1 inch. The channel for trench drain shall have a built-in slope of 1/8 inch per foot. The channels shall be constructed of minimum 1/8 inch thick fiberglass.
11. Dissimilar Materials: Where dissimilar materials are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.
12. Trash Guard: Trash Guards shall be ASTM A283 minimum 3/4 inch galvanized steel bars, transverse and longitudinal spacing as indicated on the drawings and welded at each bar intersection.
13. Concrete-Filled Metal Pan Stairs And Landings: Steel stairs shall be complete with structural or formed channel stringers, metal pan cement-filled treads or grating treads as indicated on the drawings, landings, columns, handrails, and necessary bolts and other fastenings as indicated.

Structural steel shall conform to ASTM A36/A 36M. Stairs and accessories shall be galvanized and factory primed coated. Risers on stairs with metal pan treads shall be deformed to form a sanitary cove to retain the tread concrete. Integral nosings shall have braces extended into the concrete fill. Gratings for treads and landings shall conform to NAAMM MBG 531. Grating treads shall have slip-resistant nosings.

14. Welded Wire Fabric: Welded wire fabric where indicated at stair rails shall be constructed of metal fabric attached to steel framing members. Fabric shall be 10 gauge welded wire mesh, hot dipped galvanized, factory primed, steel wires woven into 1-1/2 inch diamond mesh.

---End of Section---

SECTION 06 10 00.00 48 ROUGH CARPENTRY

Scope: 1. Provide rough carpentry work:
a. Wood framing.
b. Sheathing.
c. Nailers, blocking, and furring.
d. Equipment backing panels.
e. Roof curbs and cants.
f. Blocking in wall and roof openings
g. Wood furring and grounds
h. Concealed wood blocking for support of toilet and bath accessories and wall cabinets.
i. Preservative treatment of wood.
j. Fire Retardant treatment of wood where required

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A194.1	Cellulosic Fiber Board

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A 653/A 653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process
ASTM C1396	Standard Specification for Gypsum Board
ASTM C1177/C1177M	Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C208	Standard Specification for Cellulosic Fiber Insulating Board
ASTM D 2898	Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
ASTM D 6007	Standard Test Method for Determining Formaldehyde Concentration in Air from Wood Products Using a Small Scale Chamber
ASTM F 547	Definitions of Terms Relating to Nails for Use with Wood and Wood-Base Materials

AMERICAN WOOD COUNCIL (AWS)

AWC NDS	National Design Specification (NDS) for Wood Construction
AWC WFCM	Wood Frame Construction Manual for One- and Two-Family Dwellings

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA M4	Standard for the Care of Preservative-Treated Wood Products
AWPA T1	Use Category System: Processing and Treatment Standard
AWPA U1	Use Category System: User Specification for Treated Wood

COMPOSITE PANEL ASSOCIATION (CPA)

CPA A208.1	Medium Density Fiberboard (MDF) For Interior Applications

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM 4435	Roof Perimeter Flashing

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules	Rules for the Measurement & Inspection of Hardwood & Cypress

NATIONAL INSTITUTE OF SCIENCE AND TECHNOLOGY (NIST)

DOC PS 1-2009: U.S. Product Standard for Construction and Industrial Plywood
DOC PS 2-2004: Performance Standard for Wood-Based Structural-Use Panels
DOC PS 20-2010: American Softwood Lumber Standard

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules Standard Grading Rules for Northeastern Lumber

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Spec Standard Specifications for Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003 Standard Grading Rules for Southern Pine Lumber

US GENERAL SERVICES ADMINISTRATION (GSA)

FS UU-B-790 (Rev A; Notice 2) Building Paper Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17 Standard Grading Rules

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5 Western Lumber Grading Rules

Products:

1. Lumber, DOC PS-20, S4S, with moisture content of 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness.
   a. Lumber fabricated from old growth timber is not permitted.
   b. Solid sawn and finger-jointed lumber shall bear an authorized grade stamp or grade mark recognized by ALSC, or an ALSC recognized certification stamp, mark, or hammer brand. Surfaces that are to be exposed to view shall not bear grade marks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view
   c. Light framing: Construction grade Douglas fir or southern pine, appearance grade where exposed.
   d. Structural framing and timbers: No. 1 grade Douglas fir or southern pine, appearance grade where exposed.
   e. Boards: Construction grade.
2. Wood for nailers, blocking, and furring: Blocking shall be standard or number 2 grade, S4S, with moisture content of 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness.. Pressure preservative treat items in contact with roofing, flashing, waterproofing, masonry, concrete or the ground.
3. Plywood:
   a. Materials shall bear the grade mark or other identifying marks indicating grades of material and rules or standards under which produced, including requirements for qualifications and authority of the inspection organization. Except for plywood and wood structural panels, bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be exposed to view shall not bear grade marks or other types of identifying marks.
4. Sheathing shall be fiberglass mat gypsum, or plywood, for wall sheathing as indicated on the drawings; and plywood or structural use panels for roof sheathing as indicated on the drawings
   a. Fiberglass mat gypsum sheathing shall conform to ASTM C 1177/C 1177M. 1/2 inch thick, 4 feet wide with square edges for supports 16 inches on center without corner bracing of

framing or for supports 24 inches with V-tongue and groove edges for supports 16 or 24 inches on center with corner bracing of framing.

b. Plywood shall conform DOC PS-1, Grade C-D Exposure 1 Plywood wall sheathing 3/8 inch thick for supports spaced 16 inches on center, and 1/2 inch thick for supports spaced 24 inches on center.

c. Structural use panels: Sheathing grade with durability grade equivalent to Exposure 1, 1/2 inchthick for supports spaced 24 inches on center.

5. Anchor Bolts shall conform to ASTM A307, size as indicated, complete with nuts and washers.
6. Nails and Staples shall conform to ASTM F547, size and type best suited for purpose; staples shall be as recommended by the manufacturer of the materials to be joined.
7. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance ASTM A153/A153M. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AWC NDS
8. Building Paper: FS UU-B-790, type 1, Grade D, Style 1.
9. Wood Treatment:
   a. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
   b. Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWPA M4, the following items shall be treated:
      1) Wood members in contact with or within 18 inches of soil.
      2) Wood members in contact with water.
      3) Wood members exposed to the weather including those used in built up roofing systems or as nailing strips or nailers over fiberboard or gypsum-board wall sheathing as a base for wood siding.
      4) Wood members set into concrete regardless of location, including flush-with-deck wood nailers for roofs.
      5) Wood members in contact with concrete that is in contact with soil or water or that is exposed to weather.
   c. Fire-retardant treatment: Fire-retardant treated wood must be pressure treated. Treatment and performance inspection must be by independent and qualified testing agency that establishes performance ratings. Each piece or bundle of treated material must bear identification of the testing agency to indicate performance in accordance with such rating. Treated materials to be exposed to rain wetting must be subjected to an accelerated weathering technique in accordance with ASTM D2898 prior to being tested. Such items which will not be inside a building, and such items which will be exposed to heat or high humidity must receive exterior fire retardant treatment

---End of Section---

SECTION 06 20 00.00 48 FINISH CARPENTRY

Scope: 1. Finish carpentry for:
a. Interior finish lumber
b. Exterior treated and untreated lumber and trim
c. Wood siding
d. Millwork
e. Countertops
f. Cabinets
g. Casework
h. Fiberglass Reinforced Plastic

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20 American Softwood Lumber Standard

ASME INTERNATIONAL (ASME)

ASME B18.2.1 Square and Hex Bolts and Screws (Inch Series)

ASME B18.2.2 Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)

ASME B18.6.1 Wood Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F 547 Standard Terminology of Nails for Use with Wood and Wood-Base Materials

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA M4 Standard for the Care of Preservative-Treated Wood Products
AWPA U1 Use Category System: User Specification for Treated Wood

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

Architectural Woodwork Standards

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.9 Cabinet Hardware

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350 Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

COMPOSITE PANEL ASSOCIATION (CPA)

CPA A208.1 Medium Density Fiberboard (MDF) For Interior Applications

GREEN SEAL (GS)

GS-36 Adhesives for Commercial Use

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA LD 3 Standard for High-Pressure Decorative Laminates

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S.4 Preservative Treatment for Millwork

Products:

1. Wood Products:
   a. Sizes and Patterns of Wood Products: Provide yard and board lumber sizes in accordance with ALSC PS 20. Provide shaped lumber and millwork in the patterns indicated and in standard patterns of the association covering the species. Size references, unless otherwise specified, are nominal sizes. Provide actual sizes within manufacturing tolerances allowed by the applicable standard.
   b. Species and Grading: Provide in accordance with AWPA U1 Use Category System
   c. Materials shall bear the grade mark, stamp or other identifying marks indicating grades of material and rules or standards under which produced. Such identifying marks on a material shall be in accordance with the rule or standard under which the material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification. The inspection agency for lumber shall be certified by the Board of Review, ALSC, to grade the species used. Except for plywood, wood structural panels, and lumber, bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be architecturally exposed to view shall not bear grade marks, stamps, or other types of identifying marks.
2. Moisture Content: Air dry or kiln dry lumber. Kiln dry treated lumber after treatment. Maximum moisture content of wood products at time of delivery to the jobsite, and when installed, must be as follows:
   a. Interior Paneling: 12 percent.
   b. Interior Finish Lumber, Trim, and Millwork: 1-1/4 Inches Nominal or Less in Thickness: 12 percent on 85 percent of the pieces and 15 percent on remainder.
   c. Exterior Treated/Untreated Finish Lumber and Trim: 4 inches Nominal or Less in Thickness: 19 percent.
   d. Exterior Wood Siding: 15 percent.
   e. Provide moisture content of other materials in accordance with the applicable standards.
3. Preservative Treatment:
   a. Non-Pressure Treatment - Treat woodwork and millwork, such as exterior trim, door trim, and window trim, in accordance with WDMA I.S.4, with either 2 percent copper napthenate, 3 percent zinc napthenate, or 1.8 percent copper-8-quinolinolate. Provide a liberal brush coat of preservative treatment to field cuts and holes.
   b. Pressure Treatment: Treat lumber and plywood used on the exterior of buildings [or in contact with masonry or concrete] with a waterborne preservative listed in AWPA U1.
4. Plywood: APA L870 When located on the interior of buildings, provide products with no added urea-formaldehyde resins.
   a. Plywood for Soffits: Exterior type, B-B medium density overlay.
   b. Plywood for Shelving: Interior type, [A-B] [B-B] Grade, any species group.
   c. Plywood for Countertops: Exterior type, A-C Grad
5. Medium Density Fiberboard (MDF) and Particleboard: CPA A208.1 Grade 1-M-2 or 2-M-2 or better. For products located on the interior of the building (inside of the weatherproofing system), provide certification of indoor air quality for MDF and particleboard

6. Millwork: Standing and running trim, door frames, window frames, ornamental and miscellaneous millwork composed of Solid Wood and/or Sheet Products, AWI Quality Grade, Custom Grade minimum.
7. Countertops: Laminated Plastic -faced countertops ANSI/NEMA LD 3, Grade GP 50 or PF 42, satin or textured finish. Backing Sheet: Heavy gauge, BK 20.
8. Cabinets:
   a. Fabricate cabinets with solid ends and frame fronts, or with frames all around. Provide frames of solid hardwood not less than 3/4 by 1-1/2 inches. Provide ends, bottoms, backs, partitions, and doors as hardwood plywood. Mortise and tenon, dovetail, or dowel and glue joints to produce a rigid unit. Cover exposed edges of plywood with hardwood strips. Provide cabinet doors, frames, and solid exposed ends 3/4 inch thick minimum. Provide cabinet bottoms, partitions, and framed ends to be 1/2 inch minimum. Provide shelves to be 5/8 inch thick minimum. Provide cabinet backs 1/4 inch thick minimum.
   b. Hardware: ANSI/BHMA156.9, Provide cabinet hardware including two self, closing hinges for each door, two side mounted metal drawer slides for each drawer, and pulls for all doors and drawers.
      1) Provide frameless concealed European style, back mounted hinges with 165 degree opening and a self-closing feature when at less than 90 degrees open.
      2) Provide drawer slides having a static rating capacity of 100 lbs. minimum. Slides to have a self-closing/stay closed action, zinc or epoxy coated steel finish, ball bearing rollers, and positive stop with lift out design.
      3) Provide drawer pulls as wire type pulls with center-to-center dimension of not less than 3-1/2 inches and a cross sectional diameter of 5/16 inch. Provide handle projections not less than 1-5/16 inches.
      4) Provide heavy duty magnetic drawer catches.
   c. Finish: Provide a clear factory finish on wood surfaces after fabrication. Provide fabricator's standard natural finish equivalent to one coat of sealer, one coat of varnish on all surfaces and a second coat of varnish on surfaces exposed to view. Provide spar varnish in exterior or wet area applications. Sand lightly and wipe clean between coats.
9. Casework: AWI Quality Grade, Custom grade, minimum.
10. Fiberglass Reinforced Plastic Sheet: 3/32-inch-thick fiberglass reinforced plastic (FRP) sheet having a Class A flame spread (25 or less) and a smoke developed of 200 when tested IN accordance with ASTM E84. Adhesive and sealant as recommended by manufacturer. Color: Manufacturer's standard White. Provide largest standard size material available to minimize joints
11. Wood Screws: ASME B18.6.1.
12 Bolts, Nuts, Lag Screws, and Studs: ASME B18.2.1 and ASME B18.2.2.
13. Nails shall be the size and type best suited for each application and in accordance with ASTM F547. Nails shall be hot-dip galvanized or aluminum when used on exterior work. For siding, provide nails of sufficient length to extend -1/2 inches into supports, including wood sheathing over framing. Where nailing is impractical, provide screws of a size and type best suited for each application.
14. Adhesives: Select adhesives for durability and permanent bonding. Address factors such as materials that must be bonded, expansion and contraction, bond strength, fire rating, moisture resistance, and manufacturer's recommendations.
   a. Provide aerosol adhesives used on the interior of the building meeting either emissions requirements of VOC content requirements of GS-36, minimum.
   b. Provide certification or validation of indoor air quality for non-aerosol adhesives applied on the interior of the building (inside of the weatherproofing system).

---End of Section---

SECTION 06 61 16.00 48 SOLID SURFACING FABRICATIONS

Scope:
1. Solid Surfacing
2. Window Sills

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASTM INTERNATIONAL (ASTM)

ASTM D2583	Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM D570	Standard Test Method for Water Absorption of Plastics
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D696	Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G21	Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350 Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

CSA GROUP (CSA)

CSA B45.5-11/IAPMO Z124 Plastic Plumbing Fixtures - First Edition

Submittals:
1. Product Data: Product data indicating product description, fabrication information, and compliance with specified performance requirements for solid polymer, joint adhesive, sealants, and heat reflective tape.

Products:
1. Solid polymer material shall be a homogeneous filled solid polymer; not coated, laminated or of a composite construction; meeting CSA B45.5-11/IAPMO Z124 requirements. Material shall have minimum physical and performance properties specified. Superficial damage to a depth of 0.01 inch shall be repairable by sanding or polishing. Material thickness shall be no less than 1/2 thickness for horizontal applications and 1/4 thickness for vertical applications. Submit test report results from an independent testing laboratory attesting that the submitted solid polymer material meets or exceeds each of the specified performance requirements. Provide materials that meet the emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type). Color as selected by the Architect and accepted by the Government.
2. Provide certification or validation of indoor air quality for solid surface fabrication products
3. Window Sills: Fabricate window sills minimum 1/2 inch thick solid surfacing, solid polymer material, including dimensions, edge shape, and other details selected from manufacturer's available pre-fabricated standards.
3. Adhesives as recommended by the manufacturer.

---End of Section---

SECTION 07 11 00.00 48 BITUMINOUS DAMPPROOFING

Scope: 1. Bituminous dampproofing applied to concrete and masonry surfaces where no hydrostatic pressure is anticipated.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASTM INTERNATIONAL (ASTM)

ASTM C578	Standard Specification for Rigid Cellular Polystrene Thermal Insulation
ASTM D226/D226M	Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
ASTM D449/D449M	Standard Specification for Asphalt Used in Dampproofing and Waterproofing
ASTM D1227/D1227M	Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
ASTM D6380/D6380M	Standard Specification for Asphalt Roll Roofing (Organic Felt)
ASTM D6506	Standard Specification for Asphalt Based Protection Board for Below Grade Waterproofing

Submittals: 1. Product Data:
a. Manufacturer's product data and technical information for each product.
b. Manufacturer's installation instructions. Instructions shall specify acceptable range of asphalt application temperatures and the maximum temperature for holding asphalt in a heated condition.
2. Certificates: Certificates from manufacturer attesting that asphalt manufactured and shipped to jobsite meets the specified requirements.

Products: 1. Asphalt:
a. Hot Applied Bituminous Dampproofing: Asphalt: ASTM D449/D449M, Type I.
b. Cold Applied Bituminous Dampproofing: Asphalt: ASTM D1227, Type III (spray grade).
2. Auxiliary Materials:
a. Asphalt Saturated Felt: ASTM D226/D226M, Type I, 7 kg (15 pound).
b. Protection Course:
1) ASTM D6506, 1/8 inch thick, semi-rigid sheets of fiberglass or mineral reinforced asphaltic core, pressure laminated between two asphalt saturated fibrous liners.
2) Smooth-surfaced roll roofing complying with ASTM D6380/D6380M, Class S, Type III.
3) Extruded-polystyrene board insulation, unfaced, ASTM C 578, Type X, 13 mm (1/2 inch) thick.

---End of Section---

SECTION 07 19 00.00 48 WATER REPELLENT COATING

Scope: 1. Provide clear, penetrating water repellent coating for exterior exposed masonry, stone, stucco, and concrete walls.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501.1	Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 259	Standard Method of Test for Resistance of Concrete to Chloride Ion Penetration
AASHTO T 260	Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials

ASTM INTERNATIONAL (ASTM)

ASTM C140/C140M	Standard Test Methods for Sampling and Testing Concrete Masonry Units
ASTM C642	Standard Test Method for Density, Absorption, and Voids in Hardened Concrete
ASTM C672/C672M	Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals
ASTM D1653	Standard Test Method for Water Vapor Transmission of Organic Coating Films
ASTM D2369	Standard Test Method for Volatile Content of Coatings
ASTM D3278	Standard Test Method for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM E96/E96M	Standard Test Method for Water Vapor Transmission of Materials
ASTM E514/E514M	Standard Test Method for Water Penetration and Leakage Through Masonry
ASTM G154	Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants

Performance Requirements:

1. Water absorption: ASTM C140/C140 Comparison of treated and untreated specimens.
2. Moisture vapor transmission: ASTM E96/E96M. Comparison of treated and untreated specimens.
3. Water penetration and leakage through masonry: ASTM E514/E514M.

Regulatory Requirements:

1. Provide coating materials that conform to the restrictions of the Local Air Pollution Control jurisdiction. Notify the Contracting Officer of any water repellent coating specified herein which fails to conform to the local Air Quality Management District Rules at the location of the Project.

In localities where the specified coating is prohibited, the Contracting Officer may direct the substitution of an acceptable coating.

Testing:

1. AAMA 501 Provide field water testing of water repellent treated surfaces in the presence of the Contracting Officer and the water repellent treatment manufacturer's representative.

Products:

1. Siloxanes: Penetrating water repellent. Clear, containing 10 percent or more solids of oligomerous alkylalkoxysiloxanes; with alcohol, ethanol, mineral spirits, water, or other proprietary solvent carrier.
   a. Solids by weight: ASTM D2369.
   b. Volatile Organic Content (VOC) after blending: Less than 175 grams per liter
   c. Density, activated: 8.4 pounds per gallon, plus or minus one percent.
   d. Flash point, ASTM D3278: Greater than 212 degrees F.
2. VOC-Complying Water Repellents: Products certified by the manufacturer that they comply with local regulations controlling use of volatile organic compounds (VOCs).
3. Performance Criteria: Siloxanes
   a. Dry time for recoat, if necessary: One to two hours depending on weather conditions.
   b. Penetration: 3/8 inch, depending on substrate
   c. Water penetration and leakage through masonry, ASTM E514/E514M, percentage reduction of leakage: 97.0 percent minimum
   d. Moisture vapor transmission, ASTM E96/E96M: 47.5 perms or 82 percent maximum compared to untreated sample.
   e. Resistance to accelerated weathering, ASTM G154. Testing 2,500 hours: No loss in repellency.
   f. Resistance to chloride ion penetration, AASHTO T259 and AASHTO T260.
   g. Scaling resistance, ASTM C672/C672M, non-air-entrained concrete: Zero rating, no scaling, 100 cycles treated concrete.

---End of Section---

SECTION 07 21 00.00 48 BUILDING INSULATION

Scope: 1. Provide building insulation of types as applicable:
a. Board insulation at perimeter foundation wall.
b. Board insulation at exterior walls.
c. Blanket/batt insulation.
d. Fire safing insulation.
e. Glass fiberboard insulation.
f. Sound attenuation insulation.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASTM INTERNATIONAL (ASTM)

ASTM C 208	Standard Specification for Cellulosic Fiber Insulating Board
ASTM C518	Standard Test Method for Steady State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C578	Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C591	Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C612	Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C665	Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured HousingASTM C930 Standard Classification of Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM C1289	Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D4397	Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	Standard Test Methods for Water Vapor Transmission of Materials

Products: 1. Insulation: Thermal resistance of insulation shall be not less than R-values shown. R-values shall be determined at 75 degrees F in accordance with ASTM C 518 Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Materials containing more than one percent asbestos will not be allowed.
a. Batt or Blanket: ASTM C665
b. Cellular Glass ASTM C552
c. Extruded Preformed Cellular Polystyrene ASTM C578
d. Mineral Fiber Block and Board: ASTM C612
e. Unfaced Preformed Polyurethane and Polyisocyanurate Board: ASTM C591
1) Recycled Materials: Provide Thermal Insulation containing recycled materials to the extent practicable, provided the material meets all other requirements of this section. The minimum required recycled materials content by weight are:
Rock Wool: 75 percent slag
Fiberglass: 20 percent glass cullet
f. Rigid Insulation:
1) Polystyrene Board: Polystyrene board shall be extruded and conform to ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.

2) Polyurethane or Polyisocyanurate Board: Polyurethane or polyisocyanurate board shall have a minimum recovered material content of 9 percent by weight of core material in the polyurethane or polyisocyanurate portion. Unfaced preformed polyurethane shall conform to ASTM C 591. Faced polyisocyanurate shall conform to ASTM C 1289.
3) Mineral-Wool Board, Types IA and IB, Unfaced: ASTM C612, Types IA and IB; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics. Nominal density of 4 lb/cu. ft.

2. Vapor Retarder: 6 mil thick polyethylene sheeting conforming to ASTM D4397 and having a water vapor permeance of 1 perm or less when tested in accordance with ASTM E96/E96M.

Pressure Sensitive Tape: As recommended by manufacturer of vapor retarder(s). Match water vapor permeance rating for each vapor retarder specified. Provide tape in accordance with ASTM D3833/D3833M.

---End of Section---

SECTION 07 22 00.00 48 ROOF AND DECK INSULATION

Scope: 1. Insulation for use beneath built-up, modified bitumen. or single-ply roofing, EPDM or PVC elastomeric sheet membrane roofing.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASTM INTERNATIONAL (ASTM)

ASTM C1289	Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C208	Standard Specification for Cellulosic Fiber Insulating Board
ASTM C552	Standard Specification for Cellular Glass Thermal Insulation
ASTM C726	Standard Specification for Mineral Fiber Roof Insulation Board
ASTM C728	Standard Specification for Perlite Thermal Insulation Board
ASTM D41	Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D226	Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D312	Standard Specification for Asphalt Used in Roofing
ASTM D2178	Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D4586/D4586M	Asphalt Roof Cement, Asbestos Free
ASTM D4897	Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM 4450	Approval Standard for Class 1 Insulated Steel Deck Roofs
FM 4470	Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction
FM APP GUIDE	Approval Guide http://www.fmapprovals.com/approval-guide

UNDERWRITERS LABORATORIES (UL)

UL 1256	Fire Test of Roof Deck Constructions
UL 2818	GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

Fire Classification:

1. Insulation in Roof System shall comply with the requirements of UL 1256 or FM 4450 or FM 4470. Roof insulation to have a flame spread rating of 75 or less when tested in accordance with ASTM E84. Additional documentation of compliance with flame spread rating is not required when insulation of the type used for this project as part of the specific roof assembly is listed and labeled as FM Class 1 approved.

Thermal Barrier Requirements:

1. Separate polyurethane or polystyrene insulation from a combustible deck with a thermal barrier of glass mat gypsum roof board or other approved barrier material in accordance with the requirements of the FM 4450 or FM 4470 or UL 1256.

Products: 1. Bituminous Materials: Bituminous materials shall conform to the following requirements:

a. Asphalt Bitumen: ASTM D312, Type III or IV. Asphalt flash point, finished blowing temperature, and equiviscous temperature (EVT) for mop and for mechanical spreader application shall be indicated on bills of lading or on individual containers.
b. Asphalt Cement: ASTM D 4586/D4586M, Type I for surfaces sloped from 0 to 3 inches per foot; Type II for slopes greater than 3 inches per foot.
c. Asphalt Primer: ASTM D41/D41M.

2. Insulation: Insulation shall be a standard product of the manufacturer and shall be factory marked with the manufacturer's name or trade mark, the material specification number, the R-value at 75 degrees F, and the thickness. Minimum thickness shall be as recommended by the manufacturer. Boards shall be marked individually. The thermal resistance of insulation shall be not less than the R-value shown on the drawings. The insulation manufacturing process shall not include chlorofluoro carbons (CFC) or formaldehydes. Contractor shall comply with EPA requirements for recycled/recovered materials. Insulation shall be one, or a combination of the following materials:
   a. Cellular Glass: ASTM C552, Type IV.
   b. Expanded-Perlite Insulation Board: ASTM C728 with a minimum recovered material content of 23 percent of the expanded perlite portion of the board.
   c. Fiberboard: ASTM C208 Type II, Grade 1 roof insulating board with a minimum recovered material content of 80 percent, treated with sizing, wax or bituminous impregnation. Bituminous impregnation shall be limited to 4 percent by weight when used over steel decks.
   d. Mineral-Fiber Insulation Board: ASTM C726.
   e. Polyisocyanurate: ASTM C1289, Type I, or ASTM C1289 Type II, having minimum recovered material content of 9 percent by weight of the polyisocyanurate portion of the board.
3. Fasteners: Fasteners shall be specifically designed screws and plates or spikes and plates of sufficient length to hold insulation securely in place. Fasteners shall conform to insulation manufacturer's recommendations except that holding power, when driven, shall be not less than 120 pounds each in steel deck. Fasteners for steel or concrete decks shall conform to FM APP Guide for Class I roof deck construction, and shall be spaced to withstand an uplift pressure of 90 lbs. per square foot in accordance with FM APP Guide.
4. Venting Inorganic Base Sheet: ASTM D4897/D4897M, Type II, Non-perforated, with spot mopping holes where specified.
5. Asphalt Coated Glass Roofing Felt: ASTM D2178, Type IV.
6. Organic Roofing Felt: ASTM D226, Type I.
7. Wood Nailers: Wood nailers shall conform to Section 06 10 00.00 48 ROUGH CARPENTRY, including preservative treatment. Edge nailers shall be not less than nominal 6 inch wide and of thickness to finish flush with the top surface of the insulation. Surface mounted nailers shall be a nominal 3 inch wide by the full thickness of the insulation.

---End of Section---

SECTION 07 31 13.00 48 FIBER GLASS-BASED ASPHALT SHINGLE ROOF SYSTEM

Scope: 1. Asphalt shingle roofing, underlayments, and flashing

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C1289	Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D226/D226M	Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension
ASTM D903	Standard Test method for Peel or Stripping Strength of Adhesive Bonds
ASTM D1204	Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
ASTM D1970	Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D3018	Standard Specification for Class A Asphalt Shingles Surfaced with Mineral Granules
ASTM D3462	Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules
ASTM D4869	Standard Specification for Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing
ASTM D7158	Standard Test Method for Wind Resistance of Sealed Asphalt Shingles (Uplift Forces/Uplift Resistance Method)
ASTM E 96/E96M	Standard Test Methods for Water Vapor Transmission of Materials
ASTM E 119	Standard Test Methods for Fire Tests of Building Construction and Materials

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0437	The NRCA Roofing Manual: Steep-slope Roof Systems

UNDERWRITERS LABORATORIES (UL)

UL 1256	Fire Test for Roof Deck Construction
UL 2218	UL Standard for Safety Impact Resistance of Prepared Roof Covering Materials
UL 790	Standard for Standard Test Methods for Fire tests of Roof Covering

Submittals: 1. Product Data:
a. Shingles: Submit data including type, weight, class, UL labels, and special types of underlayment and eave flashing
b. Cross-Vented Insulation: Submit data including insulation board, nailable surface, 2-inch vent spacer strips, and UL labels
c. Undereave Soffit Vent and Ridge Vent: Data sheets for Undereave Soffit Vent and Ridge Vent.
d. Documentation of compliance with LEED™ requirements for pursued credits.

2. Samples:
a. Shingles

b. Cross-Vented Insulation
c. Undereave Soffit Vent
d. Ridge Vent

Acceptable Manufacturer Products:

1. Manufacturer's products listed in this specification are referenced to establish a standard of quality. The following manufacturer products are specifically mentioned in this specification: Fifty (50yr) year shingles

Atlas Roofing Corporation StormMaster LM
2564 Valley Road
Meridian, MS 39307
(800) 478-0258
www.atlasroofing.com

Certainteed Corporation Designer Shingles
750 East Swedesford Road
Valley Forge, PA 19482
(800) 233-8990
www.certainteed.com

Owens Corning World Headquarters Oakridge PRO 50
One Owens Corning Parkway
Toledo, Ohio 43659
(800) 438-7465
www.owenscorning.com

Ventilated Nailbase Insulation

Atlas Roofing Corporation ACFoam Vented-R CrossVent
1303 Orchard Hill Road LaGrange, GA 30240
(800) 955-1476
www.atlasroofing.com

The Dow Chemical Company Celo-Vent Insulated Shingle Deck
Dow Building Materials 200 Larkin Center
Midland, MI 48674
(989) 636-1000
www.dowbuildingmaterials.com

Hunter Cool-Vent Ventilated Nailbase Insulation Panel
15 Franklin Street Portland, Maine 04101 (888) 746-1114
www.HUNTERPANELS.COM

Warranties:

1. Warranties shall begin on the date of Government acceptance of the work. Wind warranty shall cover 90 mph wind uplift (minimum). Algae-Resistance warranty shall be for 5 years with an additional 5 years prorated (minimum).Manufacturer's Warranty: Furnish the asphalt shingle manufacturer's standard 50 year warranty for the asphalt shingles.
2. Contractor's Warranty: The Contractor shall warrant for 5 years that the asphalt shingle roofing system, as installed, is free from defects in workmanship. When repairs due to defective workmanship are required during the Contractor's warranty period, the Contractor shall make such repairs within 72 hours of notification. When repairs are not performed within the specified time, emergency repairs performed by others will not void the warranty.

Products:

1. Mineral granule-surfaced asphalt shingles, self-sealing, fungus-resistant, impact resistant shingles conforming to UL 2218, Class 4. ASTM D3018/D3018M, Type I, and ASTM D3462/D3462M architectural shingles weighing not less than 290 pounds per 100 square feet. Shingles must meet the fire resistance requirements of UL 790 for Class A and the wind resistance requirements of ASTM ASTM D7158/D7158M.
2. Asphalt Felt Underlayment: Non-perforated, - Type II (No. 30), Asphalt-saturated felt conforming to ASTM D226, or ASTM D 4869. a. For roofs with a slope less than 4:12 apply two layers of underlayment with staggered side laps.
3. Leak Barrier Underlayment: Self-adhering leak barrier or ice dam underlayment must comply with ASTM D1970/D1970M for seal ability around nails.
4. Open Valley Flashing: . Sheet metal flashing for valleys is specified in Section 07 60 00.00 48 FLASHING AND SHEET METAL. Before installing and fastening flashing in place with metal cleats:
   a. Install single layer of 36 inch wide, asphalt-saturated felt, centered on valley and extending entire length of valley over felt underlayment.
   b. Cut regular shingle courses on each roof on true line 2 inches from valley centerline at top of valley, and increase width between lines by 1 inch for each 8 feet of valley length, continuing to eaves.
   c. Apply 2 inch band of asphalt roof cement over flashing, along and under side of shingles adjoining valley.
   d. Press shingles tightly into cement, and nail in normal manner, except apply nails not closer than 5 inches to valley centerline. Do not drive nails through valley flashing.
   e. Provide a 4 inch band of asphalt roof cement for fastening shingle tabs down along open metal gutters.
5. Undereave Soffit Vent: Undereave soffit vent shall be metal or PVC material, totally perforated, as recommended by the manufacturer.
6. Ridge Vent: Ridge vent shall be VentSure Rigid Strip Ridge Vent, Externally baffled, by Owens Corning, or equal, or as recommended by the shingle manufacturer, provided in 20-foot rolls or in four foot sections.
   a.. Externally baffled for added protection against wind-driven rain and snow.
   b. Durable polypropylene construction with UV inhibitors.
   c. Interlocking tabs for self alignment.
   d. Built-in end caps.
   e. Minimum net free vent area of 60 sq. inches per 4-foot section.7. Hip and Ridge Shingles: Hip and Ridge shingles shall have the same properties as above specified asphalt shingle and shall have the same background color as the field.
8. Nails for Applying Shingles and Asphalt-Saturated Felt: Corrosion resistant or aluminum nails with minimum 12-gauge shank and a minimum 3/8-inch head. Nails must be long enough to penetrate at least 3/4-inch into solid decking or extend a minimum of 1/8-inch through the APA-rated sheathing. Staples are not acceptable. Coordinate nailable deck material selection with the project building code investigation. Fasteners for the Cross-Vented nailable insulation shall be as recommended by the manufacturer.
9. Ventilated Nailbase Insulation: Ventilated Nailbase Insulation consists of a thermally efficient, closed-cell, polyisocyanurate roof insulation board with minimum 1-inch, solid wood, vent spacer strips separating minimum 5/8-inch Plywood from the polyisocyanurate roof insulation to create a multi-directional, or cross ventilating, airspace. Nailable surface shall be rabbeted 1/8-inch on all sides to allow for substrate expansion. Panel size is 4-foot by 8-foot with 4-inches of insulation meeting ASTM C1289, Type V. System shall meet UL Standard 1256 Classification for insulated metal deck construction assemblies (Construction No. 458), UL Standard 790 Classification for use with Class A shingles, and UL Standard 263 Fire Resistance Classification (ASTM E 119).

---End of Section---

SECTION 07 41 14.00 48 HYDROSTATIC (WATER TIGHT) STANDING SEAM METAL ROOFING SYSTEM (HS-SSMRS)

Scope: 1. Requirements for both factory color finished aluminum, or galvalume steel, metal roofing, also referred to as structural standing seam metal roofing system .

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE/SEI 7	Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C1289	Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D226/D226M	Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D523	Standard Test Method for Specular Gloss
ASTM D610	Standard practice for Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D714	Standard Test Method for Evaluating Degree of Blistering of Paints
ASTM D968	Standard Test Method for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1308	Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D1654	Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D1970/D1970M	Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D2244	Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2247	Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D2794	Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3359	Standard Test Method for Rating Adhesion by Tape Test
ASTM D4214	Standard Test Methods for Evaluating Degree of Chalking of Exterior Paint Films
ASTM D4397	Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D4587	Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.
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)
ASTM E84	Standard Surface Burning Characteristics of Building Materials

ASTM E1592	Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM G154	Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Material

General Requirements:

1. Factory color finished galvalume or aluminum metal panel roof system with concealed two-piece clip attached through to deck substrate. Roof panel profile shall be smooth, embossed, or stiffening ribbed with 2-inch 90-degree vertical rib, 1 1/2-inch 180-degree vertical rib or bulb rib with eave closure inserts with no void areas within the assembled panel seam. Seam is to be machine folded and contain sealant. Sealant continuity is to be maintained at all attachment clip locations for complete with only limited exception when indicated on plans. Roof assemblies shall be thermally "floating" design when roof panel lengths exceed 30 feet; when 30 feet or less, "fixed" design may be used.
2. Thermal Movements:
   a. When panel lengths are below 30 feet in length fixed clip attachments may be used. When panel lengths exceed 30 feet, the system attachments and construction details shall be designed to maintain freedom of thermal response using surface temperature differential of 220 degrees Fahrenheit north of the 35th latitude, and 180 degrees Fahrenheit south of the 35th latitude or when the roof color is white. Attachment clips and other construction details shall allow the full range of calculated thermal movement. The roof manufacturer will provide calculations showing that proposed roof system and attachment clips can accommodate the thermal movement with a safety factor of 1.25, based on line of fixity location.
   b. Provide metal roof panel assemblies that allow for thermal movements resulting from maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
3. UL Listing: Provide metal roof panels that meet the requirements of a UL Class A assembly.

Design Requirements:

1. The required uplift resistance of the roof assembly shall be calculated in accordance with ASCE/SEI 7. Metal roof panel assembly shall resist [the calculated loads incorporating appropriate safety factors and including increased loads in perimeter and corner areas, and the following wind loads as determined by ASCE/SEI 7 with a factor of safety appropriate for the material holding the anchor. Required pressures are to be designed and stated in the following format in submittals prepared by the Contractor's registered engineer:

	Negative	Positive
a. At eaves	_____psf	_____psf
b. At rakes	_____psf	_____psf
c. At ridge	_____psf	_____psf
d. At bldg corners	_____psf	_____psf
e. At field areas	_____psf	_____psf

2. The roof panels and anchorage clips shall be tested in accordance with ASTM E 1592 using a 2.0 factor of safety, verifying the above structural capacities.

3. Attachment clip fastening of metal panels shall be designed and calculated using both clip tributary area and tensile-tested clip holding strengths. Two or more fasteners per clip are required. Use a 2.25 factor of safety for clip fasteners. Size and thickness of tested attachment clip materials will be submitted as part of the roof assembly system for approval.
4. Required maximum clip spacing to be designed and submitted in the following format for approval:

   a. At eaves _____
   b. At rakes _____
   c. At ridge _____
   d. At bldg corners _____
   e. At central areas _____

Performance Requirements:

1. Wind Uplift: The roof assembly shall tested in accordance with ASTM E 1592 to resist the calculated loads. Non-tested assemblies shall not be installed. The installed roof assembly shall conform to the roof slope, resist the uplift pressure calculated and shed water to the outside of the exterior. The Contractor shall furnish a commercially available roofing system which satisfies all specified requirements.
2. Point Line of Fixity:
   a. The point line of fixity for the roof panels shall be designed to resist the vector forces resulting from the full design (unbalanced) roof snow load or roof live load, whichever is greater. Attachment frequency shall be calculated using tested allowable values for proposed fasteners. Contractor submittals are to include fixed point calculations, locations, and methods. Purlin roll is not an allowed method to absorb movement.
   b. The fixed point shall be singular for steel panels over 30 feet in length (20 feet for aluminum) and attachment methods shall permit complete freedom of thermal movement elsewhere along their length. Construction details shall be designed to preserve thermal movement of panels. Rooftop accessories such as curbs and flashings, mechanical equipment, fall protection systems, snow retention systems, vents, stacks, lightning protection and other ancillary items shall be designed in such fashion as to preserve thermal movement of panels. Construction details that pin or fix panels shall not be used except when occurring within 15 feet of the panel's point of fixity.
3. Static Air Infiltration [Completed roof system shall have a maximum of .06 cfm/sf with 6.24 kPa air pressure differential as per ASTM E 283.] [The completed roof system shall have a maximum of 0.06cfm/sf air pressure difference as per ASTM E 1680.]
4. Water Infiltration: [No evidence of water penetration at an inward static air pressure differential of not less than 6.24 psf (43 kPa) and not more than 12.0 psf (83 kPa) as per ASTM E 331.] [There shall be no evidence of water penetration at an inward static air pressure differential of not less than 6.24 psf and not more than 12 psf as per ASTM E 1646.]
5. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to [ASTM E 1592] [ASTM E 330]
6. Snow Retention System:
   a. The snow retention system is required when the roof design snow load is 15 psf or greater, or indicated on roof plan. Snow retention systems shall be designed to resist the vector forces resulting from the full design (balanced) roof snow load. Calculate frequency of devices by using tested ultimate holding values for the device and a 2.0 factor of safety. Methods of attachment must be clamping

style, utilizing round-point setscrews or other anchorages that do not gall or penetrate the panel material with fasteners

b. When pre-painted metal roof panels are used, the snow retention system shall be color matched to the panels using the same material and paint type as the roof panels. Powder coatings and air-dried paints, pigments, or dyes are not acceptable

c. Contractor submittals are to include snow retention system frequency calculations specific to the product being submitted and documentation from an independent laboratory with respect to holding strength of the device.

d. Adhesively attached retention systems are not acceptable. Attachment with cup point setscrews is not acceptable.

7. Drainage: Gutters and downspouts shall be sized for 10-minute duration of the maximum rainfall intensity typical to the area in a 25-year mean recurrence.
8. Lightning Protection System: Lightning protection systems shall be of metallurgy compatible with the roof system. When lightning protection systems are used in climates where design snow loads are 15 psf or greater the snow detention system will protect the lightning protection system. Attachments must be non-intrusive and penetrations through roof panels minimized. Copper leads and spikes are not acceptable.
9. Fall Arrest System: Permanent fall arrest systems are required at roof edges whenever roof heights exceed 16 feet and building size exceeds 10,000 square feet. Fall arrest systems must be O.S.H.A. compliant and of metallurgy compatible with the roof system. Attachments must be non-intrusive, and penetrations through the roof obviated. Anchorages must not penetrate the roof surface. Methods of attachment must be clamping style utilizing round-point setscrews or other anchorages that do not gall or penetrate the panel material with fasteners. Attachment with cup point setscrews is not acceptable.
10. Static Air Infiltration: The completed roof system shall have a maximum of 0.06cfm/sf air pressure difference as per ASTM E283.
11. Water Infiltration: There shall be no evidence of water penetration at an inward static air pressure differential of not less than 6.24 psf and not more than 12 psf as per ASTM E331.

Submittals:

1. Manufacturer products listed in this specification are referenced to establish a standard of quality

Standing Seam Metal Roofing Panels

BEMO High Performance, 2 1/2-inch Bulb Rib
3062 N. Maple Street
Mesa, AZ 85215-1115
(800) 926-2366
www.bemousa.com

Butler VSR, 2-inch / 90-degree Vertical Rib
1540 Genessee Street
Kansas City, MO 64102
(816) 968-3800
www.butlermfg.com

MBCI Classic Series P12 or P16, 2-inch / 90-degree Vertical Rib
Division of NCI Building Systems, Inc.
P.O. Box 692055
10943 North Sam Houston Parkway West
Houston, TX 77064

(888) 624-8678
www.mbci.com

Merchant & Evans, Inc. Zip-Rib, 2 1/2-inch Bulb Rib
P.O. Box 1680
308 Connecticut Drive
Burlington, NJ 08016
(800) 257-6215
www.ziprib.com

Peterson Aluminum Corp. Tite Loc, 2-inch / 90-degree Vertical Rib
Headquarters
1005 Tonne Road
Elk Grove Village, IL 60007
(800) 722-2523
www.pac-clad.com

Ultra Seam US-200, 2-inch / 90-degree Vertical Rib
14432 State Route 141 S
Pride, KY 42437
(270) 333-9552
www.ultraseam.com

Snow Retention Systems

Alpine SnowGuards Pipe or ColorGard Styles
P.O. Box 430
Stowe, VT 05672-0432
(888) 766-4273
www.alpinesnowguards.com

LMCurbs SnoRail, SnoFence, ColorGard Styles
827 Fisher Road
Longview, Texas 75604
(800) 284-1412
www.lmcurbs.com

Snobar SnoBar
12656 E. Jameson Place
Englewood, CO 80112
(800) 711-9724
www.snobar.com

Snow Management Systems Snowguard
A Division of Contek, Inc.
699 Harrel Street
Morrisville, VT 05661
(802) 888-7100
www.snow-management.com

Sno Gem, Inc Snow Barricade System
4800 Metalmaster Way
McHenry, IL 60050
1-888-766-4367
www.snogem.com

2. Shop Drawings:
   a. Drawings consisting of catalog cuts, panel configuration, system assembly, attachment details, flashing details, erection drawings, shop coating and finishing specifications, and other data as necessary to clearly describe materials, sizes, layouts, construction details, fasteners, and erection.
   b. Details of all plane changes will be provided including, but not limited to, valleys, ridges, hips, curbs, other penetrations, and all locations where the roof panel will be cut or bent. All fastener types, sizes, and materials will be clearly identified.
   c. Drawings and specifications shall be provided by the roofing system manufacturer signed and stamped by a professional engineer.
3. Product Data: Roof System Manufacturer's Product Data for the following:
   Roof panels;
   Factory-applied color finish;
   Attachment clips;
   Closures;
   Accessories;
   Fasteners;
   Underlayment;
   Gaskets and Insulating Compounds;
   Sealants;
   Vapor Retarder;
   Curbs and Vents;
   Snow Retention System;
   Fall Arrest System;
   Lightning Protection Systems;
4. Samples:
   a. Roof Panel: each type and finish to be used, 9 inches long, full width.
   b. Provide Standard factory applied color finish charts for roof panel and accessory color selection.
   c. Each type of flashing, trim, fascia, closure, cap and similar items. Size shall be sufficient to show construction and configuration.
   d. Each type of fastener to be used with statement regarding intended use. If so requested, random samples of screws, bolts, nuts, and washers as delivered to the jobsite shall be taken in the presence of the Contracting Officer and tested to establish compliance with specified requirements.
   e. Each type of Gaskets and Insulating Compounds to be used and descriptive data.
   f. Sealant: approximately 1 pound or one tube, and descriptive data including warranties.
5 Design Data:
   a. Wind Uplift Calculations: Engineering calculations comparing wing uplift calculations with evidence of tested structural capacities and calculations of clip spacing related to pull testing of attachment clips. Calculations shall be prepared, signed, and stamped by a registered professional structural engineer.
   b. Thermal Response Calculations: Thermal response calculations shall be submitted for approval. Calculations shall be prepared, signed, and stamped by a registered professional structural engineer.
   c. Point Line of Fixity Calculations: Point line of fixity calculations shall be submitted for approval. Calculations shall be prepared, signed and stamped by a registered professional structural engineer.
   d. Snow retention system calculations: Snow retention system calculations shall be submitted for approval. Calculations shall be prepared, signed, and stamped by a registered professional structural engineer.

e. Snow Retention System Calculations: Snow retention system calculations shall be submitted for approval. Calculations shall be prepared, signed and stamped by a registered professional structural engineer.

6. Test Reports:
   a. Submit the structural performance, or wind uplift resistance, test report for the assembly to be installed.
   b. Submit test reports on the color finish for Cyclic Salt Fog, Formability, Accelerated Weathering, Chalking Resistance and Color Change, Humidity, Impact Resistance, Abrasion Resistance, Specular Gloss, and Pollution Resistance..
7. Certificates:
   a. Certificates attesting that the panels, installation and accessories conform to the specified requirements. A Certificate for the roof assembly shall certify that the assembly complies with the material and fabrication requirements specified and is suitable for the installation at the indicated design slope. Certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that at least 3 representative samples of similar material to that which will be provided on this project have been previously tested and have met the quality standards specified for factory color finish.
   b, Coil Stock Compatibility: When on-site roll forming is utilized, the coil manufacturer/supplier shall certify that the coil stock to be used is compatible with the roil forming machinery that will be used in the field.
   a. Self-Adhering Underlayment: Certification that underlayment is compatible with surface conditions for roof installation.
   b. Insulation: A Certificate attesting that the polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.
   c. Qualification of Roof Membrane Manufacturer: Certification that the manufacturer of the roof membrane meets the requirements specified under paragraph entitled "Qualification of Manufacturer."
   d. Qualification of Applicator: Certification that the applicator meets the requirements specified under paragraph entitled "Qualification of Applicator."
   e. Manufacturer's data indicating percentage of recycle material in wall panels to verify sustainable acquisition, if needed for LEED credit.
2. Manufacturer's Instructions: Submit manufacturer's printed installation manual and instructions for field construction.
3. Manufacturer's Field Reports: Copy of Manufacturer's field inspection reports submitted within 48 hours of each site visit.
4. Closeout Submittals: Warranties and Information Card

Quality Assurance:

1. Follow recommendations of SMACNA 1793, Architectural Sheet Metal Manual, for fabricating in shop and on site, and for installation
2. Qualification of Manufacturer: Metal roof panel manufacturer shall have been in the business of manufacturing metal roof panels for a period of not less than 20 years. The panel submitted shall have been manufactured for a period of not less than 10 years.
3. Contractor QC Representative: The Contractor's Quality Control (QC) Representative, in addition to keeping a daily log (weather conditions, document progress, visitors, number of workers on site, etc.) shall document all aspects of the work-in-progress on the installation of the roof system. This will include daily photographs (substrate installation, insulation and plywood attachment, ice and water shield installation, metal panel attachment, curbs and other penetrations, caulking, etc). A complete 24 exposure roll of 35mm film shall be used daily during the installation of the roof system. Two copies shall be developed, one for the COR and one for the Army Reserve.
4. Manufacturer's Technical Representative: The manufacturer's technical representative shall provide inspections during the installation of the roof system. This representative

shall be thoroughly familiar with the products to be installed, installation requirements and practices, and with all special considerations required in the geographical area where construction will take place. The representative shall perform field inspections, at least once per week during the roof panel installation.

5. Qualification of Installer: The metal roof system installer shall either be approved, authorized, or licensed, in writing by the roof system manufacturer, to install twenty (20yr) year no-dollar-limit-warranty roof systems. The Installer shall also submit proof, by letter from the roof system manufacturer, that he has a minimum of ten (10yrs) years' experience with that particular manufacturer installing that particular submitted roof system.

   The Installer shall provide a letter from the manufacturer indicating his certification.

   The Installer shall provide Proof of Membership, for the past 2-years, in one of the following professional trade organizations: NRCA, MRCA, SMACNA.

   The Installer shall supply with client contact information, names, and locations of three (3) projects of similar size, complexity, and scope using the submitted roof system.

5. Preroofing Conference: After approval of submittals and before performing roofing system installation work, hold a preroofing conference to review the following:
   a. Drawings, specifications, and submittals related to the roof work;
   b. Roof system components and installation procedures;
   c. On site storage methods and locations;
   d. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, the name and qualifications of the roof manufacturer's technical representative, the frequency of the onsite visits, distribution of copies of the inspection reports;
   e. Contractor's coordination plan for all work by various trades involved in the roofing system. This includes the roofing system and all components that either penetrate or are secured to this roofing system;
   f. Quality control plan for the roof system installation; and
   g. Safety requirements.

Warranties: 1. Provide metal roof system material and workmanship warranties meeting specified requirements. Revision or amendment to manufacturer's standard warranty shall be provided as required to comply with the specified requirements.

a. Metal Roof System Contractor Warranty: Provide the "Contractor's Five (5-yr) Year No-Penal-Sum Warranty for Non-structural Metal Roof System" b.

   Metal Roof Panel Manufacturer Warranty: Furnish the metal roof panel manufacturer's 20-year no-penal-sum roof system materials and installation workmanship warranty, including all roofing components and related sheet metal work (coping caps, expansion joints, soffit and fascia panels, flashing, counterflashing, and penetrations), insulation, and accessories necessary for a watertight and thermally responsive roof system. The warranty shall run directly to the Government and commence at time of Government's acceptance of the roof work. The warranty shall state that:

   1). The warranty issued will be backed by the assets of the manufacturer and not a subsidiary, limited partnership, or other legal entity designed to limit the liability of the manufacturer in the event of a claim.

   2). If within the 20-year warranty period the metal roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, shows evidence of moisture intrusion within the assembly, displaces, corrodes, perforates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and/or damaged materials of the metal roof system, and correction of defective workmanship, shall be the responsibility of the metal roof panel manufacturer. All costs associated with the repair or replacement work shall be the responsibility of the metal roof panel manufacturer.

3). When the manufacturer, or his approved applicator, fails to perform the repairs within 72 hours of notification emergency temporary repairs performed by others shall not void the warranty.

c. Manufacturer's Finish Warranty: Provide a manufacturer's 20-year exterior material finish warranty, for the factory-color-finish system, stating that under normal atmospheric conditions at the site the system will not crack, peel, delaminate, or chalk in excess of the numerical rating of 8 when measured in accordance with ASTM D 4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D 2244.

d. Manufacturer's Material Warranty: Provide a manufacturer's 20-year material warranty stating that, under normal atmospheric conditions at the site, the aluminum-zinc alloy coated steel oraluminum coil material will perform as intended, in accordance with the design calculations; will not twist, bend, or rupture; will not structurally fail; and will not perforate. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing non-conforming, twisted, bent, ruptured, perforated, or structurally failed coil material.

e. Manufacturer's Watertight Warranty: Provide a manufacturer's best 20-year system weathertightness warranty.

f. Continuance of Warranty: Repair or replacement work that becomes necessary within the warranty period shall be approved, as required, and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the metal roof system manufacturer warranty for the remainder of the manufacturer warranty period.

g. Sealant Warranty: The sealant manufacturer shall issue a 10-year warranty for retention of elasticity, waterproofing characteristics, and adhesion.

Conformance and Compatibility:

1. The entire metal roofing and flashing system shall be in accordance with specified and indicated requirements, including wind resistance requirements. Work not specifically addressed, and any deviation from specified requirements, shall be in general accordance with recommendations of the MBMA RSDM, NRCA RWM, the metal panel manufacturer's published recommendations and details, and compatible with surrounding components and construction. Any deviation from specified or indicated requirements shall be submitted to the Contracting Officer for approval prior to installation.

Products:

1. Roof Panels: Roof panels shall be steel, conforming to ASTM E 1514 and aluminum, conforming to ASTM E 1637 with a factory-applied color finish. Panel attachment shall be with concealed clip fasteners.

   a. Roof panels shall provide nominal [12-inches][16-inches][18-inches] of coverage in place. Panel profile shall be [vertical rib seam.] [bulb rib with eave closure inserts.] Minimum height of seams at overlap of adjacent roof sheets shall be [2-inches for 90-degree vertical rib seam.] [1 3/4-inches for 180-degree vertical rib seam.] The seam is to a be machine folded with a [single] [double] fold. Seam is to contain sealant applied during the roll forming process, and sealant continuity maintained at all clips, panel end-laps, eaves, ridges and other interfaces. Panel-to-clip interfaces shall be tested following ASTM E 2140 with no infiltration.

   b. Individual panels shall be of continuous length sufficient to cover the entire length of any unbroken roof slope with no end laps. Panels shall be formed without warping, waviness, or ripples that are not a part of the panel profile and shall be free of damage to the finish coating system. Provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. All sheets shall be either square-cut or miter-cut.

   c. Steel Panels: Steel panels will be aluminum-zinc alloy coated steel conforming to ASTM A 792, AZ 50 coating. Roof panel material shall be minimum 24 gage thick prior to coating application, and as required to meet wind uplift requirements. Panels

shall be within 95 percent of the nominal thickness. Minimum roof panel thickness, as well as minimum tensile and yield strengths, shall be the same as that tested in accordance with [ASTM E 1592] [UL 580]. Certification of material compliance with testing shall be furnished with submittals. Panels that have become wet during shipment and have started to oxidize shall be rejected.

d. Aluminum Panels: Alloy 3003 or 3004 conforming to ASTM B 209, temper as required for the forming operation; minimum 0.032 inch thick, and as required to meet wind uplift requirements. Minimum roof panel thickness, as well as minimum tensile and yield strengths, shall be the same as that tested in accordance with [ASTM E 1592] [UL 580]. Certification of material compliance with testing shall be furnished with submittals.

e. Texture: Texture will be [smooth][stucco embossed][Smooth with raised intermediate stiffening ribs].

2. Accessories: Accessories shall be compatible with the metal roof panels furnished. Sheet metal flashing, trim, metal closure strips, caps, and similar metal accessories shall be not less than the minimum thicknesses specified for roof panels. Exposed metal accessories shall be finished to match the panels furnished [, except as otherwise indicated].

   a. Molded foam rib, ridge, and other closure strips, shall be closed-cell or solid-cell synthetic rubber, or neoprene, premolded to match configuration of the panels, and shall not absorb or retain water. Metal facer shall be provided to shield foam closure strips from ultraviolet radiation.

   b. Panel closures at the ridge or hip condition shall be continuous Cee or Zee configured, or individual flanged Zee. Closures must be non-corrosive metal or coated steel. Foamed plastic or foamed rubber panel closures are not permitted. Interface of closure to panel must be completely sealed against infiltration with butyl tape sealant. Seam-end sealants shall be used at closure locations. When floating ridge details are utilized, closure location must be reinforced with back-up plate of minimum 18-gauge thickness. When roofing is prefinished, closures shall be color-finished to match roof panels and shall meet the same factory color finish performance requirements.

3. Pre-manufactured Accessories: Pre-manufactured accessories shall be manufacturer's standard for intended purpose, compatible with the metal roof system, and approved for use by the metal roof panel manufacturer. Curbs shall be constructed of welded 0.060 aluminum or 18 gage stainless steel to match roof slope. Provide a minimum of 6-inches for clearance on all four sides of curbs and the tip of the cricket. Curb will be installed per detail. Angles will NOT be used to construct diverters in curbs. Roof installation will be sequenced to minimize foot traffic on finished metal roof, based on roof hatch location. All curbs shall be factory welded, inspected, and delivered to the site with a letter stating structural soundness.

   a. Mechanical Equipment Supports: All rooftop HVAC equipment that is ducted through the roof is to be mounted using prefabricated, all-welded, custom made structural roof curbs that integrate with the roof panel profile. Material is to be a minimum of 0.080-inch aluminum. Coated steel curbs are not acceptable. Curb design must not "buck" the flow of water at any area. Curb side flanges may terminate by mating with panel seam edges, or they may terminate in the panel flat provided the upslope panel laps over the curb flange. Minimum curb wall height is to be 9 inches. Curb must be provided with water deflector on the upslope end. Downslope curb flange termination (where curb flange overlays roof panel) shall be reinforced with a back-up plate or channel beneath the roof panel. Curb sidewalls shall not occur less than 8 inches from the nearest standing seam. Curb must be of a design to "float" thermally with roof panels. Curb walls shall be insulated to minimum R-8 using rigid board type insulation and a continuous vapor retarder to the conditioned side of the insulation. Curbs are to be furnished to the slope of the roof when operable HVAC equipment is to be mounted thereupon.

Where HVAC unit must be frame-mounted, the actual duct penetration(s) shall be as described above, and the frame supports shall penetrate the roof panels using round pipe shapes, so that they can be waterproofed using rubber pipe flashings. Furnish pipe supports with sleeved connections so that the penetration(s) can be flashed to the roof prior to placement of the support frame.

b. Pipe Flashings: Pipe flashings shall be a pre-manufactured one piece design. Furnish black EPDM rubber, conical in shape, and having a moldable aluminum compression ring laminated to the base. Gray or otherwise pigmented rubber is not acceptable. Furnish a stainless steel drawband to secure the top of the pipe flashing. Where temperatures of the pipe are expected to exceed 220 degrees Fahrenheit use silicone rubber in place of EPDM.

c. Expansion Joints: All expansion joints are to be fully hydrostatic in performance and tested in accordance with ASTM E 2140. Test scope shall encompass all components of the joint including all panel terminations, joint materials, and all sealants, closures, and fasteners as depicted in the manufacturer's submitted details.

1) Joints in the transverse direction shall be fully sealed to both upper and lower roof planes with butyl tape polymer and other sealant integration details as prescribed by the roof manufacturer and tested in accordance with ASTM E 2140. Joints in the longitudinal direction shall be joined to the elevated portion of the seam, and not the panel flat.

2) Expansion joints shall incorporate a protected, flexible, elastomeric membrane such as EPDM. A metal facer, in color match roof panels, shall be provided to shield this elastomeric membrane from ultraviolet radiation.

d. Panel Clips: Panel clips shall be active series stainless steel. Provide sealant-type joints where indicated. Form joints to conceal sealant. Comply with specification Section 07 92 00.00 48, JOINT SEALERS.

e. [Interior Gutters and Downspouts: Interior gutters shall be either iron-free stainless steel (18-gage minimum) with welded joints, or coated steel lined with tapered insulation (to drains) with fully adhered 60 mil EPDM rubber. Expansion joints shall be furnished at maximum every 100 feet in stainless steel gutters. Lined coated steel gutters need not incorporate expansion joints, but joints of sheet steel substrate shall not be fastened. Downspouts shall be fabricated from the coil material used for the roof panels in the size and shape indicated. All accessories required for a complete installation shall be furnished, including gutter brackets, downspout elbows, straps and fasteners. Color and finish shall meet the requirements for the roofing panels.]

f. Exterior Gutters and Downspouts: Gutters and downspouts shall be fabricated from the coil material used for the roof panels in the size and shape indicated. All accessories required for a complete installation shall be furnished, including gutter brackets, downspout elbows, straps and fasteners. Color and finish shall meet the requirements for the roofing panels.

4. Fasteners: Fasteners for roof panels shall be corrosion resistant coated steel, aluminum, stainless steel, or nylon capped steel, compatible with the sheet panel or flashing material and of type and size as recommended by the manufacturer to meet the performance requirements. Fasteners for accessories shall be the manufacturer's standard. Exposed fasteners shall have integral metal washer head and compressible sealing EPDM washer. Neoprene shall not be used. Sealing washer shall be approximately 3/32 inch thick. Exposed portion of fasteners shall match color of attached material.

a. Concealed Anchor Clips: Concealed anchor clips are to be as specified and furnished by the panel manufacturer, and must be consistent in type, gauge, and in other particulars as tested by[ASTM E 1592. Concealed anchor clips shall have factory punched, or drilled, holes for attachment. There shall be a minimum of two fasteners per clip. Clips shall be made to accommodate the total thermal movement required.

b. Screws: Screws shall not be smaller than No. 14 diameter self-tapping type and not less than No. 12 diameter self-drilling type.
c. Rivets: Rivets are not allowed. However, blind rivets may be used in areas not located in the horizontal plane, or subject to water inundation.

5. Roof Panel Factory Color Finish: Provide factory-applied , thermally cured coating system on roof panel surfaces. Provide exterior coat of primer and 70 percent polyvinylidene fluoride resin color finish coat on the exposed side. Total color coating system thickness shall be not less than 1 mil. Where required, provide additional primer and finish coat thicknesses to meet the color finish performance requirements specified. Provide manufacturer's standard factory-applied clear coat system over color finish coat. Underside coating shall consist of roof panel manufacturer recommended protective backer coat suitable for the application conditions, not less than 0.3 mil thick. .
   a. Cyclic Salt Fog/UV Test: A sample of the sheets shall withstand a cyclic corrosion test for a minimum of 2014 hours in accordance with ASTM D 5894, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 10, no blistering, as determined by ASTM D 714; no rusting, as determined by ASTM D 610; and a rating of 6, less than 1/16-inch to 1/8-inch creepage from scribe as determined by ASTM D 1654
   b. Formability Test: When subjected to testing in accordance with ASTM D 522, Method B, 1/8-inch diameter mandrel, the coating film shall show no evidence of fracturing to the naked eye
   c. Accelerated Weathering, Chalking Resistance and Color Change: Coating sample shall withstand weathering test of 5000 hours, in accordance with ASTM D 4587, and ASTM G 154, Type D, without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating with an adhesion rating of less than 4B when tested in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. [For sheets required to have a low gloss finish, the chalk rating shall be not less than No. 6 and the color difference shall be not greater than 7 units.]
   d. Humidity Test: When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.
   e. Impact Resistance: Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 0.50-inch diameter hemispherical head indenter, equal to 1.5 times the metal thickness in mils, expressed in inch-pounds, with no cracking.
   f. Abrasion Resistance Test: When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 50 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel or the aluminum base metal.
   g. Specular Gloss: Finished roof surfaces shall have a specular gloss value of 30 plus or minus 5 at an angle of 60 degrees when measured in accordance with ASTM D 523.
   h. Pollution Resistance: Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.
6. Underlayments:
   a. Felt Underlayment: Felt underlayment shall be equal No. 30 felt in compliance with ASTM D 226, Type II.
   b. Self-Adhering Modified Bitumen Underlayment: Self-adhering modified bitumen membrane underlayment material in compliance with ASTM D 1970, and suitable for use as underlayment for metal roofing. Membrane shall be resistant to cyclical

elevated temperatures for extended periods of time and shall have an integral non-tacking top surface of polyethylene film, or other surface material, to serve as separator between bituminous material and metal products to be applied above. Membrane must resist a minimum of 170 degree F temperature.

c. Polyethylene Vapor Retarder: When required by plans within rigid board assemblies, polyethylene sheet is to be 10 mil in thickness and conform to ASTM D 4397. A fully compatible polyethylene joint and patching tape which has equal or lower permeability ratings than the vapor retarder material shall be provided

7. Insulation: Thermal resistance of insulation shall not be less than the R-value shown on the drawings. Insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark. Identification shall be on individual pieces or individual packages. Insulation, including facings, shall have a flame spread not in excess of 75 and a smoke developed rating not in excess of 150 when tested in accordance with ASTM E 84.
   a. Rigid Board Insulation for Use Above a Roof Deck:
      1). Polyisocyanurate: Polyisocyanurate insulation shall conform to ASTM C 1289, Type II, Class 1, Grade 3 (25 psi minimum compressive strength), having a minimum recovered material content of 9 percent by weight of core material in the polyisocyanurate portion. Use a value of six (6.0) as the maximum design R-value per 1-inch of insulation.
8. Sealant: Sealant shall be an elastomeric type containing no oil or asphalt, as recommended by the roof panel manufacturer. Silicone based sealants are prohibited, unless approved otherwise by the roof panel manufacturer and the Contracting Officer. Exposed sealant shall be high quality polyurethane colored to match adjacent components and shall cure to a rubber like consistency. Concealed sealant shall be noncuring, non-hardening type. Sealant placed in the roof panel standing seam ribs shall be provided in accordance with the manufacturer's recommendations, and installed at the factory.
8. Gaskets and Insulating Compounds: Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying

Equipment: 1. Snow Retention System: The snow retention system shall clamp to the standing seam of the metal roof panel using high strength stainless steel fittings that will not penetrate the seam. The retention system consists of [aluminum] [stainless steel] [bars] [pipes] [brackets] [with intermittent clips between seams] that prevent the sudden movement of snow and ice. Protection from galvanic reactions between dissimilar metals will be designed into the system. The system will not rotate, twist, or spin within their brackets. The system shall match the metal roof panels in color and finish.

2. Lightning Protection System (When required): Lightning protection cabling spikes and related components must be metallurgical compatible with roof type. Copper elements may not be used. System components and their attachment to the system must be approved by the roof manufacturer. Methods of attachment must be clamping style utilizing round-point setscrews or other anchorages that do not gall or penetrate the panel material with fasteners. Adhesively attached fixtures are not acceptable. Attachment with cup point setscrews is not acceptable. Coordinate with electrical specification.
3. Fall Arrest System (When required): Fall arrest system shall be OSHA compliant post or track type horizontal lifeline system permanently anchored to metal roofing with non-intrusive methods at ridges and perimeters or as required by OSHA standards. System must provide for continuous lifeline attachment at posts or other anchorages by using trolleys or other methods that pass anchorages without requiring disconnecting. Anchorages must not penetrate the roof surface. Methods of attachment must be clamping style, utilizing round-point setscrews or other anchorages that do not gall or penetrate the panel material with fasteners. Attachment with cup point setscrews is not acceptable. Components are to be non-corrosive 918-8) stainless steel or aluminum.

Fall arrest systems are to be furnished by a vendor regularly engaged in and specializing roof in fall protection. System must be tested to OSHA compliant forces by a recognized independent test agency.

---End of Section---

SECTION 07 42 13.00 48 METAL WALL PANELS

Scope: 1. Provide preformed and prefinished panels for walls.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ALUMINUM ASSOCIATION (AA)

AA ADM	Aluminum Design Manual
AA ASD1	Aluminum Standards and Data

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501.1	Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure
AAMA 800	Voluntary Specifications and Test Methods for Sealants</RTL>

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100	North American Specification for the Design of Cold-Formed Steel Structural Members
AISI SG03-3	Cold-Formed Steel Design Manual Set

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	Structural Welding Code – Steel
AWS D1.2/D1.2M	Structural Welding Code – Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A 463/A 463M	Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 653/A 653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 792/A 792M	Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B 209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 518	Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM D 522	Mandrel Bend Test of Attached Organic Coatings
ASTM D 610	Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D 714	Evaluating Degree of Blistering of Paints
ASTM D 968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1654	Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	Standard Practice for Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	Testing Water Resistance of Coatings in 100% Relative Humidity

ASTM D 2794	Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	Standard Test Method for Rating Adhesion by Tape Test
ASTM D 4214	Standard Test Method for Evaluating Degree of Chalking of Exterior Paint Films
ASTM D 4587	Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
ASTM D 5894	Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM E 84	Standard Test Method forSurface Burning Characteristics of Building Materials
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
ASTM E 1592	Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	Minimum Design Loads for Buildings and Other Structures

General Requirements:

1. Comply with performance requirements, conforming to AISI S100, without failure due to defective manufacture, fabrication, installation, or other defects in construction. Wall panels and accessory components must conform to the following standards:

Submittals:

1. Shop Drawings: Drawings consisting of catalog cuts, design and erection drawings, shop coating and finishing specifications, and other data as necessary to clearly describe design, materials, sizes, layouts, construction details, fasteners, and erection. Drawings shall be accompanied by engineering design calculations for the siding panels.
2. Samples:
   a. One sample of each type of flashing, trim, closure, cap and similar items. Size shall be sufficient to show construction and configuration.
   b. One piece of each type and finish (exterior and interior) to be used, 9 inches long, full width.
   c. Fasteners: Two samples of each type to be used with statement regarding intended use. If so requested, random samples of bolts, nuts, and washers as delivered to the jobsite shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.
   d. Gaskets and Insulating Compounds: Two samples of each type to be used and descriptive data.
   e. Sealant: One sample, approximately 1 pound, and descriptive data.
3. Certificates:
   a. Certificates attesting that the panels and accessories conform to the requirements specified. Certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than 5 pieces has been tested and has met the quality standards specified for factory color finish. Mill certification for structural bolts, siding, and wall liner panels.
   b. Insulation: Certificate attesting that the insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

Warranties:

1. The Contractor shall provide a weather tight warranty for the metal siding for a period of 20 years No Dollar Limit to include siding panel assembly. The warranty is to provide that if within the warranty period the metal wall panel system shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the wall panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal wall panel system manufacturer. Repairs that become necessary because of defective

materials and workmanship while metal wall panel system is under warranty are to be performed within 24 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 24 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty. The warranties shall start upon final acceptance of the work or the date the Government takes possession, whichever is earlier.

Products:

1. Siding: Panels shall be steel and shall have a mill factory color finish. Length of sheets shall be sufficient to cover the entire height of any unbroken wall surface when length of run is 30 feet or less. When length of run exceeds30 feet, each sheet in the run shall extend over two or more spans. Width of sheets with overlapping configurations shall provide not less than 24 inches of coverage in place , and those with interlocking ribs shall provide not less than 12 inches of coverage in place.
   a. Wall Panels: Wall panels shall have edge configurations for overlapping adjacent sheets or interlocking ribs for securing adjacent sheets. Wall panels shall be fastened to framework using exposed or concealed fasteners.
   b. Steel Panels: Zinc-coated steel conforming to ASTM A 653/A 653M; aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ 50 coating; or aluminum-coated steel conforming to ASTM A 463/A 463M, Type 2, coating designation T2 65. Uncoated wall panels shall be 0.024 inch thick minimum. Prior to shipment, mill finish panels shall be treated with a passivating chemical and oiled to inhibit the formation of oxide corrosion products. Panels that have become wet during shipment but have not started to oxidize shall be dried, retreated, and re-oiled.
2. Factory Color Finish: Panels shall have a factory applied polyvinylidene fluoride finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. The exterior coating shall be a nominal 1 mil thickness consisting of a topcoat of not less than 0.88 mil dry film thickness and the paint manufacturer's recommended primer of not less than 0.2 mil thickness. The interior color finish shall consist of the same coating and dry film thickness as the exterior. The exterior color finish shall meet the test requirements specified below.
   a. Salt Spray Test: A sample of the sheets shall withstand a cyclic corrosion test for a minimum of 2016 hours in accordance with ASTM D 5894, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 10, no blistering, as determined by ASTM D 714; 10, no rusting, as determined by ASTM D 610; and a rating of 6, 1/16 to 1/8 inch failure at scribe, as determined by ASTM D 1654.
   b. Formability Test: When subjected to testing in accordance with ASTM D 522 Method B, 1/8 inch diameter mandrel, the coating film shall show no evidence of fracturing to the naked eye.
   c. Accelerated Weathering, Chalking Resistance and Color Change: A sample of the sheets shall be tested in accordance with ASTM G 154, test condition UVA-340 lamp, 4h UV at 140 deg F followed by 4h CON at 122 deg F for 2000 total hours. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating with an adhesion rating of less than 4B when tested in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. For sheets required to have a low gloss finish, the chalk rating shall be not less than No. 6 and the color difference shall be not greater than 7 units.
   d. Humidity Test: When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.
   e. Impact Resistance: Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 0.500 inch diameter hemispherical head indenter, equal to1.5 times the metal thickness in mils, expressed in inch-pounds, with no loss of adhesion.

f. Abrasion Resistance Test: When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 50 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel or the aluminum base metal.

3. Accessories: Flashing, trim, metal closure strips, caps, and similar metal accessories shall be the manufacturer's standard products. Exposed metal accessories shall be finished to match the panels furnished. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chlorided premolded to match configuration of the panels and shall not absorb or retain water.
4. Fasteners: Fasteners for steel panels shall be zinc-coated steel, aluminum, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for aluminum panels shall be aluminum or corrosion resisting steel. Fasteners for attaching wall panels to supports shall provide both tensile and shear strength of not less than 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed wall fasteners shall be color finished or provided with plastic color caps to match the panels. Nonpenetrating fastener system for wall panels using concealed clips shall be manufacturer's standard for the system provided.
   a. Screws: Screws shall be as recommended by the manufacturer.
   b. End-Welded Studs: Automatic end-welded studs shall be shouldered type with a shank diameter of not less than 3/16 inch and cap or nut for holding panels against the shoulder.
   a. Explosive Actuated Fasteners: Fasteners for use with explosive actuated tools shall have a shank of not less than 0.145 inch with a shank length of not less than 1/2 inch for fastening panels to steel and not less than 1 inch for fastening panels to concrete.
   b. Blind Rivets: Blind rivets shall be aluminum with 3/16 inch nominal diameter shank or stainless steel with 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems shall have closed ends.
   c. Bolts: Bolts shall be not less than 6 mm diameter, shouldered or plain shank as required, with proper nuts.
5. Insulation: Blanket insulation is specified in Section 07 21 00.00 48 BUILDING INSULATION.
6. Sealant: Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubber like consistency.
7. Gaskets and Insulating Compounds: Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

---End of Section---

SECTION 07 52 00.00 48 MODIFIED BITUMINOUS ROOFING SYSTEM

Scope: 1. Provide manufacturer's standard, prefabricated, reinforced polymer-modified bitumen membrane, with base sheet, and insulation as specified and indicated

References:1 The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.24	Roofing - Safety Requirements of Low-Sloped Roofs

ASTM INTERNATIONAL (ASTM)

ASTM C208	Standard Specification for Cellulosic Fiber Insulating Board
ASTM C1153	Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging
ASTM D41/D41M	Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D312/D312M	Standard Specification for Asphalt Used in Roofing
ASTM D1863	Mineral Aggregate Used on Built-Up Roofs
ASTM D4586	Asphalt Roof Cement, Asbestos Free
ASTM D4073	Standard Test Method for Tensile-Tear Strength of Bituminous Roofing Membranes
ASTM D4601	Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM D 4897	Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM 4470	Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction
FM APP GUIDE	Approval Guide http://www.fmapprovals.com/approval-guide

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA Details	NRCA Roof Perimeter Flashing Systems Construction Details for Class 1 Roof Construction
NRCA 0405	Roofing and Waterproofing Manual

UNDERWRITERS LABORATORIES (UL)

UL 790	Standard for Test Methods for Fire Tests of Roof Coverings
UL RMSD	Roofing Materials and Systems Directory
UL 1256	Standard for Fire Test of Roof Deck Constructions

System Description:

1. Minimum two-ply SBS modified bitumen roof membrane in accordance with FM 4470 Class 1 consisting of modified bitumen base sheet fiberglass felt interply sheet and cap sheet. SBS modified bitumen roof membrane must be set in torch applied or set in cold-applied adhesive. All work must follow the NRCA 0405 guidelines and standards.
   a. Minimum 20 year No Dollar Limit Warranty.

2. Acceptable Manufacturer Products: Manufacturer products listed in this specification are referenced to establish a standard of quality.

   Siplast SBS-MODIFIED BITUMINOUS MEMBRANE
   1000 E Rochelle Blvd.
   Irving, TX 75062
   (800) 922-8800
   www.siplast.com

   Johns Manville SBS-MODIFIED BITUMINOUS MEMBRANE
   10100 W. Ute Avenue
   Littleton, CO 80127
   (303) 978-2000
   www.jm.com

   Soprema, Inc. SBS-MODIFIED BITUMINOUS MEMBRANE
   310 Quadral Drive
   Wadsworth, OH 44281
   (800) 356-3521
   www.soprema.us

   Georgia-Pacific DENS-DECK PRIME ROOF BOARD
   133 Peachtree Street NE
   Atlanta, GA 30303
   (404) 652-4000
   www.gp.com

Submittals:
1. Tapered Insulation Shop Drawings: Submit proposed tapered insulation and cricket system for approval prior to start of work. Provide drawings for each area and include, at minimum, concise tapered layouts, material identification, typical cross sections with each board labeled, board stagger pattern, slopes and cricket widths.
2. Roof Vent Drawings: Submit shop drawing showing proposed roof vent layout

Product Data:
1. Provide product data for the following:
   a. Primer
   b. Asphalt
   c. Bituminous cement
   d. Base sheet
   e. Modified bitumen sheet
   f. Nails and fasteners
   g. Surface material
   h. Adhesives
   i. Walking surfaces
   j. Insulation
   k. Coating
2. Certificates:
   a. Qualifications; Evidence that the manufacturer has a minimum of 10 years experience manufacturing modified bitumen roofing. The roofing system applicator shall be approved by the modified bitumen roofing manufacturer, and shall have a minimum of 3 years experience as an approved applicator. A list of installations using the same products and applicator as proposed shall be included.
   b. Materials; Certificates of compliance for felts, bitumens, and membrane sheet.
   c. Manufacturer's Instructions:

d. Materials and Installation; Manufacturer's instructions, including membrane description and performance data, detailed procedure for installation, and safety precautions, prior to the start of roofing work.

3. Records;
   a. Bills of Lading; Bills of lading shall indicate the flash point and equiviscous temperature (EVT) and this information shall be shown on labels for each unit (or plug) of asphalt.

General Requirements:

1. Membrane manufacturer's standard system of the number and type of plies specified. Materials provided must be approved by the roof membrane manufacturer and suitable for the service and climatic conditions of the application/installation.

Fire Resistance:

1. Fire Resistance: Class A rated in accordance with FM 4470, or UL 790. Be listed as part of Fire-Classified roof deck construction in UL RMSD, or Class I roof deck construction in FM APP GUIDE
2. FM or UL approved components of the roof covering assembly must bear the appropriate FM or UL label.

Wind Uplift Resistance:

1. Determine the required wind uplift resistance based on ASCE 7 wind loading calculations or applicable building code requirements. Complete roof covering assembly, including insulation, must be rated Class 1A-60 minimum in accordance with FM APP GUIDE and ASTM D 4073. Non-rated systems are not acceptable

Warranty:

1. Manufacturer's No Dollar Limit warranty for the roofing system shall be provided for not less than 20 year from acceptance of the work. Warranty shall state that manufacturer shall repair or replace defective materials if the roofing system leaks or allows the insulation beneath the membrane to become wet during the period of the warranty.

Products:

1. Primer: Primer shall conform to ASTM D 41.
2. Asphalt: Asphalt shall conform to ASTM D 312, Type III for slopes up to 25 percent (1/4 vertical/horizontal) and Type IV for slopes up to 50 percent (1/2 vertical/horizontal).
3. Asphalt Cement: Shall conform to ASTM D 4586, type 11 asbestos free.
4. Cants and Wood Nailers: Treated wood cants and wood nailers shall be of water-borne preservative-treated material as specified in Section 06 10 00.00 48 ROUGH CARPENTRY. Cants shall be made from treated wood or treated fiberboard not less than 3-1/2 inches high and cut to reduce change in direction of the membrane to 45 degrees or less. Fiberboard shall conform to ASTM C 208, treated with sizing, wax or bituminous impregnation. When membrane or flashing is to be torch applied, cants shall be fire resistant.
5. Base Sheet: Materials provided must be suitable for the service and climatic conditions of the installation. Modified bitumen sheets must be watertight and visually free of pinholes, particles of foreign matter, non-dispersed raw material, factory splices, or other conditions that might affect serviceability. Polymer modifier must be uniformly dispersed throughout the sheet. Edges of sheet must be straight and flat. Specify perforated venting base sheet over over concrete, with or without insulation. Venting inorganic felt base sheet shall conform to ASTM D 4897, Type II. Non venting base sheet shall conform to ASTM D 4601, Type
6. Membrane Materials:
   a. Base Ply: ASTM D 5147 and ASTM D 6163, Type II, Grade S, SBS-modified asphalt sheet with glass fiber mat reinforcing, suitable for application method specified. or ASTM D 5147 and ASTM D 6164, Type II, Grade S, SBS-modified asphalt sheet with polyester mat reinforcing, suitable for application method specified.
   b. Cap Sheet: ASTM D 5147 and ASTM D 6163, Type II, Grade G, SBS-modified asphalt sheet with glass fiber mat reinforcing, granular surfaced, suitable for application method specified or ASTM D 5147 and ASTM D 6164, Type II, Grade G, SBS-modified asphalt

sheet with polyester mat reinforcing, granular surfaced, suitable for application method specified.

7. Adhesive: Adhesive shall be an approved type recommended by the membrane manufacturer.
8. Walkway Surfaces: Walkway surfaces shall be either mineral surfaced modified bitumen cap sheet as recommended by the membrane manufacturer, or concrete pavers, indicate size, 1-1/2 inch minimum thickness, and made from 3000 psi air entrained concrete.
9. Insulation: Insulation shall be compatible with the membrane, as recommended by the membrane manufacturer's printed instructions, and as specified in Section 07 22 00.00 48 ROOF AND DECK INSULATION.
10. Coating: Aluminum coating shall conform to ASTM D 2824 Type I or III, or shall be as recommended by the membrane manufacturer.

---End of Section---

SECTION 07 53 23.00 48 ETHYLENE-PROPYLENE-DIENE MONOMER ROOFING

Scope: 1. Provide a fully adhered ethylene propylene-diene terpolymer (EPDM) elastomeric sheet roofing.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM D448	Standard Classification for Sizes of Aggregate for Road and Bridge Construction
ASTM D4637/D4637M	EPDM Sheet Used in Single-Ply Roof Membrane
ASTM D4811/D4811M	Standard Specification for Nonvulcanized (Uncured) Rubber Sheet Used as Roof Flashing
ASTM D6369	Design of Standard Flashing Details for EPDM Roof Membranes
ASTM E108	Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM 4470	Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction
FM APP GUIDE	Approval Guide http://www.fmapprovals.com/approval-guide

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA RoofMan	The NRCA Roofing Manual

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI RD-1 Performance Standard for Retrofit Drains

UNDERWRITERS LABORATORIES (UL)

UL RMSD	Roofing Materials and Systems Directory
UL 790	Tests for Fire Resistance of Roof Covering Materials

Submittals:1. Shop Drawings: Drawings showing size of sheets, position of sheets and splices, flashing details, fastening patterns where applicable for insulation and expansion joint details. Detail showing construction of water cutoffs to be used at membrane terminations at the end of a day's work to seal the roofing system from water intrusion.Tapered Insulation Shop Drawings: Submit proposed tapered insulation and cricket system for approval prior to start of work. Provide drawings for each area and include, at a minimum, concise tapered layouts, material identification, typical cross sections with each board labeled, board stagger pattern, slopes and cricket widths.

a. Roof Plan: Provide roof plan showing the location of all mechanical equipment, penetrations, roof drain locations and slope to drains.

2. Product Data:

a. Manufacturer's instructions for preparing and installing the membrane, flashings, seams, insulation, nailers and other accessories.

b. Protection plan showing areas to be protected, type of material used; a plan to protect the membrane from damage until completion of work by other trades, and a description of the method of repairing the roofing.
c. The inspection procedure for substrate suitability including decks, curbs and insulation installation, prior to start of the work. Inspection procedures during and after placement of the membrane, and after completion of work by other trades.

3. Certificates: Certificates of compliance attesting that the roofing system and materials meet specification requirements. The certificates shall list the components required for the specified fire and wind uplift resistance ratings.

Acceptable Manufacturer Products

1. All materials used in systems to be covered by a Manufacturer's Guarantee must be supplied by the same manufacturer, unless the manufacturer issuing the guarantee waives this requirement in writing.2. Manufacturer products listed in this specification are referenced to establish a standard of quality:

Firestone Building Products Platinum EPDM
310 East 96th Street
Indianapolis, IN 46240(800) 428-4442
firestonebpco.com

Carlisle SynTec Incorporated Sure-Seal
P.O. Box 7000
1285 Ritner Highway
Carlisle, PA 17013(800) 479-6832
Carlisle-syntec.com

Versico Versigard 90-mil
P.O. Box 1289
Carlisle, PA 17013
(800) 992-7663
Versico.com

General Requirements:

1. 60 mil elastomeric membrane roofing shall be fully adhered to the roof surfaces indicated. Roofing membrane sheet widths shall be consistent with membrane attachment methods and wind uplift requirements, and shall be as large as practical to minimize joints. Membrane shall be free of defects and foreign material. Flashing work shall be coordinated to permit continuous membrane installation operations. Applied insulation shall be weatherproofed by the membrane on the same day. The minimum thickness must not be less than minus 10 percent of the specified thickness value. EPDM membrane thickness specified is exclusive of backing material on the EPDM membrane. Principal polymer used in manufacture of the membrane sheet must be greater than 95 percent EPDM. EPDM roofing system shall be in accordance with FM 4470 Class 1 Roofing, system securement shall meet or exceed the requirements of ASCE/SEI 7 "Minimum Design Loads for Buildings and Other Structures".
2. Warranty: Manufacturer's warranty for the roofing system shall be provided for not less than 20 year No Dollar Limit from acceptance of the work. Warranty shall state that manufacturer shall repair or replace defective materials if the roofing system leaks or allows the insulation beneath the membrane to become wet during the period of the warranty.

Products:

1. Adhesives: Adhesives, splicing cements, solvents, and sealants shall be as recommended by the membrane manufacturer. Low VOC materials may be required in some geographic locations and on occupied buildings to minimize potential irritation to occupants.
2. Fasteners: Fasteners for sheet-metal flashing shall be corrosion resistant steel annular-type nails or screws.

3. Flashing: Flashing shall be of ultra-violet resistant materials as recommended by the membrane manufacturer. Prefabricated shaped flashings shall be used where possible. Sheared edges of metal flashings that contact the membrane shall be turned into a tight hem.
4. Membrane: Membrane shall conform to ASTM D 4637, Type I EPDM, Grade 1; Class U, 0.060 mil nominal thickness.
   a. Kitchen Area Protective Covering: Materials used shall be suitable for application to kitchen roofs where harmful exhausts will occur and shall provide suitable protection as recommended and warranted by the manufacturer
5. Pre-manufactured Accessories: Pre-manufactured accessories must be manufacturer's standard for intended purpose, compatible with the membrane roof system and approved for use by the roof membrane manufacture including Pipe seals and expansion joint covers shall be types and sizes recommended by the membrane manufacturer.
6. Walkways: Walkways shall be preformed reprocessed rubber, compatible with the EPDM sheet, 1/4 inch minimum thickness, and weighing not less than 1-1/2 pounds per square foot. Alternative walkway material may be used if recommended by the manufacturer.

Installation: 1. Installation shall comply with the manufacturer's approved instructions, except as otherwise specified.

Inspection: 1. The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed elastomeric roofing with the contract requirements. The procedure shall include a checklist of points to be observed. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:
   a. Observation of environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of substrate.
   b. Verification of compliance of materials before, during and after installation.
   c. Inspection of insulation, nailers, flashings, penetrations and work requiring coordination with roofing.
   d. Inspection of membrane placement, splicing, and attachment.
   e. Inspection of placement of walkways.

   f. A roofing technician responsible directly to the Contractor and experienced in the construction of elastomeric roofing systems shall perform the inspection functions and be on the site whenever roofing operations are in progress.

---End of Section---

SECTION 07 54 19.00 48 THERMOPLASTIC MEMBRANE ROOFING SYSTEM

Scope: 1. Provide a [fully adhered] [mechanically fastened] polyvinyl chloride (PVC) membrane roofing system.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/SPRI ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.24 Roofing - Safety Requirements of Low-Sloped Roofs

ASTM INTERNATIONAL (ASTM)

ASTM D4263 Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4272 Standard Test Method for Total Energy Impact of Plastic Films by Dart Drop
ASTM D4434 Standard Specification for Poly (Vinyl Chloride) Sheet Roofing
ASTM E108 Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM 4470 Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction
FM APP GUIDE Approval Guide http://www.fmapprovals.com/approvalguide

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC International Building Code

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

The NRCA Roofing Manual – Membrane Roofing Systems

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI RP-4 Wind Design Standard for Ballasted Single-ply Roofing Systems
ANSI/SPRI/FM 4425/ES-1
Test Standard for Edge Systems Used with Low Slope Roofing Systems
. ANSI/SPRI RD-1 Performance Standard for Retrofit Drains

UNDERWRITERS LABORATORIES (UL)

UL 580 Standard for Tests for Uplift Resistance of Roof Assemblies
UL 790 Standard Test Methods for Fire Tests of Roof Coverings

System Description:

1. [Fully adhered] [Mechanically fastened] PVC roof membrane system applied over [insulation] [recovery board] PVC membrane roofing manufacturer-accepted substrate.

Submittals:1. Shop Drawings: Drawings showing size of sheets, position of sheets and splices, flashing details, fastening patterns where applicable for insulation and expansion joint details. Detail showing construction of water cutoffs to be used at membrane terminations at the end of a day's work to seal the roofing system from water intrusion.
   a. Tapered Insulation Shop Drawings: Submit proposed tapered insulation and cricket system for approval prior to start of work. Provide drawings for each area and include concise tapered layouts, material identification, typical cross sections with each board labeled, board stagger pattern, slopes and cricket widths.
   b. Roof Plan: Provide roof plan showing the location of all mechanical equipment, penetrations, roof drain locations and slope to drains.
2. Product Data:
   a. Manufacturer's instructions for preparing and installing the membrane, flashings, seams, insulation, nailers and other accessories.
   b. Protection plan showing areas to be protected, type of material used; a plan to protect the membrane from damage until completion of work by other trades, and a description of the method of repairing the roofing.
   c. The inspection procedure for substrate suitability including decks, curbs and insulation installation, prior to start of the work. Inspection procedures during and after placement of the membrane, and after completion of work by other trades.
3. Certificates: Certificates of compliance attesting that the roofing system and materials meet specification requirements. The certificates shall list the components required for the specified fire and wind uplift resistance ratings.

Performance Requirements:

1. General Performance: Installed roofing and base 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. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
   b. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474 or UL 580.
2. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
   a. Fire/Windstorm Classification: [Class 1A-60] [Class 1A-75] [Class 1A-90] [Class 1A-105] [Class 1A-120].
   b. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 [MH] [SH] [VSH].
3. Warranty: Manufacturer's warranty for the roofing system shall be provided for not less than 20 years No Dollar Limit from acceptance of the work. Warranty shall state that manufacturer shall repair or replace defective materials if the roofing system leaks or allows the insulation beneath the membrane to become wet during the period of the warranty.

Acceptable Manufacturer Products

1. All materials used in systems to be covered by a Manufacturer's Guarantee must be supplied by the same manufacturer, unless the manufacturer issuing the guarantee waives this requirement in writing.

2. Manufacturer products listed in this specification are referenced to establish a standard of quality:

   Sika Sarnafil 80 mil G 410 Adhered System
   U.S. Corporate HQ
   100 Dan Road
   Canton,MA 02021
   (800) 451-2504
   sarnafilus.com

   Seaman Corporation 90 mil FiberTite-XTreme
   1000 Venture Blvd,
   Wooster, OH 44691
   (800) 927-8578
   seamancorp.com
   fibertite.com

   Carlisle SynTec Incorporated 80 mil Sure-Flex
   P.O. Box 7000
   1285 Ritner Highway
   Carlisle, PA 17013
   (800) 479-6832
   Carlisle-syntec.com

   Georgia-Pacific DENS-DECK PRIME ROOF BOARD
   133 Peachtree Street NE
   Atlanta, GA 30303
   (404) 652-4000
   gp.com

General:

1. Polyvinyl chloride (PVC) membrane roofing shall be [fully adhered] [mechanically attached] to the roof surfaces indicated. Roofing membrane sheet widths shall be consistent with membrane attachment methods and wind uplift requirements, and shall be as large as practical to minimize joints. Membrane shall be free of defects and foreign material. Flashing work shall be coordinated to permit continuous membrane installation operations. Applied insulation shall be weatherproofed by the membrane on the same day. The minimum thickness must not be less than minus 10 percent of the specified thickness value.
   a. [PVC Sheet: ASTM D 4434/D 4434M, Type II, Grade 1, fiber reinforced] or [PVC Sheet: ASTM D 4434/D 4434M, Type III, fabric reinforced] or [KEE Sheet: ASTM D 6754]
   b. PVC roofing system shall be in accordance with FM 4470 Class 1 Roofing, system securement shall meet or exceed the requirements of ASCE/SEI 7 "Minimum Design Loads for Buildings and Other Structures".
   c. Exposed Face Color: [White]
2. Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
   a. Membrane Flashing: Provide membrane flashing, including self-adhering membrane flashing, perimeter flashing, flashing around roof penetrations and prefabricated pipe seals, of a minimum polymer thickness 0.072 inch reinforced PVC for 20 year warranties, and utilized as recommended and supplied by the roof membrane manufacturer. Submit certification from PVC membrane manufacturer that the proposed PVC membrane roofing product meets the minimum polymer thickness specified.
   b. Bonding Adhesive: Provide PVC membrane manufacturer's recommended adhesive, as supplied by roof membrane manufacturer, and recommended by the manufacturer's printed data for bonding of PVC membrane materials to acceptable insulation, wood, metal,

concrete or other acceptable substrate materials. Do not use bonding adhesive to bond membrane materials to each other.

c. Water Cutoff Mastic: As supplied by the roof membrane manufacturer and recommended by the manufacturer's printed data.
d. Membrane Fasteners and Plates: Coated, corrosion-resistant fasteners as recommended and supplied by the PVC roof membrane manufacturer and meeting the requirements of FM 4470 and FM RoofNav (www. roofnav.com) or FM APP GUIDE for Class I roof deck construction and the wind uplift resistance specified. Fasteners and plates to be supplied and warranted for the substrate type(s) by PVC membrane manufacturer and recommended by PVC membrane manufacturer's printed data.
e. Stress Plates, Bar or Rail for Fasteners: Utilize corrosion-resistant stress plates as recommended by the roof membrane manufacturer's printed instructions and meeting the requirements of FM 4470. Stress plates to be supplied by PVC roof membrane manufacturer. Form stress plates to prevent dishing or cupping. Manufacturer-supplied anchoring bar or rails may be utilized for high wind conditions.
f. Auxiliary Fasteners: Provide corrosion resistant screws, nails, or anchors suitable for intended attachment purpose and be recommended and supplied for use by the PVC roof membrane manufacturer.
g. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.
h. Walkpads: Slip-resistant, heat-weldable to membrane meeting requirements of SarnaTred or Tuff-Trac, or approved equal.
i. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate or ASTM C1278/C1278M, fiber-reinforced gypsum board.
    1) Thickness: [1/4 inch (6 mm)] [1/2 inch (13 mm)] [Type X, 5/8 inch (16 mm)].
    2) Surface Finish: [Factory primed] [Unprimed].
    3) Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.
j. Vapor/Air Barrier: Self adhering membrane as supplied by the manufacturer, minimum 32 mil thickness, composed of modified asphalt and factory applied polyethylene film, meeting requirements of Sarnasap Self Adhered by Sarnafil, 725TP by Carlisle, or approved equal.\
k. Primer specifically approved for use with the vapor/air barrier as supplied by the system manufacturer.

Inspection: 1. The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed PVC roofing with the contract requirements. The procedure shall include a checklist of points to be observed. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of substrate.
b. Verification of compliance of materials before, during and after installation.
c. Inspection of insulation, nailers, flashings, penetrations and work requiring coordination with roofing.
d. Inspection of membrane placement, splicing, and attachment.
e. Inspection of placement of walkways.
f. A roofing technician responsible directly to the Contractor and experienced in the construction of PVC roofing systems shall perform the inspection functions and be on the site whenever roofing operations are in progress.

---End of Section---

SECTION 07 60 00.00 48 FLASHING AND SHEET METAL

Scope:
1. Provide flashing and sheet metal components for building construction.
   a. Masonry through-wall flashing.
   b. Metal counter-flashing.
   c. Built-in metal valleys, gutters, and scuppers.
   d. Gutters and downspouts.
   e. Miscellaneous sheet metal accessories.

References:
1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/SPRI/FM 4435 ES-1
Test Standard Edge Systems Used with Low Slope Roofing Systems

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B32	Standard Specification for Solder Metal
ASTM D226/D226M	Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D822/D822M	Standard Practice for Filtered Open Flame Carbon-Arc Exposures of Paint and Related Coatings.
ASTM D 828	Standard Test Method for Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation-Apparatus
ASTM D 1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D4586/D4586M	Standard Specification for Asphalt Roof Cement, Asbestos Free
ASTM E 96/96M	Standard Test Methods for Water Vapor Transmission of Materials

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M Structural Welding Code - Aluminum</RTL>

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Architectural Sheet Metal Manual

General Requirements:
1. Sheet metalwork shall be accomplished to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and shall allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations. Sheet metalwork pertaining to heating, ventilating, and air conditioning is specified in Division 23 HEATING VENTILATING AND AIR CONDITIONING.
2. FM Approvals' Listing: Manufacture and install [copings] [roof-edge specialties] that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, [Class 1-60] [Class 1-75] [Class 1-90] [Class 1-105] [Class 1-120]. Identify materials with FM Approvals' markings.
3. SPRI Wind Design Standard: Manufacture and install [copings] [roof-edge specialties] tested according to SPRI ES-1.

4. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

Submittals: 1. Shop Drawings: Drawings of sheet metal items showing weights, gauges or thicknesses; types of materials; expansion-joint spacing; fabrication details; and installation procedures.

Products: 1. Materials:
   a. Lead or lead-coated metal shall not be used. Any metal listed by SMACNA Arch. Manual for a particular item may be used, unless otherwise specified or indicated. Materials shall conform to the requirements specified below and to the thicknesses and configurations established in SMACNA Arch. Manual. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items shall be copper.
   b. Accessories: Accessories and other items essential to complete the sheet metal installation, though not specifically indicated or specified, shall be provided.
   c. Sheet Materials: ASTM A 653 , Factory coated, galvanized steel, G90, gauge as indicated on the drawings, factory coated with fluoropolymer coating.
   d. Asphalt Roofing Cement: ASTM D4586 Type ll asphalt cement. , minimum
   e. Sealant: Unless otherwise specified, sealant shall be an elastomeric weather resistant sealant as specified in Section 07 90 00.00 48 JOINT SEALERS.
   f. Fasteners: Fasteners shall be compatible with the fastened material and shall be the type best suited for the application.
   g. Felt: ASTM D 226, Type I, minimum
   h. Polyvinyl Chloride (PVC) Reglets: ASTM D1784, Type II, Grade 1, Class 14333-D, 0.075 inch minimum thickness
. i. Solder: ASTM B 32, with 50% lead and 50%..
   j. Through-Wall Flashing
      1) Nonreinforced, waterproof, impermeable extruded elastomeric single ply sheeting not less than 30 mils thick.
      2) Other through-wall flashing material may be used provided the following performance criteria are met.
         a) No cracking or flaking when bent 180 degrees over a 1/32 inch mandrel and rebent at the same point over the same mandrel in an opposite direction at 32 degrees F.
         b) Water vapor permeability not more than 2 perms when tested in accordance with ASTM E 96.
         c) Minimum breaking strength of 90 pounds per inch width in the weakest direction when tested in accordance with ASTM D 828.
         d) No visible deterioration after being subjected to a 400-hour direct weathering test in accordance with ASTM D 822.
         e) No shrinkage in length or width and less than 5 percent loss of breaking strength after a 10-day immersion, per ASTM D 543, in 5 percent (by weight) solutions, respectively, of sulfuric acid, hydrochloric acid, sodium hydroxide or saturated lime (calcium hydroxide).
2. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet, concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.
3. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous metal receiver with integral drip-edge cleat to engage fascia cover [and secure single-ply roof membrane]. Provide matching corner units.
4. Gutters and downspouts shall be designed and fabricated in conformance with SMACNA Arch. Manual.

k. Louvers shall be fabricated in conformance with SMACNA Arch. Manual and as indicated. Unless otherwise specified or indicated, exposed edges shall be folded back to form a 1/2 inch hem on the concealed side, and bottom edges of exposed vertical surfaces shall be angled to form drips.

l. Expansion Joints: Expansion joints shall be provided as specified in SMACNA Arch. Manual. Expansion joints in continuous sheet metal shall be provided at 40 foot intervals for copper and stainless steel and at 32 foot intervals for aluminum, except extruded aluminum gravel stops and fascias which shall have expansion joints at not more than 12 foot spacing. Joints shall be evenly spaced. An additional joint shall be provided where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing.

---End of Section---

SECTION 07 84 00.00 48 FIRESTOPPING

Scope: 1. Firestopping using tested and listed firestop systems to form an effective barrier against the spread of fire, smoke and gases, and to maintain the integrity of fire resistance rated construction

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E119	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E1399/E1399M	Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E 814	Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM 4991	Standard for the Approval of Firestop Contractors
FM APP GUIDE	Approval Guide http://www.fmapprovals.com/approval-guide

UNDERWRITERS LABORATORIES (UL)

UL 723	UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL 1479	Standards for Fire Tests of Through-Penetration Firestops
UL 2079	Standards for Tests for Fire Resistance of Building Joint Systems
UL Fire Resistance	Fire Resistance Directory

Submittals: 1. Shop Drawings: Detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance Directory or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal shall indicate the firestopping material to be provided for each type of application. When more than 5 penetrations or construction joints are to receive firestopping, drawings shall indicate location and type of application.

2. Certificates:
   a. Certificates attesting that firestopping material complies with the specified requirements. In lieu of certificates, drawings showing UL classified materials as part of a tested assembly may be provided. Drawings showing evidence of testing by an alternate nationally recognized independent laboratory may be substituted.
   b. Installer Qualifications: FM Research approved in accordance with FM 4991, operating as a UL Certified Firestop Contractor.

General Requirements:

1. Firestopping shall consist of furnishing and installing tested and listed firestop systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and

vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint. Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above.

Products:

1. Firestopping Materials: Firestopping materials shall consist of commercially manufactured, asbestos-free products complying with the following minimum requirements:
   a. Fire Hazard Classification: Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resistance Directory or by a nationally recognized testing laboratory.
   b. Toxicity: Material shall be nontoxic to humans at all stages of application.
   c. Fire Resistance Rating: Firestopping will not be required to have a greater fire resistance rating than that of the assembly in which it is being placed.
   a. Through-Penetrations: Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479. Fire resistance ratings shall be as follows:
      1) Penetrations of Fire Resistance Rated Walls and Partitions: F Rating = Rating of wall or partition being penetrated.
      2) Penetrations of Fire Resistance Rated Floors, Roof-Ceiling Assemblies and Ceiling-Floor Assemblies: F Rating = one hour, T Rating = one hour.
   b. Construction Joints and Gaps: Fire resistance ratings of construction joints, as described in paragraph GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested per ASTM E 119 or UL 2079 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079.

---End of Section---

SECTION 07 90 00.00 48 JOINT SEALANTS

Scope: 1. Provide sealants at intersection of building components.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1311	Standard Specification for Solvent Release Agents
ASTM C 509	Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 734	Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C 834	Latex Sealants
ASTM C919	Practice for Use of Sealants in Acoustical Applications
ASTM C 920	Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 217	Cone Penetration of Lubricating Grease
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials

General: 1, 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.

Products: 1. Back Stops: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing. Back Stops shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated.
   a. Cylindrical Sealant Backings: ASTM C1330, [Type C (closed-cell material with a surface skin)] [Type O (open-cell material)] [or 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.
2. Bond-Breaker: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.
3. Primer: Primer shall be non-staining type as recommended by sealant manufacturer for the application.
4. Sealant:
   a. Latex: Latex Sealant shall be ASTM C834, Type OP, Grade NF.
   b. Elastomeric: Elastomeric sealants shall conform to ASTM C 920 and the following:
      1) Urethane sealant: Type S, Grade P, Class 25, Use T, Single-component, pourable, plus 25 percent and minus 25 percent movement capability, nontraffic-use; ASTM C920
      2) Silicone sealant: Type S, Grade NS, Class 50, Use NT, M, G, A, and O. Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing; ASTM C920.
5. Acoustical: Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E90.
   a. Use at the perimeter of sound-rated partitions and acoustical ceilings, around window and door openings, at electrical switches and outlets, and elsewhere as required to seal voids and eliminate sound transmission flanking paths by sealing gaps, openings, and joints in sound-rated construction.

b. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.

6. Butyl: Butyl sealant shall be ASTM C1311.
7. Cleaning Agents: Cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

---End of Section---

SECTION 08 11 13.00 48 STEEL DOORS AND FRAMES

Scope: 1. Provide hollow metal doors and door frames, sidelight and transom framing.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASTM INTERNATIONAL (ASTM)

ASTM A 653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A879/A879M	Standard Specification for Steel Sheet, zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
ASTM A 924	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C 591	standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM D 2863	Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.115	Hardware Preparation in Steel Doors and Steel Frames

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 105	Standard for Smoke Door Assemblies and Other Opening Protectives
NFPA 252	Standard Methods of Fire Tests of Door Assemblies
NFPA 80	Standard Test for Fire Doors and Other Opening Protections

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR 111	Recommended Selection and Usage Guide for Standard Steel Doors, Frames and Accessories
SDI/DOOR 113	Determining the Steady State Thermal Transmittance of Steel Door and Frame Assemblies
SDI/DOOR A250.3	Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames
SDI/DOOR A250.4	Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings
SDI/DOOR A250.6	Hardware on Standard Steel Doors (Reinforcement - Application)
SDI/DOOR A250.8	Recommended Specifications for Standard Steel Doors and Frames
SDI/DOOR A250.11	Recommended Erection Instructions for Steel Frames

UNDERWRITERS LABORATORIES (UL)

UL 10C	UL Standard for Safety Positive Pressure Fire Tests of Door Assemblies

Submittals: 1. Shop Drawings: Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.
2. Product Data: Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and

door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI/DOOR A250.8 requirements.

Products:

1. Doors: SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive hardware specified in Section 08 70 00.00 48, DOOR HARDWARE. Doors shall be reinforced at all hardware locations. Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be min. 3'-0" wide by 7'-0" high by 1 3/4 inch thick, unless otherwise indicated. It shall be the Contractor's responsibility to verify that the selected frames meet all performance criteria.
   a. Classification - Level, Performance, Model
      1) Heavy Duty Doors: SDI/DOOR A250.8, Level 2, physical performance Level B, Model 2, with core construction as required by the manufacturer for interior doors and for exterior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation. Provide Level II for all interior doors.
      2) Extra Heavy Duty Doors: SDI/DOOR A250.8, Level 3, physical performance Level A, Model 2 with core construction as required by the manufacturer for all exterior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation. Provide Level 3 for all exterior doors.
      3) Insulated Steel Door Systems: Provide insulated steel doors with a core of polyurethane foam; face sheets, edges, and frames of galvanized steel not lighter than 16 gage; magnetic weatherstripping; nonremovable-pin hinges; thermal-break aluminum threshold; and vinyl door bottom. Provide to doors and frames a phosphate treatment, rust-inhibitive primer, and baked acrylic enamel finish. Test doors in accordance with SDI/DOOR A250.4 and meet the requirements for Level C. Prepare doors to receive specified hardware.
2. Frames: Welded construction with mitered corners; gage as follows:
   a. SDI/DOOR A250.8, Level 2, 16 gauge, .. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, sidelights, mullions, cased openings, and interior glazed panels, unless otherwise indicated. It shall be the Contractor's responsibility to verify that the selected frames meet all performance criteria.
2. Mullions and Transom Bars: Mullions and transom bars shall be closed or tubular construction and shall member with heads and jambs butt-welded thereto or knock-down for field assembly. Bottom of door mullions shall have adjustable floor anchors and spreader connections. Mullions shall be removable where indicated.
3. Stops and Beads: Form stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inches on centers. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.
4. Fire Doors and Frames: NFPA 80. The requirements of NFPA 80 shall take precedence over details indicated or specified. Fire doors and frames shall bear the label of Underwriters Laboratories, Inc. (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10C. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.
5. Astragals: For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08 70 00.00 48 DOOR HARDWARE, provide overlapping steel astragals with the doors. Astragal on Fire and Smoke Doors: On pairs of labeled fire doors, conform to NFPA 80 and UL requirements. On smoke control doors, conform to NFPA 105.
6. Moldings: Provide moldings around glass of interior and exterior doors and louvers of interior doors. Provide nonremovable moldings on outside of exterior doors and on corridor side of

interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings. Muntins shall interlock at intersections and shall be fitted and welded to stationary moldings.

7. Shelves for Dutch Doors: SDI/DOOR 111. Fabricate shelves of steel not lighter than 16 gage. Brackets shall be stock type fabricated of the same metal used to fabricate shelves.Hardware Preparation: Provide minimum hardware reinforcing gages as specified in SDI/DOOR A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI/DOOR A250.8 and SDI/DOOR A250.6. For additional requirements refer to ANSI/DHI A156.115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI/DOOR A250.8, as applicable. Punch door frames, with the exception of frames that will have weatherstripping or lightproof or soundproof gasketing, to receive a minimum of three rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.
8. Finishes: Color shall be as selected by the DB Contractor and accepted by the Government
   a. Factory-Primed Finish: All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in SDI/DOOR A250.8.
   b. Hot-Dip Zinc-Coated and Factory-Primed Finish: Fabricate exterior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A 924/A 924M and ASTM A 653/A 653M. The Coating weight shall meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot total both sides, i.e., A40. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI/DOOR A250.8. Provide for all exterior doors.
   c. Electrolytic Zinc-Coated Anchors and Accessories: Provide electrolytically deposited zinc-coated steel in accordance with ASTM A879/A879M, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI/DOOR A250.8.
9. Louvers: Sight proof, stationary type, 24 gage cold rolled steel in 20 gage frame.

---End of Section---

SECTION 08 11 16.00 48 ALUMINUM DOORS AND FRMES

Scope: 1. Aluminum doors and frames intended for use principally as main entrance and vestibule doors, and for prominent interior doors from lobbies and similar spaces in buildings of public access.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ALUMINUM ASSOCIATION (AA)

AA DAF- 45	Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2603	Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
AAMA 2604	Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE/SEI 7	Minimum Design Loads and Associated Criteria for Building and Other Structures.

ASTM INTERNATIONAL (ASTM)

ASTM A 36	Standard Specification for Carbon Structural Steel
ASTM B 209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM E1886	Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
ASTM E 283	Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 331	Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	Procedure for Determining Fenestration Product U-Factors
NFRC 200	Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

Performance Requirements:

1. Wind Loads: In accordance with ASCE/SEI 7.

2. Air Infiltration: When tested in accordance with ASTM E 283, air infiltration shall not exceed 0.06 cubic feet per minute per square foot of fixed area at a test pressure 6.24 pounds per square foot (50 mile per hour wind).
3. Water Penetration: When tested in accordance with ASTM E331, there can be no water penetration at a pressure of 2.86 pounds per square foot of fixed area.
4. Thermal Transmittance, Solar Heat Gain, Visible Light Transmittance: Provide products bearing NFRC Project Label Certificates for Fenestration verifying compliance with requirements for each assembly indicated.
   a. U-Factor: Provide exterior glazed assemblies, including aluminum entrances doors with greater than 50 percent glazed area, certified and labeled by the NFRC as having a whole window U-factor of [_____] or less as determined in accordance with ASHRAE 90.1 - IP and as verified in accordance with NFRC 100.
   b. Solar Heat Gain Coefficient (SHGC): Provide exterior glazed assemblies, including aluminum entrances doors with greater than 50 percent glazed area, certified by the National Fenestration Rating Council with a whole window SHGC of [_____] or less as determined in accordance with ASHRAE 90.1 - IP and as verified in accordance with NFRC 200.
   c. Visible Light Transmittance (VLT): Provide exterior glazed assemblies, including aluminum entrances doors with greater than 50 percent glazed area, certified by the NFRC with a whole window VLT of [_____] or greater as determined in accordance with ASHRAE 90.1 - IP and as verified in accordance with NFRC 200.
   d. Doors with Less than 50 Percent Glazed Area: For exterior aluminum entrances doors with less than 50 percent glazed area, the glazed area is considered the fenestration area and must be certified by the National Fenestration Rating Council with a whole window U-Factor, SHGC and VLT as required above.

Submittals:
1. Shop Drawings: Show elevations of each door type, size of doors and frames, metal gages, details of door and frame construction, methods of anchorage, glazing details, weatherstripping, provisions for and location of hardware, and details of installation.
2. Manufacturer's Instructions: Submit detail specifications and instructions for installation, adjustments, cleaning, and maintenance.
3. Test Reports: Test reports for Air infiltration and water penetration.
4. Certificates: NFRC Project Label Certificates for Fenestrations.

Products:
1. Anchors: Stainless steel or steel with hot-dipped galvanized finish.
2. Weatherstripping: Continuous wool pile, silicone treated, or type recommended by door manufacturer.
3. Aluminum Alloy for Doors and Frames: ASTM B 221M/ASTM B 221, Alloy 6063-T5 for extrusions. ASTM B 209M/ASTM B 209, alloy and temper best suited for aluminum sheets and strips. It shall be the Contractor's responsibility to verify that the selected frames meet all performance criteria.
4. Fasteners: Hard aluminum or stainless steel.
5. Structural Steel: ASTM A 36/A 36M

Fabrication:
1. Frames: Extruded aluminum shapes with contours approximately as indicated. Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 12 inches o.c. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically. Provide removable mullions were indicated.
2. Aluminum Doors: Of type, size, and design indicated and not less than 1 3/4 inches thick. Minimum wall thickness, 0.125 inch, except beads and trim, 0.050 inch. Door sizes shown are nominal and shall include standard clearances as follows: 0.093 inch at hinge and lock stiles, 0.125 inch between meeting stiles, 0.125 inch at top rails, 0.187 inch between bottom and threshold, and 0.687 inch between bottom and floor. Bevel single-acting doors 0.063 or 0.125

inch at lock, hinge, and meeting stile edges. It shall be the Contractor's responsibility to verify that the selected frames meet all performance criteria.

2. Full Glazed Stile and Rail Doors: Doors shall have medium stiles and rails as indicated. Fabricate from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Fasten top and bottom rail together by means of welding or by 3/8 or 1/2 inch diameter cadmium-plated tensioned steel tie rods. Provide an adjustable mechanism of jack screws or other methods in the top rail to allow for minor clearance adjustments after installation.
3. Flush Doors: Use facing sheets with [a vertical ribbed] [an embossed] [or] [a plain smooth] surface. Use one of the following constructions:
   a. A phenolic resin-impregnated Kraft paper honeycomb core, surrounded at edges and around glass and louvered areas with extruded aluminum shapes. The impregnation of core shall have a minimum of 18 percent resin content. Provide sheet aluminum door facings, not less than 0.032 inch thick laminated to a 0.10 inch thick tempered hardboard backing, and bond the backing to the honeycomb core. Bond facing sheets to core under heat and pressure with a thermosetting adhesive, and mechanically lock to the extruded edge members.
   b. A phenolic resin-impregnated Kraft paper honeycomb core. Use aluminum facing sheets not less than 0.050 inch thick and form into two pans which will eliminate seams on the faces. Bond honeycomb core to the face sheets using an epoxy resin or contact cement-type adhesive.
   c. A solid fibrous core, surrounded at edges and around glass and louvered areas and cross-braced at intermediate points with extruded aluminum shapes. Use aluminum facing sheets of not less than 0.050 inch thickness. Bond facing sheets to core under heat and pressure with a thermosetting adhesive, and mechanically lock to the extruded edge members.
   d. Form from extruded tubular stiles and rails mitered at corners, reinforce, and continuously weld at miters. Facing sheets shall consist of 0.032 inch thick sheet aluminum internally reinforced with aluminum channels or Z-bars placed horizontally not more than 16 inches apart and extending full width of panel. Fit spaces between reinforcing with sound-deadening insulation. Facing sheets shall finish flush with faces of stiles and rails and be welded to reinforcing bars or channels and to stiles and rails.
   e. Form from an internal grid system composed of extruded aluminum tubular sections. Provide extruded aluminum tubular sections at both sides, and at perimeters of louver and glass cutouts. Provide three extruded aluminum tubular sections at top and bottom of door. Wall thickness of tubular sections shall be not less than 0.09 inch except that lock rail shall be not less than 0.125 inch thick, hinge lock rail shall be not less than 0.125 inch thick, and hinge rail edge shall be not less than 0.19 inch thick. Fill spaces in door with mineral insulation. Facing sheets shall be of aluminum not less than 0.09 inch thick.
   f. Form from extruded aluminum members at top and bottom, both sides, and at perimeters of louver and glass cutouts. Wall sections of extruded aluminum members shall be not less than 0.09 inch thick and be properly reinforced for application of hardware. Framing members shall be covered on both sides with aluminum facing sheets not less than 0.064 inch thick. Fill door with foamed-in urethane with a 3 pound density.
4. Welding and Fastening: Where possible, locate welds on unexposed surfaces. Dress welds on exposed surfaces smoothly. Select welding rods, filler wire, and flux to produce a uniform texture and color in finished work. Remove flux and spatter from surfaces immediately after welding. Exposed screws or bolts will be permitted only in inconspicuous locations, and must have countersunk heads. Weld concealed reinforcements for hardware in place.
5. Weatherstripping: Provide on stiles and rails of exterior doors. Fit into slots which are integral with doors or frames. Weatherstripping shall be replaceable without special tools, and adjustable at meeting rails of pairs of doors. Installation shall allow doors to swing freely and close positively. Air leakage of a single leaf weather-stripped door shall not exceed 0.5 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283
4. Hardware is specified in Section 08 70 00.00 48 DOOR HARDWARE. Deliver hardware templates and hardware (except field-applied hardware) to the door manufacturer for use in

fabrication of aluminum doors and frames. Cut, reinforce, drill, and tap doors and frames at the factory to receive template hardware. Provide doors to receive surface-applied hardware, except push plates, kick plates, and mop plates, with reinforcing only; drill and tap in the field. Provide hardware reinforcements of stainless steel or steel with hot-dipped galvanized finish, and secure with stainless steel screws. Provide reinforcement in core of flush doors as required to receive locks, door closers, and other hardware.

5. Provisions for Glazing: Provide extruded aluminum snap-in glazing beads on interior side of doors. Provide extruded aluminum, theft-proof, snap-in glazing beads or fixed glazing beads on exterior or security side of doors, glazing beads shall meet the Minimum Antiterrorism Performance Criteria. Glazing beads shall have vinyl insert glazing gaskets. Design glazing beads to receive glass of thickness indicated or specified. Glazing is specified in Section 08 80 00.00 48 , GLASS.
6. Finishes: Shall be as selected conforming to the following:
   a. Anodic Coating: Clean exposed aluminum surfaces and provide an anodized finish conforming to AA 45. Finish shall be [clear (natural), designation AA-M10-C22-A31, Architectural Class II 0.4 mil to 0.7 mil] [clear (natural), designation AA-M10-C22-A41, Architectural Class I 0.7 mil or thicker)] [integral color-anodized, designation AA-M10-C22-A32, Architectural Class II 0.4 mil to 0.7 mil] [integral color-anodized, designation AA-M10-C22-A42, Architectural Class I 0.7 mil or thicker] [electrolytically deposited color-anodized, designation AA-M10-C22-A34, Architectural Class II 4 mil to 0.7 mil] [electrolytically deposited color-anodized, designation AA-M10-C22-A44, Architectural Class I .7 mil or thicker]. Color shall be as selected and accepted by the Government.
   b. Organic Coating: Clean and prime exposed aluminum surfaces. Provide [a baked enamel finish in accordance with AAMA 2603,.8 with total dry film thickness not less than 0.8 mil] [a high-performance finish in accordance with AAMA 2604, .2 with total dry film thickness of not less than 1.2 mils]. The finish color shall be as selected and accepted by the Government.

---End of Section---

SECTION 08 14 00.00 48 WOOD DOORS

Scope: 1. Provide wood doors and wood panels for transoms.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASTM INTERNATIONAL (ASTM)

ASTM E 2074	Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies

THE ARCHITECTURAL WOODWORK STANDARDS (AWS)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 105	Standard for Smoke Door Assemblies and Other Opening Protectives
NFPA 80	Standard for Fire Doors and Other Opening Protectives
NFPA 252	Standard Methods of Fire Tests of Door Assemblies

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

ANSI/WDMA I.S.1A	Interior Architectural Wood Flush Doors
ANSI/WDMA I.S.6A	Interior Architectural Stile and Rail Doors

UNDERWRITERS LABORATORIES (UL)

UL 10B	Fire Tests of Door Assemblies
UL 10C	Standard for Positive Pressure Fire Test of Door assemblies

Submittals:
1. Shop Drawings: Submit drawings or catalog data showing each type of door unit. Drawings and data shall indicate door type and construction, sizes, thickness, door louvers, and glazing.
2. Product Data: Doors, recycled content for door cores, accessories, sample warranty, STC rating and Fire resistance rating.
3. Samples: Prior to the delivery of wood doors, submit a sample section of each type of door which shows the stile, rail, veneer, finish, and core construction and door finish.
4. Test Reports: Submit cycle-slam test report for doors tested in accordance with ANSI/WDMA I.S.1A, and hinge loading resistance test report for doors tested in accordance with ANSI/WDMA I.S.6A.

Warranty: 1. Warranty shall warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

Products: 1. Wood doors for transparent finish:
   a. Solid core flush wood door with staved lumber or particleboard core Type II, for interior use; conforming to WWDA I.S.1-A with faces of premium grade natural birch, red or white oak, or walnut. Hardwood veneers shall be plain sliced book matched.
   b. Stile and Rail Construction: WDMA I.S.6A Custom Grade, Heavy Duty minimum. Veneered, structural composite lumber or veneered, edge- and end-glued clear lumber. Select veneers for similarity of grain and color, and arrange for optimum match between adjacent pieces. Use veneers not less than 1/16 inch (1.6 mm) thick.
   c. Fire Rated Wood Doors: Doors Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-

protection ratings [and temperature-rise limits]indicated on Drawings, based on testing at positive pressure in accordance with UL 10B, UL 10C, or NFPA 252.

d. Finish: ANSI/WDMA I.S. 1A, TR 6, Premium Grade , Transparent, catalyzed polyurethane, premium quality, satin sheen. Use stain when required to produce the finish specified for color. Seal edges, cutouts, trim, and wood accessories, and apply two coats of finish compatible with the door face finish. Touch-up finishes that are scratched or marred, or where exposed fastener holes are filled, in accordance with the door manufacturer's instructions. Match color and sheen of factory finish using materials compatible for field application.

---End of Section---

SECTION 08 31 13.00 48 ACCESS DOORS AND FRAMES

Scope: 1. Provide access doors for access to valves, controls, and concealed items requiring maintenance.

Products: 1. Non-Fire Rated Access Panels
   a. Flush Style, Gypsum Board Access Panels: 16 ga steel or 0.6 inch extruded aluminum frame with drywall flange and 14 ga steel door panels; concealed continuous steel piano hinge which allows 175 deg. opening; screw driver slot, quarter turn cam lock. Provide manufacturer's standard factory applied baked enamel primer.
      1) Cesco Products, Inc., SR-III.
      2) J.L. Industries, Model WB.
      3) Karp Associates, Inc., Model KDW.
      4) Milcor, Inc., Style DW.
      5) Nystrom, Inc., WB Series
   b. Flush Style, Masonry Access Panels: 16 ga steel or 0.6 inch extruded aluminum frame with drywall flange and 14 ga steel door panels; concealed continuous steel piano hinge which allows 175 deg. opening; screw driver slot, quarter turn cam lock. Provide manufacturer's standard factory applied baked enamel primer.
      1) Cesco Products, Inc., Model W.
      2) J.L. Industries, Model TM.
      3) Karp Associates, Inc., Model DSC-214M.
      4) Milcor, Inc., Style M.
      5) Nystrom, Inc., TM Series.
2. Fire Rated Access Panels
   a. Flush Style, Fire Rated Gypsum Board Wall Access Panels: 16 ga steel door frames and 20 steel door panels; concealed continuous steel piano hinge which allows 175 deg. opening; self closing; recessed turn ring. Provide manufacturer's standard factory applied baked enamel primer.
      1) Cesco Products, Inc., FB.
      2) J.L. Industries, Model FD.
      3) Karp Associates, Inc., Model KRP-150FR.
      4) Milcor, Inc., Fire Rated Access Doors.
      5) Nystrom, Inc., FR Series.

---End of Section ---

SECTION 08 33 13.00 48 METAL COILING COUNTER DOORS

Scope: 1. Provide coiling counter doors at service counters.

References:

1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASTM INTERNATIONAL (ASTM)

ASTM A 240/A240M	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	Standard for Fire Doors and Other Opening Protectives

Submittals:

1. Shop Drawings: Drawings showing elevations of each door type, details of anchorage, details of construction, location and description of hardware, shape and thickness of materials, details of joints and connections, and details of guides and fittings. A schedule showing the location of each counter door shall be included with the drawings.
2. Product Data: Manufacturer's descriptive data and catalog cuts, Manufacturer's preprinted installation and cleaning instructions.
3. Operation and Maintenance Data: Operations and Maintenance Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed. Spare parts data for each different item of material and equipment specified shall be supplied not later than 30 days prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 year and 3 years of service.

Warranty:

1. Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

Products:

1. Rolling counter doors: Standard product of a manufacturer regularly engaged in the production of rolling counter doors. Provide each door with a permanent label showing the manufacturer's name and address and the model number of the door.
2. Curtain: Curtain shall be of extruded aluminum slats conforming to ASTM B221, Alloy 6063 or 22 gauge stainless steel slats conforming to ASTM A240/A240M, Type 304 or Type 430. Provide thickness of slat material as required by width of opening or as required by specified fire-rating. Use slats approximately 1-1/4 to 1-1/2 inch wide with a depth of crown of 1/2 inch. Fit alternate slats with endlocks to maintain curtain alignment. Provide bottom of curtain with angle or tubular bar reinforcement matching the curtain, and fitted with a resilient bottom seal.\
3. Jamb Guides: Furnish guides of 1/8 inch minimum thickness extruded aluminum conforming to ASTM B221, Alloy 6063 or 13 gauge minimum thickness stainless steel conforming to ASTM A240/A240M, Type 304 or Type 430, and fitted with neoprene silencers or replaceable heavy nap striping to eliminate noise and dust infiltration.
4. Counterbalance Shaft Assembly: The curtain shall be coiled around a steel tube of sufficient thickness and diameter to prevent deflection exceeding 0.03 inch per foot. The barrel shall contain oil tempered helical steel torsion springs capable of sufficient torque to counterbalance the weight of the curtain. Springs shall be calculated to provide a minimum of 7,500 operating

cycles (one complete cycle of door operation will begin with the door in the closed position, move to the full open position and return to the closed position).

5. Brackets: Brackets shall be a minimum 12 gauge thickness steel if flat plate, or 16 gauge thickness if there are a minimum of 3 returns of 3/4 inch width.
6. Hood: Provide a hood of 0.040 inch minimum thickness aluminum sheet conforming to ASTM B209, Alloy 5005. or 24 gauge stainless steel conforming to ASTM A240/A240M, Type 304 or Type 430.
7. Locks: The curtain shall be locked at each side of the bottom bar by an integral slide bolt suitable for padlocks by others.
8. Fire-Rated Rolling Counter Doors: shall be rated as required and shall conform to the requirements specified and to NFPA 80 for the class indicated. Doors shall bear the labels of a recognized testing agency indicating the applicable fire resistance rating. The construction details necessary for labeled rolling counter doors shall take precedence over details indicated or specified herein. Door curtains, guides and hood shall be stainless steel. Fire-rated rolling counter doors shall be complete with hardware, accessories, and automatic closing device. Rolling counter doors in exit corridor walls shall be provided with perimeter smoke and draft control gasketing.

Operation:

1. Manual Operation; The curtain shall be operated by means of manual push-up with lift handles or continuous full width lift bar.

Automatic Closing Device:

1. Fire-rated counter doors shall be equipped with an automatic closing device which shall operate upon the fusing of a 165 degree F fusible link and by activation of the building's fire alarm system and smoke alarm system. Fire and smoke doors shall be easily reset by the facility user after they have been released by the detection system. Resetting the door shall not require the use of special tools.

Finish:

1. Exposed parts of the counter door, including the curtain, bottom rail, guides, and hood shall be of uniform finish and appearance. Stainless steel shall have a No. 4 finish. All other, non-exposed, steel parts shall be given a shop coat of primer paint standard with the manufacturer.

---End of Section---

SECTION 08 33 23.00 48 OVERHEAD ROLLING DOORS

Scope: 1. Overhead Rolling doors for commercial use.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE FUN IP Fundamentals Handbook, I-P Edition

ASME INTERNATIONAL (ASME)

ASME B29.400 Combination, "H" Type Mill Chains, and Sprockets

ASTM INTERNATIONAL (ASTM)

ASTM 653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E330/E330M	Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 6	Industrial Control and Systems Enclosures
NEMA MG 1	Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code
NFPA 80	Fire Doors and Other Opening Protectives

Submittals: 1. Shop Drawings: Drawings showing the location of each door including schedules. Drawings shall include elevations of each door type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of guides, power operators, controls, and other fittings.
2. Product Data: Manufacturer's catalog data, test data, and summary of forces and loads on the walls/jambs. Manufacturer's preprinted installation instructions.
3. Samples: Manufacturer's standard color samples of factory applied finishes.
4. Operation and Maintenance Data: Operation Manual, Maintenance and Repair Manual; copies of the system operation manual and system maintenance and repair manual for each type of door and control system.

Warranty: 1. Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

Operation and Maintenance Manuals:

1. Operating instructions outlining the step-by-step procedures required for motorized door and shutter operation for the overhead rolling door unit shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed shall be provided. A complete list of parts and supplies, source of supply, and a list of the high mortality maintenance parts shall be provided.

Products:

1. Overhead rolling doors shall be spring counterbalanced, rolling type, with interlocking slats, complete with guides, fastenings, hood, brackets, and operating mechanisms, and shall be designed for use on openings as indicated. Doors shall be surface-mounted type with guides at jambs set back a sufficient distance to clear the opening. Exterior doors shall be mounted on interior side of walls. Fire doors shall bear the Underwriters Laboratories, Warnock Hersey, Factory Mutual or other nationally recognized testing laboratory label for the rating required. Each door shall be provided with a permanent label showing the manufacturer's name and address and the model/serial number of the door. Doors in excess of the labeled size shall be deemed oversize and shall be provided with a listing agency oversize label, or a listing agency oversize certificate, or a certificate signed by an official of the manufacturing company certifying that the door and operator have been designed to meet the specified requirements.
   a. Wind Load Requirements: Doors and components shall be designed to withstand the minimum design wind load of 20 psf. Doors shall be constructed to sustain a superimposed load, both inward and outward, equal to 1-1/2 times the minimum design wind load. Calculations shall be provided that prove the door design meets the design windload requirements. As an option, test data showing compliance with design windload requirements for the specific door design tested in accordance with the uniform static air pressure difference test procedures of ASTM E 330 shall be provided. Recovery shall be at least 3/4 of the maximum deflection within 24 hours after the test load is removed. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested.
   b. Operational Cycle Life: All portions of the door and door operating mechanism that are subject to movement, wear, or stress fatigue shall be designed to operate through a minimum number of 20,000 cycles. One complete cycle of door operation is defined as when the door is in the closed position, moves to the full open position, and returns to the closed position.
2. Curtains: The curtains shall roll up on a barrel supported at the head of opening on brackets, and shall be balanced by helical torsion springs. Steel slats for doors less than 15 feet wide shall be minimum bare metal thickness of 0.0281 inches. Steel slats for doors from 15 – 21 feet wide shall be minimum bare metal thickness of 0.0344 inches. Steel slats for doors 21 feet wide and wider shall be minimum bare metal thickness of 0.0438 inches. . Slats shall be of the minimum bare metal decimal thickness required for the width indicated and the wind pressure specified above.
3. Non-Insulated Curtains: Curtains shall be formed of interlocking slats of shapes standard with the manufacturer. Slats for exterior doors shall be flat type.
4. Insulated Curtains: Slats shall be filled with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, accordance with ASTM E84. Enclose insulation completely within slat faces on interior surface of slats.. Exterior face of slats shall be gauge as specified for curtains. Interior face shall be not lighter than 0.0219 inches.

Operation:

1. Manual Chain-Hoist Door Operators: Door operators shall consist of an endless steel hand chain, chain-pocket wheel, guard, and a geared reduction unit with a maximum lifting force of 25 lbf. Required pull for operation cannot exceed 35 pounds. Chain hoists shall be a self-locking mechanism allowing the curtain to be stopped at any point in its upward or downward travel and to remain in that position until moved to the fully open or closed position. Provide hand chains

of cadmium-plated alloy steel conforming to ASME B29.400. Ensure yield point of the chain is at least three times the required hand-chain pull.

2. Electric Power Operator with Auxiliary Chain Hoist Operation: Electric power operators shall be heavy-duty industrial type. The unit shall operate the door through the operational cycle life specified. The electric power operator shall be complete with electric motor, auxiliary operation, necessary means of reduction for medium-duty doors, or self-locking worm gear in oil bath for heavy-duty doors, brake, mounting brackets, push button controls, limit switches, magnetic reversing starter, and all other accessories necessary to operate components specified in other paragraphs of this section. The operator shall be so designed that the motor may be removed without disturbing the limit-switches settings and without affecting the emergency chain operator. Doors shall be provided with an auxiliary operator for immediate emergency manual operation of the door in case of electrical failure. Auxiliary operation shall be by means of galvanized endless chain extending to within 3 feet of the floor. The emergency manual operating mechanism shall be so arranged that it may be operated from the floor without affecting the settings of the limit switches. A mechanical device shall be included that will disconnect the motor from the drive operating mechanism when the auxiliary operator is used. Where control voltages differ from motor voltage, a control voltage transformer shall be provided in and as part of the electric power operator system. Control voltage shall not exceed 120 volts.
3. Motors: Drive motors shall conform to NEMA MG 1, shall be high-starting torque, reversible type, and shall be of sufficient wattage and torque output to move the door in either direction from any position at a speed range of 6 to 8 inches per second without exceeding the rated capacity. Motors shall be suitable for operation on 208-230 volts, 60 hertz, 3- phase current and shall be suitable for across-the-line starting. Motors shall be designed to operate at full capacity over a supply voltage variation of plus or minus 10 percent of the motor voltage rating. Motors shall be provided with overload protection.
4. Controls: Control equipment shall conform to NEMA ICS 2. Enclosures shall conform to NEMA ICS 6, Type 12 (industrial use), Type 7 or 9 in hazardous locations, in accordance with NFPA 70. Exterior control stations shall be weatherproof key-operated type with corrosion-resistant cast-metal cover. Each control station shall be of the three position button type, marked "OPEN," "CLOSE," and "STOP." The "OPEN" and "STOP" controls shall be of the momentary contact type with seal-in contact. The "CLOSE" control shall be of the momentary contact type. When the door is in motion and the "STOP" control is pressed, the door shall stop instantly and remain in the stop position; from the stop position, the door shall be operable in either direction by the "OPEN" or "CLOSE" controls. Controls shall be of the full-guarded type to prevent accidental operation. Readily adjustable limit switches shall be provided to automatically stop the doors at their fully open and closed positions.
5. Sensing Edge Device: The bottom edge of electric power operated doors shall have an electric sensing edge for non-hazardous areas that will reverse the door movement upon contact with an obstruction and cause the door to return to its full open position. The sensing edge shall not substitute for a limit switch. Exterior doors shall be provided with a combination compressible weather seal and sensing edge.
6. Electrical Work: Conduit and wiring necessary for proper operation shall be provided under Division 26 ELECTRICAL. Flexible connections between doors and fixed supports shall be made with flexible type SJO cable, except in hazardous locations where wiring shall conform to NFPA 70, as appropriate. The cable shall have a spring-loaded automatic take up reel or a coil cord equivalent device.
7. Inertia Brake: Overhead rolling door shall have a mechanical inertia brake device which will stop the door from free fall in any position, should there be a failure in the motor operator brake or roller chain drive. The unit shall be capable of being reset with a back drive action.
8. Locking: Locking for motor operated doors shall consist of self-locking gearing and optional master keyed cylinder with electrical interlock.

---End of Section---

SECTION 08 34 59.00 48 VAULT DOORS AND DAY GATES

Scope: 1. Armory vault door units meeting the protective storage criteria for armory materials.

Reference: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS AA-D-600 Door, Vault, Security

Submittals: 1. Product Data: Manufacturer's catalog data including catalog cuts and brochures. The data shall show that the proposed Armory vault door unit conforms with the requirements in FS AA-D-00600, and has been tested and approved by the General Services Administration (GSA).
2. Certificates: Certification shall state that Armory vault-door units that do not bear the GSA label are constructed to Class 5 standards.

Products: 1. Armory Vault Door and Frame: Design and construction of the door and frame assembly shall conform to current version of FS AA-D-600. The door shall be Class 5-A, swing, without optical device.
2. Day gate: The day gate shall be the manufacturer's standard product designed for use with the Armory vault door furnished, and shall provide access control and visual security. The gate shall be hinged on the same side as the Armory vault door, shall swing into the vault, and shall have a locking device operable from both sides by key. Day gate shall have lockable pass through sized to support interior arms distribution with interior shelf below pass through.

---End of Section---

SECTION 08 44 00.00 48 GLAZED CURTAIN WALLS

Scope: 1. Complete glazed curtain wall system exclusive of doors, entrances, and store fronts.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ALUMINUM ASSOCIATION (AA)

AA ADM	Aluminum Design Manual
AA ASD1	Aluminum Standards and Data
AA DAF-45	Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA MCWM-1	Metal Curtain Wall Manual
AAMA CW-10	Care and Handling of Architectural Aluminum from Shop to Site
AAMA 501.1	Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure
AAMA 501.4/501.6	Recommended Static Test Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind Induced Interstory Drifts & Recommended Dynamic Test Method for Determining the Seismic Drift Causing Glass Fallout from a Wall System
AAMA 609/610	Cleaning and Maintenance Guide for Architecturally Finished Aluminum
AAMA 611	Voluntary Specification for Anodized Architectural Aluminum
AAMA 800	Voluntary Specifications and Test Methods for Sealants
AAMA/WDMA/CSA 101/I.S.2/A440	North American Fenestration Standard/Specification for Windows, Doors, and Skylights

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.10/A5.10M	Welding Consumables - Wire Electrodes, Wires and Rods for Welding of Aluminum and Aluminum-Alloys – Classification
AWS D1.1/D1.1M	Structural Welding Code – Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A606/A606M	Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
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.
ASTM B136	Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum

ASTM B137	Standard Test Method for Measurement of Coating Mass Per Unit Area on Anodically Coated Aluminum
ASTM B 209/B209M	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221/B221M	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B244	Standard Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments.
ASTM C542	Standard Specification for Lock-Strip Gaskets
ASTM C864	Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM C1363	Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
ASTM E34	Chemical Analysis of Aluminum and Aluminum-Base Alloys
ASTM E283	Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E330/E330M	Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E331	Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E546	Frost Point of Sealed Insulating Glass Units
ASTM E576	Frost Point of Sealed Insulating Glass Units in the Vertical Position

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500 Metal Finishes Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1201 Safety Standard for Architectural Glazing Materials</RTL>

Submittals:
1. Shop Drawings: Submit for curtain wall system, and accessories. Drawings shall indicate in detail all system parts including elevations, full-size sections, framing, jointing, panels, types and thickness of metal, flashing and coping details, field connections, weep and drainage system, finishes, sealing methods, glazing, glass sizes and details, firestopping insulation materials, and erection details.
2. Product Data: Include descriptive literature, detailed specifications, and available performance test data.
3. Design Data: Calculations: Submit structural and thermal calculations for complete wall assembly

Quality Assurance:
1. Testing Requirements: The components listed below shall have been tested in accordance with the requirements below, and shall meet performance requirements specified.
   a. Joint and Glazing Sealants: Perform tests as required by applicable publications referenced.
   b. Preformed Compression Gaskets and Seals: ASTM C864.
   c. Preformed Lock-strip Gaskets: ASTM C542, modified as follows: Heat age specimens seven days at 158 degrees F, in zipped or locked position under full design compression.

Unzip, cool for one hour, re-zip, and test lip seal pressure, which shall be minimum 2.5 pounds per linear inch on any extruded or corner specimen.

d. Anodized Finishes: Stain resistance, coating weight, and coating thickness tests, ASTM B136, ASTM B137, and ASTM B244, respectively.
e. Insulating Glass: ASTM E546 or ASTM E576 at minus 20 degrees F, no frost or dew point.

2. Factory Tests: Perform the following tests except that where a curtain wall system or component of similar type, size, and design as specified for this project has been previously tested, under the conditions specified herein, the resulting test reports may be submitted in lieu of testing the components listed below:
   a. Deflection and Structural Tests: No curtain wall framing member shall deflect, in a direction normal to the plane of the wall, more than 1/175 of its clear span or 3/4 inch, whichever is less, when tested in accordance with ASTM E330/E330M, except that when a plastered surface will be affected the deflection shall not exceed 1/360 of the span. No framing member shall have a permanent deformation in excess of 0.2 percent of its clear span when tested in accordance with ASTM E330/E330M for a minimum test period of 10 seconds at 1.5 times the design wind pressures specified
   b. Water Penetration Test: No water penetration shall occur when the wall is tested in accordance with ASTM E331 at a differential static test pressure of 20 percent of the inward acting design wind pressure as specified, but not less than 4 psf. Make provision in the wall construction for adequate drainage to the outside of water leakage or condensation that occurs within the outer face of the wall. Leave drainage and weep openings in members and wall open during test.
   c. Air Infiltration Test: Air infiltration through the wall, when tested in accordance with ASTM E283, shall not exceed 0.06 cfm per square foot of fixed wall area, plus the permissible allowance specified for operable windows within the test area.
   d. Thermal Conductance Tests: The thermal transmittance of opaque panels shall not exceed specified U-value, when tested in accordance with ASTM C1363.. Determine U-values of components in accordance with ASTM C 1363.
   e. Window Tests: Windows shall meet the requirements specified in Section 08 51 13.00 48 ALUMINUM WINDOWS except where the requirements of this section differ, the more stringent requirements shall govern. Windows shall meet the same requirements for deflection and structural adequacy as specified for framing members when tested in accordance with ASTM E330/E330M except permanent deformation shall not exceed 0.4 percent; there shall be no glass breakage, and no permanent damage to fasteners, anchors, hardware, or operating devices. Windows shall have no water penetration when tested in accordance with ASTM E331.

Glazed Curtain Wall System Requirements:

1. Provide system complete with framing, mullions, trim, glass, glazing, sealants, fasteners, anchors, accessories, concealed auxiliary members, and attachment devices for securing the wall to the structure as specified or indicated.
2. Source: Curtain wall system components shall be furnished by one manufacturer or fabricator; however, all components need not be products of the same manufacturer.
3. Design: Tubular aluminum sections with self supporting framing, factory prefinished, vision glass, related flashings, anchorage, and attachment devices. Mullion profile, horizontal and vertical members thermally broken with interior section insulated from exterior section; matching stops and pressure plate of sufficient size and strength to provide bite on 1 inch insulated glass; drainage holes, deflector plates and internal flashings to accommodate internal weep drainage system, internal mullion baffles to eliminate 'stack effect' air movement within internal spaces. Fully coordinate system accessories directly incorporated, and adjacent to contiguous related work and insure materials compatibility, deflection limitations, thermal movements, and clearances and tolerances as indicated or specified.
4. Thermal Movement: Fabricate, assemble, and erect system with adequate allowances for expansion and contraction of components and fastenings to prevent buckling damage, joint seal failure, glass breakage, undue stress on fastenings or other detrimental effects. For design

purposes, base provisions for thermal movement on assumed ambient temperature range appropriate to the geographic location of the project site

5. Tolerances: Design and erect wall system to accommodate tolerances in building frame and other contiguous work as indicated or specified. Provide with the following tolerances:
   a. Maximum variation from plane or location shown on approved shop drawings: 1/8 inch per 12 feet of length up to not more than /2 inch in any total length.
   b. Maximum offset from true alignment between two identical members abutting end to end in line: 1/16 inch.
6. Structural Requirements: No member shall deflect in a direction parallel to the plane of the wall, when carrying its full design load, more than an amount which will reduce the edge cover or glass bite below 75 percent of the design dimension. No member after deflection under full design load, shall have a clearance between itself and the top of the panel, glass, sash, or other part immediately below it less than 1/8 inch; the clearance between the member and an operable window or door shall be minimum 1/16 inch. Design entire system to withstand a design wind pressure acting inward and outward.

Products:

1. Aluminum: Must be free from defects impairing strength or durability of surface finish. Provide standard alloys conforming to standards and designations of AA ASD1. Special alloys, not covered by the following ASTM specifications, must conform to standards and designations recommended by the manufacturer for the purpose intended.
   .
2. Wrought Aluminum Alloys: Shall be those which include aluminum alloying elements not exceeding the following maximum limits when tested and additional in accordance with ASTM E 34. These limits apply to both bare products and the core of clad products. The cladding of clad products shall be within the same limits except that the maximum zinc limit may be 2.5 percent in order to assure that the cladding is anodic to the core. Special wrought alloys with a silicon content not more than 7.0 percent will be acceptable for limited structural uses where special appearance is required:

ALLOY	PERCENT
Silicon	1.5
Magnesium, Manganese, and Chromium combined	6.0
Iron	1.0
Copper	0.4
Zinc	1.0

3. Within the chemical composition limits set forth above, wrought aluminum alloys shall conform to the following:
   a. Extruded bars, rods, shapes and tubes: ASTM B221.
   b. Sheet and Plate: ASTM B209.
4. Welding Rods and Electrodes: Welding rods and bare electrodes shall conform to AWS A5.10 as recommended by the manufacturer of the aluminum base metal alloy being used.
5. Finish: Finishes shall be as selected by the Architect and accepted by the Government. The following designation of finishes refer to standard finishes as defined in the NAAMM MFM. Colored anodized aluminum shall have a finish designation AA-MIO-C22-A34 and AA-MIOC22-A44, meeting the requirements of AAMA 608.1. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: complying with AAMA 607.1. Painted Aluminum Finish: Thermally cured, multi-coat, fluoropolymer coating containing not less than 70 percent Kynar 500 resin as manufactured by Atochem North America, Inc. and conforming to AAMA 605.2. Galvanizing; Conform to ASTM A 123, ASTM A 153, and ASTM A 653 as applicable.

6. Strength: Aluminum extrusions for framing members used in curtain walls and main frame and sash or ventilator members in windows shall have a minimum ultimate tensile strength of 22,000 psi and a minimum yield strength of 16,000 psi.
7. Steel Sections: Conform to ASTM A36 for structural shapes, plates, and bars.
8. Metal Fasteners: Provide fasteners as specified in paragraph entitled "Fastener Metals for Joining Various Metal Combinations" in "Part 2 - Products" of the AAMA MCWM-1. Metals used for fasteners shall be chemically and galvanically compatible with contiguous materials. Anchoring and fastening devices for antiterrorism curtain walls, including spacing, shall be designed by the manufacturer and included in the Design Analysis and indicated on the Shop Drawings
9. Joint Sealants and Accessories: Provide manufacturer's standard colors as closely matching the adjacent surfaces as possible.
10. Elastomeric, Single or Multiple Component: ASTM C920, Type S, single component or Type M, multiple component. Use Grade NS, nonsag type in joints on vertical surfaces and use Grade P, self-leveling or flow type, in joints on horizontal surfaces.
11. Single Component Silicone Rubber Base: ASTM C920, Type S, Grade NS (Silicone).
12. Solvents and Primers: Provide material which is quick drying, colorless, nonstaining, compatible with compound used, as recommended by sealant manufacturer. Where primer is specified or recommended by sealant manufacturer, tests related to that material shall include primer.
13. Preformed Sealing Compound: Provide nonskinning type conforming to AAMA 800. Tapes, beads, ribbons or other shapes as required.
14. Glass and Glazing: Materials are specified under Section 08 80 00.00 48 GLASS.

---End of Section---

SECTION 08 45 23.00 48 INSULATED TRANSLUCENT FIBERGLASS SANDWICH PANEL

Scope: 1. Transparent and translucent plastic glazing for general and special purpose applications.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution which may be specified in this Section.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 1503	Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
AAMA 2604	Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

ASTM INTERNATIONAL (ASTM)

ASTM C236	Steady-State Thermal Performance of Building Assemblies by Means of Guarded Hot Box
ASTM C920	Elastomeric Joint Sealants
ASTM D1002	Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)
ASTM D 2244	Calculations of Color Differences from Instrumentally Measured Colored Coordinates
ASTM D3841	Glass-Fiber-Reinforced Polyester Plastic Panels.
ASTM E 283	Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 84	Surface Burning Characteristics of Building Materials

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	Procedure for Determining Fenestration Product U-Factors

Submittals: 1. Product Manufacturers: Insulated translucent fiberglass sandwich panel wall/roof system

a. Kalwall Corporation
111 Candia Road
P.O. Box 237
Manchester, NH 03105
Phone: 603-627-3861
Fax: 603-627-7905
www.Kalwall.com

b. Structures Unlimited, Inc.
P.O. Box 5650
Manchester, NH 03108
800-225-3895
www.skylightinfo.com

c. Skywall Translucent Systems
803 Airport Road
P.O. box 629

Terrell, TX 75160
Phone: 972-551-6470
Fax: 972-551-6129
www.Skywall.com

d. Approved equal complying with design intent and all performance and material requirements.

2. Shop Drawings: Submit shop drawings of face sheets and finishes.
3. Product Data: Data composed of catalog cuts, brochures, cleaning directions, and compatible cleaning agents. Manufacturer's installation instructions.
4. Samples: Three samples of each indicated material. Samples of plastic sheets shall be minimum 5 by 7 in.
5. Certificates: Certificates stating that the plastic sheets and glazing material meet the specified requirements.

Warranty: 1. Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

Products: 1. Translucent fiberglass faces shall be manufactured from glass fiber reinforced thermoset resins by insulated system fabricator especially for architectural use. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable. Panel system shall be 2-3/4" thick, made of two (2) sheets of translucent fiberglass, bonded by heat and pressure to either an aluminum or composite grid core specifically for architectural use. Interior and exterior face sheets shall be Crystal.

a. Performance Criteria: Thermal Performance: U factor appropriate for the geographical location of the project when tested in accordance with ASTM C236, ASTM E 1423 and ASTM C 1199. System shall be NFRC certified.
b. Condensation Resistance Factor (CRF): 80 (min) measured on the grid.
c. Light Transmission: As required for geographical location of project.
d. Shading Coefficient: As required for geographical location of project.
e. Air/Water Infiltration: For Water Penetration, system shall be tested per procedures of ASTM E331, and shall show no water entry at WTP=10.00 psf, @ 5.00 gph/ft. squared. Test shall be performed before and after uniform loads are applied. For Air Leakage, system shall be tested per procedures of ASTM E283 and shall show results of no more than 0.01 cfm/ft. squared @ 1.56 psf (25 mph) and 0.01 cfm/ft. squared @ 6.24 psf (50 mph).
f. Color Stability: Exterior face sheets shall not change color more than 3.0 units (Delta E according to ASTM D2244) after five years of weathering. The exterior face shall have a permanent glass erosion barrier integrally embedded to provide maximum long-term resistance to fiber exposure. Sacrificial plastic surface films, coatings or veils not acceptable.
g. Impact Resistance: The exterior panel face shall repel an impact of 60 ft. lbs. without fracture or tear when impacted by 3-1/4" diameter, 5 lb. free-falling ball per

2. Framing Materials: Aluminum frame shall be in accordance with ASTM B 221, 6063-T5, extruded aluminum I-beam sections. The thermally broken (aluminum) I-beam grid core shall be 6063 T6 or 6005 T5 with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I-beam shall be no less than 7/16". The I-beam grid shall be machined to tolerances of not greater than +/- .002". Thermal break shall be 1" minimum. Finishes as specified in Section 08 51 13.00 48 – ALUMINUM WINDOWS.
3. Glazing Tape: Glazing tape shall be fully-cured synthetic rubber, or plastic composition; and shall be unreinforced, 100 percent solid, resilient, nonsagging, nonstaining, and noncrazing. The tape shall be pressure sensitive. The tape shall be capable of sealing out moisture, air, and dust when compressed to the extent recommended by the glazing tape manufacturer for the extensibility requirements of the joint. The tape shall be furnished in the proper width and depth for the particular application in order to obtain the required degree of compression when installed in the joint. The tape shall withstand temperatures of minus 40 degrees F up to 160

degrees F without bleeding, cracking, flowing, or showing signs of deterioration. Tape color shall be aluminum color to match framing.

4. Sealant: Sealant shall conform to ASTM C 920, Grade NS, Class 25; Use G. Sealant shall be gray or neutral color for glazing in wood, steel, or color finished aluminum, and aluminum color for glazing in natural color aluminum.
5. Glazing Accessories: Glazing accessories shall be as required to supplement the items to be glazed including glazing points and spacer shims. Ferrous metal accessories shall have a finish that will not stain or corrode while in service. Spacer shims shall be of material and of dimensions recommended by the plastic sheet manufacturer.
6. Primary and secondary sealants: As recommended by system manufacturer.
7. Condensation Control System: Mechanically design entire condensation control system to function properly with minimal dependency upon sealants.
   a. Perimeter Framing: Two-piece, snap and capture channel.
   b. Weep Holes:
      1). Sill Components: Weep holes located as required to control condensation that may enter system by allowing it to pass to exterior.
      2). Baffles: Weep holes baffled to prevent water infiltration due to unequal pressures

---End of Section---

SECTION 08 51 13.00 48 ALUMINUM WINDOWS

Scope: 1. Provide commercial grade, awning type and fixed, high-performance, aluminum windows, accessories, and screens.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA/WDMA/CSA 101/I.S.2/A440	North American Fenestration Standard Specification for Windows Doors and Skylights.
AAMA 1503	Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
AAMA 2603	Pigmented Organic Coatings on Aluminum Extrusions and Panels
AAMA 2604	High Performance Organic Coatings on Aluminum Extrusions and Panels
AAMA 2605	Superior Performing Organic Coatings on Aluminum Extrusions and Panels
AAMA 611	Anodized Architectural Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A276	Stainless Steel Bars and Shapes
ASTM D3656	Standard Specification Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns
ASTM E283	Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	Procedure for Determining Fenestration Product U-factors
NFRC 200	Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	Life Safety Code

Performance:

1. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
   a. Performance Class: Commercial Window (CW) minimum.
   b. Performance Grade: 30 minimum.
2. Design Loads: ASCE/SEI 7
3. Air Infiltration: Air infiltration for each window type shall not exceed the amount established by AAMA/WDMA/CSA 101/I.S.2/A440
4. Water Penetration: Water penetration for each window type shall not exceed the amount established by AAMA/WDMA/CSA 101/I.S.2/A440

5. Non-residential aluminum windows (including frames and glass) must be certified by the National Fenestration Rating Council with a whole-window Solar Heat Gain Coefficient (SHGC) maximum of [_____] determined according to NFRC 200 procedures and a U-factor maximum of [_____] Btu/hr-ft2-F in accordance with NFRC 100.
6. Condensation Resistance Factor: The condensation resistance factor shall be determined in accordance with AAMA 1503.

4. Life Safety Criteria: Windows shall conform to NFPA 101 Life Safety Code when rescue and/or second means of escape are indicated.

Submittals:
1. Shop Drawings: Drawings indicating elevations of window, rough-opening dimensions for each type and size of window, full-size sections, thicknesses of metal, fastenings, methods of installation and anchorage, connections with other work, type of wall construction, size and spacing of anchors, method of glazing, types and locations of operating hardware, mullion details, weatherstripping details, screen details including method of attachment, and window schedules showing locations of each window type.
2. Product Data: Manufacturer's descriptive data and catalog cut sheets for windows and hardware Manufacturer's preprinted installation instructions and cleaning instructions.
3. Samples: Sample window, Manufacturer's standard color samples of the specified finishes.
4. Test Reports: Reports for each type of aluminum window attesting that identical windows have been tested and meet all performance requirements established under paragraph Performance.
6. Certificates: Certificates stating that the aluminum windows are AAMA certified conforming to requirements of this section. Labels or markings permanently affixed to the window will be accepted in lieu of certificates. Product ratings determined using NFRC 100 and NFRC 200 shall be authorized for certification and properly labeled by the manufacturer.

Qualifications:
1. Window manufacturer shall specialize in designing and manufacturing the type of aluminum windows specified in this section, and shall have a minimum of 5 years of documented successful experience. Manufacturer shall have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

Warranty:
1. Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

Products:
1. Window Types
   a. Provide prime windows that comply with AAMA/WDMA/CSA 101/I.S.2/A440 and the requirements specified herein. In addition to compliance with AAMA/WDMA/CSA 101/I.S.2/A440, window framing members for each individual light of glass must not deflect to the extent that deflection perpendicular to the glass light exceeds L/175 of the glass edge length when subjected to uniform loads at specified design pressures. Provide Structural calculations for deflection to substantiate compliance with deflection requirements. Provide windows of types, performance classes, performance grades, combinations, and sizes indicated or specified Design windows to accommodate hardware, glass, weatherstripping, screens, and accessories to be furnished. Each window must be a complete factory assembled unit with or without glass installed. Dimensions shown are minimum. Provide windows with insulating glass and thermal break necessary to achieve a minimum Condensation Resistance Factor (CRF) of [_____] when tested in accordance with AAMA 1503.
   b. Awning/Hopper/Projected Windows: Designation AP-CW30 type consisting of hinged ventilators arranged in a single or vertical series within a common frame. Ventilators shall be operated by a device which shall securely close the ventilator at both jambs without the use of additional manually-controlled locking device equipped with concealed four-bar friction hinges. Operating hardware, except ventilator arms and rotary operators, shall be concealed within frame and sill. Ventilator arms shall be concealed when windows are closed. Frames shall be not less than 2 1/2 inches frame depth and 2 1/2 inches deep sash, of minimum 1/8 inch thick section. Include locking hardware.

1) Window Materials: Window frames and sash members, mullions, mullion covers, screen frames, and glazing beads must be fabricated in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
2) Provide woven wool pile weatherstripping 0.210 inch thick, conforming to AAMA 701/702, or polypropylene multifilament fiber weatherstripping installed in an integral weatherstripping groove in the sash or frame, and flexible polyvinylchloride weatherstripping installed in the sill member
3) Insect Screens: Insect screens shall be aluminum window manufacturer's standard design, and shall be provided where scheduled on drawings. Insect screens shall be fabricated of roll-formed tubular-shaped aluminum frames conforming to SMA ANSI/SMA 1004 and (18 x 16) aluminum mesh screening conforming with ASTM D 3656.

c. Fixed Windows Type F-CW30

2. Accessories:
   a. Fasteners: Provide concealed anchors of the type recommended by the window manufacturer for the specific type of construction. Anchors and fasteners must be compatible with the window and the adjoining construction. Provide a minimum of three anchors for each jamb located approximately 6 inches from each end and at midpoint.
   b. Hardware: AAMA/WDMA/CSA 101/I.S.2/A440. The item, type, and functional characteristics must be the manufacturer's standard for the particular window type. Provide [stainless steel] hardware of suitable design and of sufficient strength to perform the function for which it is used. Equip all operating ventilators with a lock or latching device which can be secured from the inside.
   c. Window Anchors: Anchoring devices for installing windows must be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA/WDMA/CSA 101/I.S.2/A440.
   d. Glass and Glazing: Aluminum windows shall be designed for inside glazing, field glazing, and for glass types scheduled on drawings and specified in Section 08 80 00.00 48 GLASS. Units
3. Finish: As selected conforming to the following:
   a. Anodized Aluminum Finish: Exposed surfaces of aluminum windows shall be finished with anodic coating conforming to AA DAF-45: [Architectural Class II, AA-M10-C22-A31, clear anodic coating, 0.4 to 0.7 mil, 204-R1 Natural Color] [Architectural Class I, AA-M10-C22-A41, clear anodic coating, 0.7 mil thick, 215-R1 Natural Color] [Architectural Class I, AA-M10-C22-A44, color anodic coating, 0.7 mil or thicker]. Finish shall be free of scratches and other blemishes.
   b. Baked-Acrylic Resin-Based Coating: Exposed surfaces of aluminum windows shall be finished with acrylic resin-based coating conforming to AAMA 603, total dry thickness of 1.0 mils. Finish shall be free of scratches and other blemishes. Color shall be as selected and accepted by the Government
   c. High-Performance Coating: Exposed surfaces of aluminum windows shall be finished with a two-coat fluoropolymer coating system containing at least 70 percent by weight polyvinylidene fluoride, PVF2 resin, factory-applied, oven-baked, conforming to AAMA 605, with a primer coat of 0.20 to 0.30 mils and a color coat of minimum 1.0 mil, total dry film thickness of 1.20 to 1.3 mils. Finish shall be free of scratches and other blemishes. Color shall be as selected and accepted by the Government.

---End of Section---

SECTION 08 70 00.00 48 DOOR HARDWARE

Scope: 1. Provide finish hardware for permanent structures.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283	Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM F 883	Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1	Butts and Hinges
ANSI/BHMA A156.3	Exit Devices
ANSI/BHMA A156.4	Door Controls - Closers
ANSI/BHMA A156.5	Auxiliary Locks & Associated Products
ANSI/BHMA A156.6	Architectural Door Trim
ANSI/BHMA A156.7	Template Hinge Dimensions
ANSI/BHMA A156.8	Door Controls - Overhead Holders
ANSI/BHMA A156.13	Mortise Locks & Latches
ANSI/BHMA A156.15	Closer Holder Release Devices
ANSI/BHMA A156.16	Auxiliary Hardware
ANSI/BHMA A156.18	Materials and Finishes
ANSI/BHMA A156.21	Thresholds
ANSI/BHMA A155.26	Continuous Hinges
ANSI/BHMA A156.31	Electric Strikes and Frame Mounted Actuators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code
NFPA 72	National Fire Alarm and Signaling Code
NFPA 80	Fire Doors and Other Opening Protectives
NFPA 101	Life Safety Code
NFPA 252	Standard Methods of Fire Tests of Door Assemblies

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8	Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL305	Standard for Panic Hardware
UL Bld Mat Dir	Building Materials Directory

Submittals: 1. Shop Drawings:
   a. Manufacturers Detail Drawings
   b. Verification of Existing Conditions
   c. Hardware schedule
   d. Keying system.
2. Product Data: Hardware items
3. Manufacturer's Installation Instructions
4. Operation and Maintenance Data: Operations and Maintenance Manuals

Predelivery Conference:

1. Upon approval of the Hardware Schedule, the Contractor shall arrange a conference with the hardware supplier, the Government and the using agency to determine lock cylinder key requirements. The electronic access control system configuration will be determined, and the location of the software/ computer and key control storage system shall be finalized. Initial system programming of locks and keys shall be finalized.

Products:

1. Template Hardware: Hardware to be applied to metal or to prefinished doors shall be made to template. Promptly furnish template information or templates to door and frame manufacturers. Template hinges shall conform to ANSI/BHMA A156.7. Coordinate hardware items to prevent interference with other hardware.
2. Hardware for Fire Doors And Exit Doors: Provide all hardware necessary to meet the requirements of NFPA 72 for door alarms, NFPA 80 for fire doors and NFPA 101 for exit doors, NFPA 252 for fire tests of door assemblies, ABA/ADA accessibility requirements, and all other requirements indicated, even if such hardware is not specifically mentioned in paragraph HARDWARE SCHEDULE. Such hardware shall bear the label of Underwriters Laboratories, Inc., and be listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the Government.
3. Hardware Items: Hinges, pivots, locks, latches, exit devices, bolts, and closers shall be clearly and permanently marked with the manufacturer's name or trademark where it will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.
   a. Hinges: ANSI/BHMA A156.1, 4 1/2 x 4 1/2 inches unless otherwise specified. Construct loose pin hinges for interior doors and reverse-bevel exterior doors so that pins will be nonremovable when door is closed.
   b. Continuous Hinges: In accordance with BHMA A156.26
   c. Mortise Locks and Latches: ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with escutcheons not less than 7 by 2 1/4 inches with a bushing at least 1/4 inch long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Knobs and roses of mortise locks shall have screwless shanks and no exposed screws. All locksets and latchsets shall have lever handles. Locksets shall be compatible with the Governments standard key system.
   d. Credential Readers: Credential Readers shall be as specified in Division 28 ELECTRONIC SAFETY AND SECURITY.
   e. Electric Strikes: Conform to ANSI/BHMA A156.31, Grade 1.
   f. Magnetic Hold Opens: Magnetic Hold Opens shall be as specified in Division 26 - ELECTRICAL
   g. Exit Devices: ANSI/BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Listed and labeled for panic protection in accordance with UL305
   h. Cylinders and Cores: Cylinders and cores shall have not less than six pin tumblers interchangeable type cores, conforming to ANSI/BHMA A156.5.
   i. Lock Trim: Cast, forged, or heavy wrought construction and commercial grade 1.
   j. Lever Handles: Provide lever handles in lieu of knobs for all locksets and latchsets. Lever handles for exit devices shall meet the test requirements of ANSI/BHMA A156.13 for mortise locks. Lever handle locks shall have a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when a force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Lever handles shall return to within ½ inch of the door face.
   k. Texture: Provide knurled or abrasive coated knobs or lever handles for doors which are accessible to blind persons and which lead to dangerous areas.
   l. Door Bolts: ANSI/BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: ANSI/BHMA A156.3, Type 25.

m. Closers: ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.
   1) Identification Marking: Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.
   2) Closer Holder-Release Devices: Provide door mounted Electromagnetic or electromechanical release devices connected to fire and smoke detecting devices.
n. Overhead Holders: ANSI/BHMA A156.8.
o. Door Protection Plates: ANSI/BHMA A156.6.
   1) Sizes of Mop and Kick Plates: Width for single doors shall be 2 inches less than door width; width for pairs of doors shall be 1 inch less than door width. Height of kick plates shall be 10 inches for flush doors. Height of armor plates shall be not less than 36 inches for flush doors .Height of mop plates shall be 4 inches.
p. Door Stops and Silencers: Wall stops shall conform to ANSI/BHMA A156.16, Type L02251. Silencers Type L03011. Provide three silencers for each single door, two for each pair.
q. Padlocks: ASTM F 883, Type P0-1, Option B, Grade 6. Cylinder type to match building standard. Padlocks shall receive finish to be durable with exterior conditions. Padlocks shall not have removable cores.
r. Thresholds: ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, handicapped accessible, for exterior doors opening out, unless specified otherwise.
s. Weather Stripping: Provide in accordance with ANSI/BHMA A156.22. Set shall include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weather stripped doors shall not exceed 0.5 cubic feet of air per square foot of door area when tested in accordance with ASTM E 283.
   1) Extruded Aluminum Retainers: Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Aluminum shall be clear (natural) anodized.
   2) Rain Drips: Extruded aluminum, not less than 0.08 inch thick, clear anodized. Set drips in sealant conforming to Section 07 90 00.00 48 JOINT SEALERS, and fasten with stainless steel screws. Overhead Rain Drips; approximately 1 1/2 inches high by 2 1/2 inches projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.
t. Special Tools: Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.
u. Fasteners: Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Fasteners exposed to weather shall be of nonferrous metal or stainless steel. Provide fasteners of type necessary to accomplish a permanent installation.
v. Finishes: ANSI/BHMA A156.18. Hardware shall have BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except surface door closers which shall have aluminum paint [prime coat] finish, and except steel hinges which shall have BHMA 652 finish (satin chromium plated) . Hinges for exterior doors shall be stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish. Exit devices may be provided in BHMA 626 finish in lieu of BHMA 630 finish except where BHMA 630 is specified under paragraph entitled "Hardware Sets". Exposed parts of concealed closers shall have finish to match lock and door trim. Hardware for aluminum doors shall be finished to match the doors.
w. Key Control Storage System: Key control storage system for storage of battery powered electronic key shall be a system as recommended by the manufacturer that provides a minimum 26 gauge steel cabinet with a tumbler type locking device and is large enough to store 1000 keys. The cabinet shall be properly labeled for key identification. Set up, identification labeling and location of the key control storage shall be as directed in the Predelivery Conference.

Execution: 1. Hardware shall be located according to SDI/DOOR locations. Electric hardware items and access control devices shall be installed in accordance with manufacturers printed instructions. Program access control system, including keys per government agreement as determined at the Predelivery Conference. All wiring shall be concealed in the wall or ceiling and shall be coordinated with Electrical

Sample Hardware Schedule:

1 Hardware for hollow metal and aluminum doors shall be provided under this section. Deliver Hardware templates and hardware, except field-applied hardware to the aluminum and hollow metal door and frame manufacturer for use in fabricating the doors and frames.

HW-1 (Office, non-rated, single)

1 1/2 Pairs Hinges	A8112 x 652
Lockset	F21
Kickplate	J102 x 630
Wall Bumper	L02251

HW-2 (Office, rated, single)

1 1/2 Pairs Hinges	A8112 x 652
Lockset	F21
Closer	C02011
Kickplate	J102 x 630
Wall Bumper	L02251
Smoke Seals	

HW-3 (Lavatory, rated, single)

1 1/2 Pairs Hinges	A8112 x 652
Lockset	F01
Closer	C02011
Kickplate	J102 x 630
Wall Bumper	L02251
Smoke Seal	

---End of Section---

SECTION 08 80 00.00 48 GLAZING

Scope:

1. Provide glass and glazing for all applications, including without limitation, entrances and storefront, windows, glazed curtain wall, glazed doors, transoms, and sidelights, interior glazed partition walls, mirrors, and glass handrails.

2. Contractor shall comply with anti-terrorism standards requirements in accordance with UFC 4-010-01

References:

1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	Minimum Design Loads for Buildings and Other Structures

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA/WDMA/CSA 101/I.S.2/A440	North American Fenestration Standard Specification for Windows Doors and Skylights.
AAMA 1503	Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections

ASTM INTERNATIONAL (ASTM)

ASTM C1036	Standard Specification for Flat Glass
ASTM C1048	Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass
ASTM C1172	Standard Specification for Laminated Architectural Flat Glass
ASTM C1184	Standard Specification for Structural Silicone Sealants
ASTM C1249	Standard Guide for Secondary Seal for Sealed Insulating Glass Units for Structural Sealant Glazing Applications
ASTM C1369	Standard Specification for Secondary Edge Sealants for Structurally Glazed Insulating Glass Units.
ASTM C509	Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C864	Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM E1300	Standard Practice for Determining Load Resistance of Glass in Buildings
ASTM E1424	Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure and Temperature Differences Across the Specimen.
ASTM E1425	Standard Practice for Determining the Acoustical Performance of Windows, doors Skylight and Glazed Wall Systems.
ASTM E2188	Standard Test Method for Insulating Glass Unit Performance
ASTM E2190	Standard Specification for Insulating Glass Unit Performance and Evaluation.

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual
GANA Sealant Manual
GANA Standards Manual Engineering Standards Manual

INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)

IGMA TB-1200	Guidelines for Insulating Glass Dimensional Tolerances
IGMA TB-3001	Guidelines for Sloped Glazing
IGMA TM-3000	North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	Procedure for Determining Fenestration Product U-Factors
NFRC 200	Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252	Standard Methods of Fire Tests of Door Assemblies
NFPA 257	Standard on Fire Test for Window and Glass Block Assemblies
NFPA 80	Standard for Fire Doors and Other Opening Protectives

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1201	Safety Standard for Architectural Glazing Materials

UNDERWRITERS LABORATORIES (UL)

UL 752	Standard for Bullet-Resisting Equipment

Submittals:
1. Product Data: Glass and glazing accessories; Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.
2. Shop Drawings: Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.
3. Certificates: Certificates stating that the glass meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.
4. Samples: Samples of the following: insulating glass units, spandrel glass, etched glass.

Warranty:
1. Manufacturer shall warrant the insulating glass to be free of fogging or film formation on the internal glass surfaces caused by failure of the hermetic seal for a period of 10 years from Date of Substantial Completion. Warranty shall be signed by manufacturer.

System description:
1. Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E 1300. All exterior glazing shall be laminated glass, the interior pane of insulated glass shall be laminated.

Product:
1. Glass: ASTM C1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

3. Clear Float Glass : Clear float glass shall be Type I transparent flat type, Class 1-clear, Quality q3 - glazing select, conforming to ASTM C1036 minimum 1/4 inch thick.
4. Wired Glass : Wired glass shall be 1/4 inch minimum thickness Type II flat type, Class 1 - translucent, Quality q8 - glazing, Form 1 - wired and polished both sides. Wire mesh shall be polished stainless steel Mesh 1 - diamond. Wired glass for fire-rated windows shall bear an identifying UL label or the label of a nationally recognized testing agency, and shall be rated for 45 minutes when tested in accordance with NFPA 257. Wired glass for fire-rated doors shall be tested as part of a door assembly in accordance with NFPA 252.
5. Fire/Safety Rated Glass Fire/safety rated glass must be laminated Type I transparent flat type, Class 1-clear. Glass rating, as required when tested in accordance with ASTM E119. Glass must be permanently labeled with appropriate markings.
6. Insulating Glass: Insulating glass shall be Class A preassembled units of dual-seal construction consisting of lites of glass separated by an aluminum, steel, or stainless steel, spacer and dehydrated space conforming to ASTM E2190. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.
7. Low Emissivity Insulating Glass: Low emissivity coating shall be on the air space surface of the inner pane of glass (the number 3 surface) in heating-dominated buildings, and on the number 2 surface (inside surface of the exterior pane) in cooling-dominated buildings.
8. Laminated Glass: ASTM C1172, Kind LA fabricated from two nominal minimum 1/8 inch pieces of Type I, Class 1, Quality q3, flat annealed transparent glass conforming to ASTM C1036. Flat glass must be laminated together with a minimum of 0.030 inch thick, clear polyvinyl butyral interlayer with a total nominal thickness of 1/4 inch.
9. Heat-Treated Glass: Heat-treated glass shall conform to the following requirements.
   a. Tempered glass shall be 1/4 inch minimum thickness kind FT fully tempered transparent flat type, Class 1-clear, for interior applications and laminated for exterior windows and vestibules, Condition A uncoated surface, Quality q3 - glazing select, conforming to ASTM C 1048 and GANA Standards Manual.
   a. Tempered etched glass shall be 1/4 inch minimum thickness kind FT fully tempered transparent flat type 1, Class 2, obscured, Grade B, for interior applications Quality q3, sandblasted or acid etched - glazing select, conforming to ASTM C1048 and GANA Standards Manual. Provide pencil polished edges. Color shall be as selected.
   b. Ceramic-opacified insulated spandrel glass shall be kind HS heat-strengthened transparent flat type, Condition B, coated with a colored ceramic material on No. 3 surface, Quality q3 - glazing select, conforming to ASTM C 1048, low-emissivity coating on No. 2 surface . . Interior pane shall be laminated. Total thickness shall be 1 inch. Color shall be as selected.
10. Mirrors: Glass for mirrors shall be Type I transparent flat type, Class 1-clear, Glazing Quality q1 1/4 inch thick conforming to ASTM C 1036. Glass color shall be clear. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint , and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.
11. Glazing Accessories:
    a. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated.
    b. Sealant: Sealant shall be elastomeric conforming to ASTM C 920, Type S or M, Grade NS, Class 12.5, Use G, of type chemically compatible with setting blocks, preformed sealing

tape and sealants used in manufacturing insulating glass. Color of sealant shall be as selected to match adjacent surface.

1) Structural Sealant ASTM C1184, Type S.

c. Glazing Gaskets: Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as indicated on drawings.

d. Fixed Glazing Gaskets: Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C509, Type 2, Option 1.

e. Wedge Glazing Gaskets: Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C 864, Option 1, Shore A durometer between 65 and 75.

f. Aluminum Framing Glazing Gaskets: Glazing gaskets for aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

g. Putty and Glazing Compound: Provide glazing compound as recommended by manufacturer for face-glazing metal sash. Putty must be linseed oil type. Do not use putty and glazing compounds with insulating glass or laminated glass.

h. Setting and Edge Blocking: Closed-cell neoprene setting blocks must be dense extruded type conforming to ASTM C509 and ASTM D395, Method B, Shore A durometer between 70 and 90. Edge blocking must be Shore A durometer of 50 (plus or minus 5). Provide silicone setting blocks when blocks are in contact with silicone sealant. Profiles, lengths and locations must be as required and recommended in writing by glass manufacturer. Block color must be black.

---End of Section---

SECTION 08 90 00.00 48 LOUVERS AND VENTS

Scope: 1. Provide wall louvers and vents, screens, frames and accessories.:

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-L	Laboratory Methods of Testing Louvers for Rating
AMCA 511	Certified Ratings Program for Air Control Devices

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2603	Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
AAMA 2604	Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
AAMA 2605	Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
AAMA 611	Voluntary Specification for Anodized Architectural Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

Products: 1. Galvanized Steel Sheet: ASTM A653/A653M, coating designation G90 (Z275).
2. Aluminum Sheet: ASTM B209, alloy 3003 or 5005 with temper as required for forming.
3. Extruded Aluminum: ASTM B221, alloy 6063-T5 or -T52.
4. Metal Wall Louvers:
   a. Weather resistant type, with bird screens and made to withstand a wind load as required for location of project. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-L and AMCA 511. The rating shall show a water penetration of 0.20 or less ounce per square foot of free area at a free velocity of 800 feet per minute.
   b. Louver frame shall be channel shaped with welded corner joints and a frame depth as selected.
   c. Louver blade design shall be sloped at 45 degrees, reinforced with intermediate stiffeners, and integral and lateral rain water stops positioned on blade.
   d. Extruded Aluminum Louvers: Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 0.081 inch.
   e. Mullions and Mullion Covers: Same material and finish as louvers. Provide mullions where indicated. Provide mullions covers on both faces of joints between louvers.

f. Screens and Frames: For aluminum louvers, provide 1/2 inch square mesh, 14 or 16 gage aluminum or ¼ inch square mesh, 16 gage aluminum bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2. Fasteners and Accessories: Provide stainless steel screws and fasteners for aluminum louvers and zinc-coated or stainless steel screws and fasteners for steel louvers. Provide other accessories as required for complete and proper installation.
3. Finishes: Aluminum; Provide factory-applied organic coating. Organic Coating: Clean and prime exposed aluminum surfaces and apply a baked enamel finish conforming to AAMA 603.8, 0.8 mil minimum dry film thickness, color shall be as selected by the Architect and accepted by the Government.

---End of Section---

SECTION 09 29 00.00 48 GYPSUM BOARD

Scope: 1. Provide gypsum drywall work including metal support systems:
a. Interior walls, partitions, and ceilings.
b. Exterior ceilings and soffits.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 341 Seismic Provisions for Structural Steel Buildings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11 Interior Installation of Cementitious Backup Units

ASTM INTERNATIONAL (ASTM)

ASTM A580/A580M	Standard Specification for Stainless Steel Wire
ASTM A853	Standard Specification for Steel Wire, Carbon, for general Use.
ASTM B164	Standard Specification for Nickel-Copper Alloy Rod, Bar and Wire
ASTM C1002	Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
ASTM C1047	Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C1177/C1177M	Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C1178/C1178M	Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel
ASTM C1396/C1396M	Standard Specification for Gypsum Board
ASTM C1629/C1629M	Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels
ASTM C475/C475M	Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C514	Standard Specification for Nails for the Application of Gypsum Board
ASTM C557	Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing
ASTM C645	Nonstructural Steel Framing Members
ASTM C754	Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C840	Standard Specification for Application and Finishing of Gypsum Board
ASTM C954	Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness

GYPSUM ASSOCIATION (GA)

GA 214	Recommended Levels of Gypsum Board Finish
GA 216	Application and Finishing of Gypsum Board
GA 253	Application of Gypsum Sheathing
GA 600	Fire Resistance Design Manual

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance Directory

System Description:

1. Fire-Resistive Construction: For fire-resistive assemblies, drawing details must follow the tested and approved designs. Tested and approved designs are published by gypsum wallboard manufacturers, Underwriters Laboratory, and Factory Mutual, and are included in the Gypsum Association Fire Resistance Design Manual.
2. Comply with specified fire-rated assemblies for design numbers indicated per UL Fire Resistance or FM APP GUIDE
2. Seismic Requirements: For lateral supports of partitions and suspended ceilings required for seismic bracing, in accordance with AISC 341and to meet applicable codes, ordinances and regulations

Products:

1. Non-Loadbearing Stud Walls: ASTM C645, but not thinner than 0.0179 inch thickness, with 0.0329 inch minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures.
2. Suspended and Furred Ceiling Systems ASTM C645
3. Furring Structural Steel Columns ASTM C645. Steel (furring) clips and support angles listed in UL Fire Resistance may be provided in lieu of steel studs for erection of gypsum wallboard around structural steel columns.
4. Z-Furring Channels with Wall Insulation: The depth specified for Z-furring channels should be coordinated with the R-value specified for wall insulation thickness. Not lighter than 26 gage galvanized steel, Z-shaped, with 1-1/4 inch and 3/4 inch flanges
3. Gypsum Board: Gypsum board shall be asbestos-free. Gypsum board shall have square-cut ends, tapered or beveled edges and shall be maximum possible length. Gypsum board thickness shall be as shown.
   a. Standard Gypsum Board: Regular gypsum board shall conform to ASTM C 1396, and shall be 4 feet wide.
   b. Fire-Rated Gypsum Board: Fire-rated gypsum board shall conform to ASTM C 1396, and shall be Type X or Type C as required, 4 feet wide.
   c. Water-Resistant Gypsum Backing Board: Water-resistant gypsum board shall conform to ASTM C1396/C1396M, regular or Type X where required for fire rating, with water-resistant paper faces, paintable surfaces, and shall be 4 feet width and maximum permissible length.
   d. Mold Resistant / Anti-Microbial Gypsum ASTM D3273 48 inch wide, tapered edges.
   e. Exterior Sheathing Board: Exceeds properties of ASTM C1396/C1396M and ASTM C1177/C1177M. Minimum 1/2 inch, gypsum sheathing. Provide gypsum board of with a noncombustible water-resistant core, with glass mat surfaces embedded to the gypsum core or reinforcing embedded throughout the gypsum core. Warrant gypsum sheathing board for at least twelve months against delamination due to direct weather exposure.
   f. Glass-Mat Water-Resistant Gypsum Tile Backing Board: Glass mat water-resistant gypsum backing panels shall conform to ASTM C 1178, Type X where required for fire rated construction, shall have a water-resistant core with water and mold/mildew resistant fiberglass faces imbedded into the core and shall have square edges thickness shall be as indicated on the drawings or as required for fire rating.
4. Shaftwall liner panel shall conform to UL Fire Resistance. Liner Panel shall be specifically manufactured for cavity shaftwall system, with water-resistant paper faces, bevel edges, single lengths to fit required conditions, 1 inch thick, by 24 inches wideTrim, Moldings, And Accessories:
   a. Taping and embedding compound shall conform to ASTM C 475. Compound shall be specifically formulated and manufactured for use in embedding tape at gypsum wallboard joints and fastener heads, and shall be compatible with tape and substrate.

b. Finishing or topping compound shall conform to ASTM C 475. Compound shall be specifically formulated and manufactured for use as a finishing compound for gypsum board.
c. All-purpose compound shall be specifically formulated and manufactured to use as a taping and finishing compound, and shall be compatible with tape and substrate.
d. Joint tape shall conform to ASTM C 475 and shall be as recommended by gypsum board manufacturer.

5. Trim, Control Joints, Beads, Stops and Nosings: Items used to protect edges, corners, and to provide architectural features shall be in accordance with ASTM C 1047.
6. Fastening and Adhesives:
   a. Screws: Screws shall conform to ASTM C 1002. Screws shall be self-drilling and self-tapping steel, Type G for gypsum board to gypsum board and Type S for wood or light-gauge steel framing.
   b. Adhesives: Adhesives shall conform to ASTM CASTM557. Adhesives shall be formulated to bond gypsum board to wood framing members. For securing gypsum board to metal framing, adhesive shall be as recommended by gypsum board manufacturer.
   c. Hangers: Suspended ceiling runner channel hangers shall be soft, annealed steel wire not less than No. 8 SWG, conforming to ASTM A 853.
   d. Wire and Clip Type Fastenings: Tie wire, clips, rings, and other fastenings shall be corrosion-resisting steel conforming to ASTM A580/A580M, composition 302, 304, or 316, Condition A, or nickel-copper alloy conforming to ASTM B164, annealed condition except that walls, partitions, and other vertical surfaces not incorporated in ceiling construction may be erected with soft, annealed steel conforming to ASTM A 853.
   e. Tie Wire: Tie wire for constructing partitions and vertical furring, for securing metal lath to supports, and for lacing shall be not less than No. 18 SWG. Tie wire for other applications shall be not less than No. 16 SWG.
   f. Clips: Clips used in lieu of tie wire for securing the furring channels to the runner channels in ceiling construction shall be made from strip not less than 1/8 inch thick or shall be hairpin clip, formed of wire not less than 0.01620 inch nominal diameter. Other clips and rings or fastenings of similar materials shall be equivalent in holding power to that provided by tie wire for the specific application.
7. Cementitious Backer Units: Cementitious backer units shall comply with ANSI A118.9, for adhesive applied ceramic tile in wet areas (tubs, shower enclosures, saunas, steam rooms, gang shower rooms), specify only cementitious backer units in accordance with the Tile Council of America (TCNA) Handbook.

2. Execution: 1. Steel framing and furring members shall be installed in accordance with ASTM C 754Suspended ceiling system framing shall be installed in accordance with ASTM C 754.
3. Main runner channels shall be installed in accordance with ASTM C 754.
4. Furring channels shall be spaced in accordance with ASTM C 754.
5. Gypsum board shall be installed in accordance with ASTM C 840, GA 214 and GA 216 and as specified. Paragraph 17.3.1 GENERAL of ASTM C 840 which permits usage of water resistant gypsum board as a base for adhesive application of ceramic or plastic tile on ceilings, does not apply
6. Two-Ply Gypsum Board: Second layer of gypsum board shall be applied perpendicular to first layer with joints staggered and secured with mechanical fasteners or adhesive. The use of adhesive shall be in accordance with ASTM C 840.
7. Trim, moldings and accessories shall be installed in accordance with GA 216.
8. Finish: Gypsum board shall be finished in accordance with ASTM C 840, GA 214 and GA 216. Plenum areas above ceilings shall be finished to Level 1 in accordance with GA 214. Water resistant gypsum backing board, ASTM C 630/C 630M, to receive ceramic tile shall be finished to Level 2 in accordance with GA 214. Walls and ceilings to receive a heavy-grade wall covering or heave textured finish before painting shall be finished to Level 3 in accordance with GA 214. All other walls and ceilings shall be finished to Level 4 in accordance with GA 214
9. Cementitious backer units shall be installed in accordance with ANSI A108.11. Fasteners shall be the type designed for cement board application.

10. Gypsum wallboard construction for fire-rated assemblies shall be in accordance with UL Fire Resist Dir, or GA 600, indicate design number on drawings.

---End of Section---

SECTION 09 30 00.00 48 CERAMIC TILE

Scope: 1. Provide ceramic, porcelain and quarry tile work for walls and floors.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A136.1	American National Standard Specifications for Organic Adhesives for Installation of Ceramic Tile
ANSI A137.1	American National Standards Specifications for CeramicTile
ANSI A137.2	American National Standards Specifications for Glass Tile<

ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C1026	Standard Test Method for Measuring the Resistance of Ceramic and Glass Tile to Freeze-Thaw Cycling
ASTM C1027	Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C1178/C1178M	Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150/C150M	Standard Specification for Portland Cement
ASTM C206	Standard Specification for Finishing Hydrated Lime
ASTM C207	Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C241	Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C373	Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products
ASTM C648	Standard Test Method for Breaking Strength of Ceramic Tile
ASTM C650	Standard Test Method for Resistance of Ceramic Tile to Chemical Substrates.
ASTM C847	Standard Specification for Metal Lath

MARBLE INSTITUTE OF AMERICA (MIA)

MIA Design Manual	Dimension Stone Design Manual

TILE COUNCIL OF NORTH AMERICA (TCNA)

TCNA Handbook	Handbook for Ceramic Tile, Glass and Stone Tile Installation

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines

Warranty: 1. Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

Products:

1. Tile shall be standard grade conforming to ANSI A137.1. Containers shall be grade sealed. Seals shall be marked to correspond with the marks on the signed master grade certificate. Tile shall be impact resistant with a minimum breaking strength for wall tile of 90 lbs and 250 lbs for floor tile in accordance with ASTM C648. Tile for cold climate projects shall be rated frost resistant by the manufacturer as determined by ASTM C1026. Water absorption shall be 0.50 maximum percent in accordance with ASTM C373. Floor tile shall have a dynamic coefficient of friction not less than 0.42 in accordance with ANSI A137.1. Floor tile shall be unglazed, Class III-Medium Heavy Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C1027 for abrasion resistance as related to foot traffic. Tile size and color shall be as selected by the Architect and accepted by the Government.
2. Mosaic Tile: Ceramic mosaic tile and trim shall be unglazed porcelain with pressed cushioned edge. Water absorption not to exceed 0.5% per ASTM C373 test method. Mosaic's to be mounted into sheets to facilitate handling and installation. Tile, size and color shall be as selected by Architect and accepted by the Government.
3. Quarry Tile: Quarry tile and trim shall be unglazed with non-slip surface, finish shall not be abrasive or contain metal particles. Tile size and color shall be as selected by the Architect and accepted by the Government.
4. Porcelain Tile: Porcelain tile and trim shall be unglazed with color extending uniformly through the body of the tile. Meet. Tile to be resistant to chemicals per ASTM C650. Tile size and color shall be as selected by the DB Contractor and accepted by the Government.
5. Glazed Wall Tile: Glazed wall tile and trim shall be non-vitreous with either semi-gloss or matte glaze. Edge of tile to be cushioned and lugged. Tile size and color shall be as selected by the DB Contractor and accepted by the Government.
6. Setting-Bed: The setting-bed shall be composed of the following:
   a. Aggregate for Concrete Fill: Aggregate shall conform to ASTM C33. Maximum size of coarse aggregate shall not be greater than one-half the thickness of concrete fill.
   b. Portland Cement: Cement shall conform to ASTM C150, Type I, white for wall mortar and gray for other uses.
   c. Sand: Sand shall conform to ASTM C144.
   d. Hydrated Lime: Hydrated lime shall conform to ASTM C206, Type S or ASTM C207, Type S.
   e. Metal Lath: Metal lath shall be flat expanded type conforming to ASTM C847, and weighing not less than 2.5 pounds per square yard.
   f. Reinforcing Wire Fabric: Wire fabric shall conform to ASTM A1064/A1064M. Wire shall be either 2 x 2 inch mesh, 16/16 wire or 1-1/2 x 2 inch mesh, 16/13 wire.
   g. Water: Water shall be potable
   a. Mortar, grout, and adhesive shall conform to the following. Dry-Set Portland Cement Mortar: Conform to TCNA Handbook.
   b. Conductive Dry-Set Mortar: Conform to TCNA Handbook.
   c. Latex-Portland Cement Mortar: Conform to TCNA Handbook.
   d. Ceramic Tile Grout: Conform to TCNA Handbook.; latex-Portland cement grout.
   e. Organic Adhesive: Conform to TCNA Handbook., Type I, water resistant.
   f. Epoxy and / or Furan Resin Grout: If required, conform to TCNA Handbook.
   g. Color(s) shall be as selected by the DB Contractor and accepted by the Government.
7. Cementitious backer units, for use as tile substrate over wood sub-floors, in accordance with TCNA Hdbk. Furnish 1/2 inch thick cementitious backer units.
8. Glass Mat Gypsum Backer Panel: Glass mat water-resistant gypsum backer board, for use as tile substrate over walls, shall be in accordance with ASTM C1178/C1178M. Glass mat gypsum backer board shall be 1/2 inch thick.
9. Thresholds: Thresholds shall be of size required by drawings or conditions.
   a. Marble shall be Group A as classified by MIA Design Manual. Marble shall have a fine sand-rubbed finish and shall be white in color as accepted by the Government. Marble abrasion shall be not less than 12.0 when tested in accordance with ASTM C 241.

b. Acrylic Thresholds and Reducer Strips: Poured acrylic solid surfacing material, in accordance with Section 06 16 06.00 48

---End of Section---

SECTION 009 50 00 ACOUSTICAL CEILINGS

Scope: 1. Provide acoustical ceilings, hangers and metal suspension system.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASTM INTERNATIONAL (ASTM)

ASTM C635/C635M	Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C636/C636M	Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E1264	Acoustical Ceiling Products
ASTM E1414/E1414M	Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
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
ASTM E795	Standard Practices for Mounting Test Specimens During Sound Absorption Tests</RTL>ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials

General Requirements:

1. Acoustical treatment shall consist of sound controlling units mechanically mounted on a ceiling suspension system. The unit size, texture, finish, and color shall be specified.

Seismic Requirements:

1. For lateral support of ceiling suspension systems required for seismic bracing, construct the Work as specified herein and in compliance with applicable codes, ordinances, and regulations. Comply with requirements of ASTM E580 for installation of ceiling suspension systems requiring seismic restraint.

Warranty: 1. Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided. Standard performance guarantee or warranty shall contain an agreement to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

Extra Materials:

1. Spare tiles of each color shall be furnished at the rate of 10 percent of the units in the original pattern and lot as installed.

Products: 1. Acoustical units: Acoustical units shall conform to ASTM E 1264, Class A, and the following requirements:
   a. (EXAMPLE) Units for Exposed-Grid System: Type: III (mineral fiber with painted finish), wet felted. Type III acoustical units shall have a minimum recycled material content of 18 percent.
   b. Minimum NRC: 0.55 when tested on mounting No. E-400
   c. Pattern: Fissured, non-directional
   d. Nominal size: 24” x 24”.
   e. Edge detail: Tegular/reveal with beveled edge.
   f. Finish: Factory-applied vinyl latex paint, non-directional. Color: White.

g. Minimum LR coefficient: 0.80.
h. Minimum CAC: 35.

2. Suspension System: Suspension system shall be standard exposed-grid standard width flange or as indicated, and shall conform to ASTM C635 for intermediate-duty systems. Surfaces exposed to view shall be aluminum or steel with a factory-applied white baked-enamel finish. Wall molding shall have a flange of not less than15/16 inch. Inside and outside corner caps. Standard corners shall be provided. Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of 1/360 of span length. Seismic details shall conform to the guidance in ASTM E580.
3. Hangers: Hangers shall be galvanized steel wire. Hangers and attachment shall support a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.
4. Ceiling Attenuation Class and Test: Ceiling attenuation class (CAC) range of acoustical units, when required, shall be determined in accordance with ASTM E1414. Test ceiling shall be continuous at the partition and shall be assembled in the suspension system in the same manner that the ceiling will be installed on the project. System shall be tested with all acoustical units installed.

---End of Section---

SECTION 009 65 00.00 48 RESILIENT FLOORING

Scope:
1. Provide resilient flooring and base.
2. Interlocking athletic flooring tiles.

References:
1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASTM INTERNATIONAL (ASTM)

ASTM D4078	Water Emulsion Floor Polish
ASTM E648	Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F1066	Standard Specification for Vinyl Composition Floor Tile
ASTM F150	Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring
ASTM F1344	Rubber Floor Tile
ASTM F1700	Standard Specification for Solid Vinyl Floor Tile
ASTM F1861	Standard Specification for Resilient Wall Base
ASTM F2034	Sheet Linoleum Floor Covering
ASTM F2169	Standard Specification for Resilient Stair Treads

Fire Resistive Testing Requirements:
1. Provide a minimum average critical radiant flux of 0.22 watts per square centimeter for flooring in corridors and exits when tested in accordance with ASTM E648.

Warranty:
1. Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

Extra Materials:
1. Extra flooring material of each color and pattern shall be furnished at the rate of 5 percent of total of each color shall be furnished. Extra materials shall be from the same lot as those installed. Extra base material composed of 15 ft. of each color shall be furnished.

Products:
1. Static Dissipative Vinyl: Static Dissipative Vinyl Tile shall conform to ASTM F1066, Class 2, (through pattern tile), Composition 1, asbestos- free or shall conform to ASTM F1700 Class I (monolithic vinyl tile), Type A. Tile shall have an Electrical Resistance of 10e6 to 10e9 in accordance with ASTM F150. Tile shall have the color and pattern uniformly distributed throughout the thickness of the tile. Flooring in any one continuous area shall be from the same lot and shall have the same shade and pattern. Tile size, pattern, and color shall be as selected by the DB Contractor and accepted by the Government.
2. Solid Vinyl Tile with an embossed surface. Solid vinyl tile shall conform to ASTM F1700 Class I, Type B. Tile size, pattern, and color shall be as selected by the DB Contractor and accepted by the Government.
3. Luxury Vinyl Tile: Conform to ASTM F1700 Class III printed film with a minimum wear layer thickness 0.030 inch and minimum overall thickness 0.118 inch with non-slip/skid backing, Type A (smooth) or B (embossed). Provide tile with a factory protective finish that enhances cleanability and durability. Tile size, pattern, and color shall be as selected by the DB Contractor and accepted by the Government.
4. Sheet Linoleum: Conform to ASTM F2034 and consist of a homogeneous layer of a mixture of linoleum cement (binder in linoleum consisting of a mixture of linseed oil, pine rosin, fossil, or other resins or rosins, or an equivalent oxidized oleoresinous binder), cork and/or wood flour, mineral fillers, and pigments bonded to a jute backing. Provide a minimum 6 feet wide and overall thickness not less than 0.100 inch for linoleum. As required, provide welding rods as recommended by the manufacturer for heat welding of joints. Size, pattern, and color shall be as selected by the DB Contractor and accepted by the Government

5. Rubber Flooring Type: Rubber tile shall conform to ASTM F1344 Class I homogeneous construction Type A or Type B.
   a. Rubber athletic floor tile designed specifically for athletic training rooms. Product to be cushioned, and have a waterproof finish suitable to be wet mopped. with square-shaped, raised surface pattern. Tiles to interlock below top surface. Provide related beveled border transition tiles as required for complete floor. Tile size, pattern, and color shall be as selected by the DB Contractor and accepted by the Government.
   b. Stair Treads, Risers, And Stringers; Conform to ASTM F2169, Type TS (vulcanized thermoset rubber) or Type TP (thermoplastic rubber). Conform to ASTM F2169 for surface of treads Class 2 raised round or square or diamond pattern and have Group 2 strip for visually impaired of contrasting color of abrasive material. Provide square or round nosing. Provide either a one piece nosing/tread/riser or a two piece nosing/tread design with a matching coved riser. Size pattern and color as selected by DB Contractor and accepted by the Government.
   c. Resilient Base: Conform to ASTM F1861 Type TS (vulcanized thermoset rubber) or Type TP (thermoplastic rubber), Style A (straight - installed with carpet), and Style B (coved - installed with resilient flooring), Provide minimum 4 inch high and 1/8 inch thick wall base.. Color shall be as selected by the DB Contractor and accepted by the Government.
6. Transition Strip: A rubber transition strip tapered to meet abutting material shall be provided. Color shall be as selected by the DB Contractor and accepted by the Government.
7. Adhesive: Adhesive for flooring and wall base shall be as recommended by the flooring manufacturer.
8. Polish: Polish shall conform to ASTM D4078.

---End of Section ---

SECTION 09 67 00.00 48 FLUID APPLIED FLOORING

Scope: 1. Industrial resin based flooring for areas requiring spill containment and where chemical spills are likely or for explosive or ammunition facilities.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C722 Standard Specification for Chemical-Resistant Monolithic Surfacing

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3 Commercial Blast Cleaning

Products:
1. Trowel or spray applied, epoxy, polyester, or other resinous material conforming to ASTM C 722 with Type A surfacings (chemical resistance and moderate to heavy traffic resistance). Chemical resistance shall be as indicated.
2. Protective Top Coat: Shall be as recommended by the base coat manufacturer.
3. Chemical Resistance: Industrial resin-based flooring shall be chemically resistant based on a 7 day total immersion test for the following chemicals: Sulfuric acid, phosphoric acid, acetic acid, and sodium hydroxide at 50 percent solution.
4. Primer: Primer shall be a material recommended by the industrial resin-based flooring manufacturer which will penetrate the pores of the substrate and bond with the topping to form a permanent monolithic bond between the substrate and the topping.
5. Resin: Resin shall be suitable for the type application indicated.
6. Fillers: Fillers, if required, shall be inert silica, quartz or other hard aggregate material as recommended by the flooring manufacturer. Fillers shall be furnished in the quantity necessary to impart the required color and physical characteristics. The filler shall contain sufficient fines to provide an even-textured, nonslip type of surface on the finished topping.
7. Sealer: Sealer shall be a product recommended by the industrial resin-based flooring manufacturer. When applied to the resin topping and dry, it shall be nonslip and resistant to staining.
8. Wall Base: Self-coving shall consist of industrial resin-based flooring coved up at the base 12 inches high minimum or as required for containment. Coved base shall be the same thickness as the flooring.

Testing 1. Liquid Retention: When required, and after the system is cured, the membrane on horizontal and vertical surfaces shall be tested by flooding the entire waterproofed area with water for a period of 24 hours. There shall be no water added after the start of the period. Measure water level at the beginning and at the end of the 24 hour period. If the water level falls, remove the water and inspect the special coating system. Leak sites shall be marked, dried, and repaired, and the test shall be repeated.

---End of Section---

SECTION 09 68 00.00 48 CARPETING

Scope: 1. Modular carpet tile and entrance modular carpet tile.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution which may be specified in this Section.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC TM 16	Test Method: Colorfastness to Light
AATCC TM 107	Test Method: Colorfastness to Water
AATCC TM 134	Test Method: Electrostatic Propensity of Carpets
AATCC TM 165	Test Method: Colorfastness to Crocking: Carpets - AATCC Crockmeter Method
AATCC TM 174	Antimicrobial Activity Assessment of Carpets

AMERICAN NATIONAL STANDARDS INSTITUTE

NSF/ANSI 140	Environmental Standards for carpet and floor covering based on life cycle analysis testing

ASTM INTERNATIONAL (ASTM)

ASTM D 297	Rubber Products – Chemical Analysis
ASTM D 418	Pile Yarn Floor Covering Construction
ASTM D 1423	Twist in Yarns by Direct-Counting
ASTM D 1667	Flexible Cellular Materials – Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam)
ASTM D 3278	Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM D 3676	Rubber Cellular Cushion Used for Carpet or Rug Underlay
ASTM D 5252	Practice for the Operation of the Hexapod Tumble Drum Tester
ASTM D 5417	Practice for Operation of the Vettermann Drum Tester
ASTM D 5793	Binding Sites Per Unit Length or Width of Pile Yarn Floor Coverings
ASTM D 5848	Mass per Unit Area of Pile Yarn Floor Coverings
ASTM E 648	Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM E 2129	Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 2471	Standard Test Method for Use of Seeded Agar for Screening Assessment of Antimicrobial Activity in Carpet

CARPET AND RUG INSTITUTE (CRI)

CRI 104	Commercial Carpet Installation Standard

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 2551	Machine-made Textile Floor Coverings – Determination of Dimensional Changes Due to the Effect of Varied Water and Heat Conditions (AACHEN Test)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS SS-W-40	Wall Base: Rubber, and Vinyl Plastic

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1630	Standard for the Surface Flammability of Carpets and Rugs (FF 1-70)
40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

Quality Assurance:

1. Installation Provider:
   a. The Contractor shall be responsible for the quality of the completed floorcovering installation, including both the quality of the materials and labor used in the installation. The Contractor shall warrant to owner that all products, materials and services related to the floorcovering installation, including any floorcovering(s), adhesive(s) and/or other products or materials used in the installation, meet specifications set forth herein.

Submittals:

1. Shop Drawings: Three copies of drawings indicating areas receiving carpet, carpet types, textures and patterns, direction of pile, location of seams, and locations of edge molding.
2. Quality Assurance:
   a. Manufacturer:
      (1.) Commitment to quality: Three copies of verification of carpet manufacturer's registration to the ISO 9001 / 9002 Quality Management System
      (2.) Commitment to Sustainability: Three copies of verification of carpet manufacturer's environmental responsibility through programs of source reduction, recycling, reuse and conservation, and registration to the ISO 14001 Environmental Management System
   b. Installation Provider:
      (1.) Three copies of verification showing that the installation provider has minimum 5 year experience in successful carpet installation experience similar to the work of this Section.
3. Product Data:
   a. Three copies of the carpet manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory.
      (1) Fiber Verification – Certification from the fiber producer verifying use of the premium branded, type 6,6 or type 6 fiber in the submitted carpet product. Fiber must have a cross-section modification ratio no greater than 2.5.
   b. Three copies of the carpet manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.
   c. Regulatory Requirements: Three copies of report stating that carpet contains recycled materials and/or involvement in a recycling or reuse program. Report shall include percentage of recycled material.
4. Samples:
   a. Carpet: Three "Production Quality" samples minimum 18 inches x 18 inches (or full carpet tile size whichever is larger) of each carpet proposed for use, showing quality, pattern, and color specified. If carpet pattern is extended across multiple carpet tiles, three "sets of carpet tile shall be provided with the "set" of carpet tiles equal to the numbers of full size carpet tiles needed to fully show the carpet pattern.
   b. Rubber, Vinyl or Aluminum Moldings: Three pieces of each type proposed for use, showing quality, pattern, and color specified, at least 12 inches long.
   c. Special Treatment Materials: Three samples of each type proposed for use, showing quality, pattern, and color specified, at least 12 inches long showing system and installation method
5. Test Reports: Moisture and Alkalinity Tests: Three copies of test reports of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.
6. Certificates:
   a. Certificates of compliance from a laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards and Technology attesting that

each type of carpet and carpet with cushion material conforms to the standards specified.
   b. Regulatory Requirements: Report stating that the carpet contains recycled materials and indicating the actual percentage of recycled material.
   c. Installation provider's proof of insurance, copy of contractor's license and worker's compensation certificate.
7. Installation References; Five current project references for installation provider, with scope, date and customer contact with telephone number in compliance letter.
8. Reclamation Plan: A reclamation plan shall be submitted providing directions for the reclamation of all carpet at the job which is be returned to the carpet manufacturer for use in their reclamation / recycling methods.
10. Operation and Maintenance Data: Operations and Maintenance Manuals will be submitted in accordance with the requirements of specification Three copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles

Warranty:
1. Manufacturer's standard performance guarantees or warranties including minimum fifteen (15) year wear warranty. The product warranty required herein must be provided directly by the carpet manufacturer.
   a. Wear - Surface fiber wear shall not be more than 10% by weight in 15 years. (Note: Wear warranty shall not require use of chair pads)
   b. Static - Static generation at less than 3.0 kV at 70º F, and 20% R.H.
   c. No delamination
   d. No edge ravel
   e. No dimensional instability (i.e., shrinkage, curling and doming) which adversely affect the ability of the tile to lay flat
2. Carpet and Rug Institute NVLAP: Submit manufacturer's CRI NVLAP certified test results to show that carpet meets or exceeds product performance specification criteria for carpet testing requirements.

Extra Material:
1. Extra material from same dye lot / run consisting of full size carpet tiles shall be provided for future maintenance. A minimum of 5 percent of total square feet of each carpet type, pattern, and color and 20 lineal feet of base shall be provided.

Products:
1. Carpet Type: Carpet shall be first quality; free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains; and shall have adequate yarn coverage, be free of any yarn voids and other physical and manufacturing defects. Carpet materials and treatments shall be reasonably nonallergenic and free of other recognized health hazards. All grade carpets shall have a static control construction which gives adequate durability and performance.
2. Physical Characteristics
   a. Carpet Construction: Tufted
   b. Type: Carpet Tile
   c. Pile Type: Level-loop or Multilevel Texture loop
   d. Pile or Wire Thickness: Minimum .113 inches in accordance with ASTM D 418
   e. Gauge or Pitch: Minimum 1/10 per inch in accordance with ASTM D 418
   f. Stitches or Rows/Wires: Minimum 9 per sq. in.
   g. Finished Pile Yarn Weight: Minimum 20 ounces per square yard. This does not include weight of backings. Weight shall be determined in accordance with ASTM D 418.
   h. Pile Density: Minimum 6000
   i. Dye Method: Solution dyed
   j. Backing Materials: Primary backing materials shall be those customarily used and accepted by the trade for each type of carpet. Secondary backing to suit project requirements shall be those customarily used and accepted by the trade for each type of carpet. Secondary Backing shall contain minimum 30 percent post consumer and/or post industrial material content. Secondary backing must be 100 percent recyclable into carpet tile backing at the end of its useful life. 100 percent Virgin PVC shall not be used in

secondary backing.

k. Antimicrobial: Antifungal and Antibacterial ASTM E 2471 Standard Test Method for Use of Seeded Agar for Screening Assessment of Antimicrobial Activity in Carpet. Minimum allowable growth ratings for a "passing result" on washed and unwashed carpet samples after 72 hours incubation are complete to partial inhibition (high) on shaven primary and unshaven fiber layers. Or, if AATCC 174 Parts 2&3 (AATCC 171 Washed) is used, must pass both Part 2 and Part 3 of AATCC 174 with a minimum of 90% reduction both gram negative and gram positive bacteria and no macroscopic growth against the fungi. The antimicrobial preservative shall be incorporated into the product during the manufacturing process, not topically applied to the carpet.

m. Attached Cushion for Command Suites only: Provide an attached cushion for Command Suites only. Do not exceed the maximum ash content of 50 percent when tested in accordance with ASTM D 297. Pass the accelerated aging test in accordance with [ASTM D 3676] [ASTM D 1667] for the cushion.

1) Chemically frothed polyurethane with minimum weight of 18 oz/sq. yard, minimum density of 11 lb/cubic foot with minimum 30 percent post-consumer recycled content.
2) Mechanically frothed polyurethane with minimum weight of 22 oz/sq. yard, minimum density of 14 lb/cubic foot, minimum thickness of 0.100 inch, and maximum compression resistance of 5 psi, and compression set of 15 percent in accordance with ASTM D 3676, with minimum 30 percent post-consumer recycled content.
3) Ethylene vinyl acetate (EVA) with minimum weight of 28 oz/sq. yard, minimum thickness of 0.150 inch, and minimum density of 15 lb/cubic foot and a maximum compression set of 15 percent in accordance with ASTM D 1667, minimum 30 percent recycled content.
4) Polyvinyl chloride (PVC) with minimum weight of 28 oz/sq. yard, minimum thickness of 0.150 inch, and minimum density of 15 lb/cubic foot and a maximum compression set of 15 percent in accordance with ASTM D 1667, minimum 30 percent recycled content.
5) Minimum 30 percent recycled urethane foam.

3. Adhesives, Installation Connectors and Concrete Primer: Concrete primers for installation of carpet shall be waterproof, nonflammable, meet local air-quality standards, and shall be as required by the carpet manufacturer. Adhesives for installation of carpet shall be waterproof, nonflammable, meet local air-quality standards, and shall be as required by the carpet manufacturer. Seam adhesive shall be waterproof, nonflammable, and non-staining as recommended by the carpet manufacturer. Release adhesive for modular tile carpet shall be as recommended by the carpet manufacturer. Adhesives flashpoint shall be minimum 140 degrees F in accordance with ASTM D 3278. Installation Connectors shall be compounded acrylic adhesive, applied to polyester backing with polyester release liner (clear three inch by three inch polyester squares with small quantity of a pressure sensitive adhesive applied on one side of the polyester film). The squares connect the carpet modules together to form a stable surface over almost any hard surface. The connectors shall contain no liquid components and shall have "zero" calculated VOC's.
4. Rubber or Carpet Base: Minimum four inch high Rubber Base per Section 09 65 00.00 48 RESILIENT FLOORING. Color as indicated. Carpet Wall Base shall be minimum four inch high, surged edge, cut from roll stock. Color shall match carpet.
5. Molding/Transition Strip: Molding and transition strips for the type of carpet being installed shall be provided. Molding and transition strips shall be heavy-duty rubber or homogeneous composition of polyvinyl chloride (PVC), high quality additives, and colorants. Floor flange shall be a minimum 2 inch wide. Transition strips shall be tapered to meet abutting materials. Color shall match carpet.
6. Installation Connectors: Installation Connector squares used to connect carpet modules together shall be as recommended by the carpet manufacturer for the type of carpet modules used in installation.
7. Color, Texture and Pattern: Color, textures, and patterns shall be as selected by the Architect and approved by the Government.

Performance Requirements:

1. Appearance Retention Rating (ARR). The end-use application of a carpet will determine carpet wear classification and ARR. For commercial carpet, ARR evaluation is based on a 12,000-cycle Hexapod drum test performed in accordance with ASTM D5252, *Standard Practice for the Operation of the Hexapod Drum Tester*. Commercial carpets shall have a rating of:
   •• Heavy: Classification has a 3.0–3.5 ARR.
   • Severe: Classification has a 3.5–4.0 ARR.

   The ARR scale must be used in accordance with the recommended practice outlined in CRI TM-101, *Assessment of Carpet Surface Appearance Change Using the CRI Reference Scales*.
2. Static Control: Static control shall be provided to permanently control static buildup to less than 3.5 kV when tested at 20 percent relative humidity and 70 degrees F in accordance with AATCC TM 134.
3. Flammability and Critical Radiant Flux Requirements: Comply carpet with 16 CFR 1630. Carpet in corridors and exits shall have a minimum average critical radiant flux of 0.45 watts per square centimeter when tested in accordance with ASTM E 648
4. Tuft Bind: Tuft bind force required to pull a tuft or loop free from carpet backing shall be a minimum 10 pound average force for loop pile 3 pound average force for cut pile.
5. Colorfastness to Crocking: Dry and wet crocking shall comply with AATCC TM 165 and shall have a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.
6. Colorfastness to Light: Colorfastness to light shall comply with AATCC TM 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and shall have a minimum 4 grey scale rating after 40 hours.
7. Colorfastness to Water: Comply colorfastness to water with AATCC 107 and with a minimum 4.0 gray scale rating and a minimum 4.0 transfer scale rating.
8. Delamination Strength: Delamination strength for tufted carpet with a secondary back shall be minimum of 2.5 lbs./inch
9. Antimicrobial: Nontoxic antimicrobial treatment in accordance with AATCC 174 Part I (qualitative), guaranteed by the carpet manufacturer to last the life of the carpet.
10. Moisture and Alkalinity Tests: Concrete slab shall be tested for moisture content and excessive alkalinity in accordance with CRI 104.

---End of Section---

SECTION 09 72 00.00 48 WALL COVERINGS

Scope: 1. Provide acrylic PTEG sheet at locations indicated

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D543	Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM E84	Test Method for Surface Burning Characteristics of Building Materials.

Products: 1. Acceptable Manufacturer Products; Manufacturers names, model numbers, and colors are given to establish a standard of quality and to clarify the designers intent and are not intended to limit selection of similar products from acceptable manufacturers. The following manufacturer products are specifically mentioned in this specification:

2. Construction Specialties, Acrovyn, Engineered PETG: Rigid sheet should be high-impact Acrovyn 4000 with standard Suede texture, nominal .040" (1.02mm) thickness. Chemical and stain resistance should be per ASTM D543
   a. Color, Texture and Pattern: Color, textures, and patterns shall be as selected by the DB Contractor and accepted by the Government.
3. Accessories:
   a. Adhesive: Acrovyn wall covering shall be furnished as a complete packaged system, including appropriate standard adhesive.

---End of Section---

SECTION 09 90 00 PAINTS AND COATINGS

Scope: 1. Provide painting and surface preparation for all unfinished interior and exterior surfaces, including electrical and mechanical equipment.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100DOC	Documentation of Threshold Limit Values and Biological Exposure Indices

ASTM INTERNATIONAL (ASTM)

ASTM D 235	Standard Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D 523	Standard Test Method for Specular Gloss
ASTM D 4263	Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4444	Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters
ASTM F 1869	Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI	MPI Architectural Painting Specification Manual

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SP-01	Environmentally Preferable Product Specification for Architectural and Anti-Corrosive Paints

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	Shop, Field, and Maintenance Painting
SSPC PA Guide 3	A Guide to Safety in Paint Application
SSPC VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC VIS 3	Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool CleaningSSPC VIS 4/NACE VIS 7 Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting
SSPC SP 1	Solvent Cleaning
SSPC SP 2	Hand Tool Cleaning
SSPC SP 3	Power Tool Cleaning
SSPC SP 6/NACE No.3	Commercial Blast Cleaning
SSPC SP 7/NACE No. 4	Brush-Off Blast Cleaning
SSPC SP 10/NACE No. 2	Near-White Blast Cleaning

SSPC SP 12/NACE No. 5
Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultra High-Pressure Water Jetting Prior to Recoating

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 Safety and Health Requirements Manual

Applicator's Qualifications:

1. Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three similar projects within the past three years. List information by individual and include the following:
   a. Name of individual and proposed position for this work.
   b. Information about each previous assignment including:
      1) Position or responsibility
      2) Employer (if other than the Contractor)
      3) Name of facility owner
      4) Mailing address, telephone number, and telex number (if non-US) of facility owner
      5) Name of individual in facility owner's organization who can be contacted as a reference
      6) Location, size and description of structure
      7) Dates work was carried out
      8) Description of work carried out on structure

Quality Assurance:

1. Field Samples and Tests: The Government may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that conform to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.
   a. Sampling Procedure: The Government will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one liter samples of the selected paint materials. The samples shall be taken in the presence of the Government, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.
   b. Testing Procedure: Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.
      1) Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

Regulatory Requirements:

1. Environmental Protection: In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Government of any paint specified herein which fails to conform.
2. Lead Content: Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.
3. Chromate Content: Do not use coatings containing zinc-chromate or strontium-chromate.
4. Asbestos Content: Materials shall not contain asbestos.
5. Mercury Content: Materials shall not contain mercury or mercury compounds.
6. Silica: Abrasive blast media shall not contain free crystalline silica.
7. Human Carcinogens: Materials shall not contain ACGIH 0100Doc confirmed human carcinogens (A1) or suspected human carcinogens (A2).

Safety And Health:

1. Apply coating materials using safety methods and equipment in accordance with the following:
   a. Comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS and in Appendix A of EM 385-1-1. Include in the Activity Hazard Analysis the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone..
   b. Safety Methods Used During Coating Application: Comply with the requirements of SSPC PA Guide 3.
   c. Toxic Materials: To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:
      1) The applicable manufacturer's Safety Data Sheets (SDS) or local regulation.
      2) 29 CFR 1910.1000.
      3) ACGIH 0100, threshold limit values.

Color Selection:

1. Colors of finish coats shall be as selected by the Architect and accepted by the Government. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.
2. Tint each coat progressively darker to enable confirmation of the number of coats.
3. Color, texture, and pattern of wall coating systems shall be as selected.

Location and Surface Type to be Painted:

1. Painting Included: Where a space or surface is indicated to be painted, include the following unless indicated otherwise.
   a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.
   b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.
   c. Existing coated surfaces that are damaged during performance of the work.
2. Exterior Painting: Includes new surfaces of the buildings and appurtenances as indicated. Also included are existing coated surfaces made bare by cleaning operations.
3. Interior Painting: Includes new surfaces of the buildings and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.
   a. Exposed columns, girders, beams, joists, and metal deck; and
   b. Other contiguous surfaces.
4. Painting Excluded: Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.
b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.
c. Steel to be embedded in concrete.
d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.
e. Hardware, fittings, and other factory finished items.

5. Mechanical and Electrical Painting: Includes field coating of interior and exterior new surfaces.
   a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.
      1) Exposed piping, conduit, and ductwork
      2) Supports, hangers, air grilles, and registers;
      3) Miscellaneous metalwork and insulation coverings.
   b. Do not paint the following, unless indicated otherwise:
      1) New zinc-coated, aluminum, and copper surfaces under insulation
      2) New aluminum jacket on piping
      3) New interior ferrous piping under insulation.

Definitions and Abbreviations:

1. MPI Gloss Levels: MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.
2. Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

   Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).
3. MPI System Number: The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

Products: 1. Conform to the coating specifications and standards referenced in Paint Table (below).

Preparation:

1. General Requirements: Surfaces shall be clean, dry, and free from contaminants and foreign matter. Mildew and chalking shall be removed and the surface thoroughly sterilized. Chipped, peeling, or blistered paint shall be removed and the surface spot primed. Hard glossy surfaces shall be dulled and roughened to ensure proper adhesion.
2. Ferrous Surfaces: Surfaces shall be free from dirt, oil, grease, wax, and other contaminants. Heavy rust and loose mill scale shall be removed by hand, power tool, or blast cleaning.
3. Galvanized Surfaces: Surfaces shall be cleaned of all contaminants using a solvent such as lacquer thinner or xylol. After cleaning, the surface shall be etched with a phosporic acid pre-treatment solution.
4. Non-Ferrous Metallic Surfaces: Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces: Surfaces shall be clean, dry, and free from oil and grease. Oxide

film and corrosion shall be removed by hand or power tool cleaning. Concrete and Masonry: Surfaces shall be free from dirt, oil, grease, wax, form-release compounds, laitance, and other contaminants. Cracks, voids, and other major surface imperfections shall be filled with mortar.

6. Gypsum Board, Plaster, and Stucco: Surfaces shall be clean and dry. Cracks and other surface imperfections shall be filled with spackling compound and sanded smooth. 7. New Plywood and Wood Surfaces, Except Floors: Surfaces shall be clean, dry, smooth, and free from oil, grease, and dirt. Knots shall be sealed with a mixture of equal parts of shellac and alcohol. Nail holes, cracks, and other defects shall be filled with plastic wood or putty. Concealed surfaces shall be back-primed before installation.

Application: 1. Coating Application: Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA

a.. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

Piping Identification:

1. Piping Identification, Including Surfaces In Concealed Spaces: Stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inch high elsewhere.

Paint Table:

1. Exterior Paint Table

Division 5: Exterior Metal, Ferrous and Non-Ferrous Paint Table

Steel / Ferrous Surfaces

New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

Alkyd
New; MPI EXT 5.1Q-G5 (Semigloss)/ Existing; MPI REX 5.1D-G5

Primer:	Intermediate:	Topcoat:
MPI 23	MPI 94	MPI 94

System DFT: 5.25 mils

New Steel that has been blast-cleaned to SSPC SP 6/NACE No. 3:

Alkyd
New; MPI EXT 5.1D-G5 (Semigloss) / Existing; MPI REX 5.1D-G5

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 94	MPI 94

System DFT: 2.25 mils

New steel blast cleaned to SSPC SP 10/NACE No.2:

Waterborne Light Industrial
MPI EXT 5.1R-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 110-G5

System DFT: 8.5 mils

Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations.:

Alkyd Floor Enamel
MPI EXT 5.1S-G6 (Gloss)

Primer: Intermediate: Topcoat:
MPI 79 MPI 27 MPI 27 (+NSA)
System DFT: 5.25 mils

Exterior Galvanized Surfaces

New Galvanized surfaces:

Waterborne Primer / Waterborne Light Industrial Coating
MPI EXT 5.3J-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 134 MPI 110-G5 MPI 110-G5
System DFT: 4.5 milss

Galvanized surfaces with slight coating deterioration; little or no rusting:

Waterborne Light Industrial Coating
MPI REX 5.3J-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 134 N/A MPI 110-G5
System DFT: 4.5 mils

Galvanized surfaces with severely deteriorated coating or rusting:

Waterborne Light Industrial Coating
MPI REX 5.3L-G5(Semigloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 108 MPI 163
System DFT: 8.5 mils

Exterior Surfaces, Other Metals (Non-Ferrous)

Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment. Match surrounding finish:

Alkyd
MPI EXT 5.4F-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 94 MPI 94
System DFT: 5 mils

Surfaces adjacent to painted surfaces; Mechanical, Electrical, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

Alkyd
MPI EXT 5.1D-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 94 MPI 94
System DFT: 5.25 mils

Hot metal surfaces subject to temperatures up to 205 degrees C (400 degrees F):

Heat Resistant Enamel
MPI EXT 5.2A

Primer: Intermediate: Topcoat:
MPI 21 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer

Ferrous metal subject to high temperature, up to 400 degrees C (750 degrees F):

Inorganic Zinc Rich Coating
MPI EXT 5.2C
Primer: Intermediate: Topcoat:
MPI 19 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer

Heat Resistant Aluminum Enamel
MPI EXT 5.2B (Aluminum Finish)
Primer: Intermediate: Topcoat:
MPI 2 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer

2. Interior Paint Table

Division 3: Interior Concrete Paint Table

New and uncoated concrete floors as scheduled on the drawings and recess area at floor mat:

Epoxy
New; MPI INT 3.2C-G6 (Gloss) / Existing; MPI RIN 3.2C-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 77 MPI 77 MPI 77
System DFT: 5 mils

Note: Primer may be reduced for penetration per manufacturer's instructions.

Division 4: Interior Concrete Masonry Units Paint Table

New Concrete masonry:

High Performance Architectural Latex
MPI INT 4.2D-G5 (Semigloss)
Filler Primer: Intermediate: Topcoat:
MPI 4 N/A MPI 141 MPI 141
System DFT: 11 mils

Fill all holes in masonry surface

Institutional Low Odor / Low VOC Latex
New; MPI INT 4.2E-G5 (Semigloss)
Filler Primer: Intermediate: Topcoat:
MPI 4 N/A MPI 147 MPI 147
System DFT: 100 microns

New Concrete masonry units in areas requiring a high degree of sanitation or high humidity areas :

Waterborne Light Industrial Coating
MPI INT 4.2K-G5(Semigloss)
Filler: Primer: Intermediate: Topcoat:

MPI 4 N/A MPI 153153 MPI 153153
System DFT: 11 mils
Fill all holes in masonry surface

Epoxy
MPI INT 4.2G-G6 (Gloss)
Filler: Primer: Intermediate: Topcoat:
MPI 116 N/A MPI 77 MPI 77
System DFT: 10 mils
Fill all holes in masonry surface

Division 5: Interior Metal, Ferrous And Non-Ferrous Paint Table

Interior Steel / Ferrous Surfaces

Metal, Mechanical, and Electrical. Surfaces adjacent to painted surfaces (Match surrounding finish),and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

Alkyd
MPI INT 5.1E-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 79 MPI 51 MPI 51
System DFT: 5.25 mils

Division 6: Interior Wood Paint Table

New Wood and plywood not otherwise specified:

High Performance Architectural Latex
MPI INT 6.4S-G3 Eggshell
Primer: Intermediate: Topcoat:
MPI 39 MPI 139 MPI 139
System DFT: 4.5 mils
Institutional Low Odor / Low VOC Latex
New; MPI INT 6.3V-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 39 MPI 145 MPI 145 System DFT: 4 mils

New and Existing Wood and Plywood, except floors; natural finish or stained:

Natural finish, oil-modified polyurethane
New; MPI INT 6.4J-G4 / Existing; MPI RIN 6.4L-G4
Primer: Intermediate: Topcoat:
MPI 57 MPI 57 MPI 57
System DFT: 4 mils

Stained, oil-modified polyurethane
New; MPI INT 6.4E-G4 / Existing; MPI RIN 6.4G-G4
Stain: Primer: Intermediate: Topcoat:
MPI 90 MPI 57 MPI 57 MPI 57
System DFT: 4 mils

New and Existing Wood Doors; Natural Finish or Stained:

Natural finish, oil-modified polyurethane

New; MPI INT 6.3K-G4 / Existing; MPI RIN 6.3K-G4
Primer: Intermediate: Topcoat:
MPI 57 MPI 57 MPI 57
System DFT: 4 mils Note: Sand between all coats per manufacturers recommendations.

Stained, oil-modified polyurethane
New; MPI INT 6.3E-G4 / Existing; MPI RIN 6.3E-G4
Stain: Primer: Intermediate: Topcoat:
MPI 90 MPI 57 MPI 57 MPI 57
System DFT: 4 mils
Note: Sand between all coats per manufacturers recommendations.

New Wood Doors; Pigmented finish:

Alkyd
New; MPI INT 6.3B-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 45 MPI 47 MPI 47
System DFT: 4 mils
Note: Sand between all coats per manufacturers recommendations.

Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table

New and Existing Previous Painted Wallboard not otherwise specified:

Latex
New; MPI INT 9.2A-G3 (Eggshell) / Existing; RIN 9.2A-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 50 MPI 52 MPI 52
System DFT: 4 mils

Institutional Low Odor / Low VOC Latex
New; MPI INT 9.2M-G3 (Eggshell) / Existing; MPI RIN 9.2M-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 50 MPI 145 MPI 145
System DFT: 4 mils

New Wallboard in toilets, food-preparation, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high humidity areas not otherwise specified.:

Epoxy
New; MPI INT 9.2E-G6 (Gloss) / Existing; MPI RIN 9.2D-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 77 MPI 77
System DFT: 4 mils

---End of Section---

SECTION 10 00 10.00 48 MISCELLANEOUS SPECIALITIES

Scope: 1. Provide miscellaneous items as specified

Warranty: 1. Provide manufacturer's standard warranty for the items.

Products:
1. Mooring Eye: Mooring eye shall be a standard casting product constructed of ductile iron and made to be installed in concrete with top of casting flush with top of finish concrete.
2. Security Mesh (Mail Room partition component): Security mesh shall be a minimum of 16 gauge metal and weigh a minimum of .75 pounds per square foot. The mesh shall be diamond type with a minimum of 73% open area. The overall mesh size and orientation shall as recommended by the manufacturer.
3. Open Work Bench : Penco Products or equal open work bench, adjustable height unit from 30 to 36 inch with laminated hardwood top (#30567). Provide back and end stops (#30988); riser with electrical strip (#30967 & 09372); case and drawer 22 inch wide (#30962), 72 inch shelf and stringer (#31120H & 31137H). standard finish for all steel parts, #028 'Grey' baked enamel.

---End of Section---

SECTION 10 10 00.00 48 VISUAL DISPLAY BOARDS

Scope: 1. Provide markerboards, bulletin boards, maprails and tackboards.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 Performance Specifications and Methods of Testing for Safety Glazing Materials Used in Buildings

ASTM INTERNATIONAL (ASTM)

ASTM B221 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM C1048 Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM F152 Tension Testing of Nonmetallic Gasket Materials

Warranty: 1. Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

Products:
1. Porcelain-on-metal chalkboards: Enameling grade sheet steel with porcelain finish with gloss finish for use with liquid chalk markers; Porcelain Enamel Marker board writing surface shall be composed of porcelain enamel fused to a nominal 28 gauge thick steel, laminated to a minimum 1/4 inch thick core material with a steel or foil backing sheet. Writing surface shall be capable of supporting paper by means of magnets. Marker board surface for display track system may be a powder paint dry erase surface adhered to a nominal 18 gauge thick steel.
2. Cork: Cork shall be a continuous resilient sheet made from soft, clean, granulated cork relatively free from hardback and dust and bonded with a binder suitable for the purpose intended. The wearing surface shall be free from streaks, spots, cracks or other imperfections that would impair its usefulness or appearance. The material shall be seasoned, and a clean cut made not less than ½ inch from the edge shall show no evidence of soft sticky binder. Natural Cork; Material shall be a single layer of pure grain natural cork without backing or facing. The cork sheet shall have a tensile strength of not less than 40 psi when tested in accordance with ASTM F152.
3. Aluminum: Aluminum frame extrusions shall be alloy 6063-T5 or 6063-T6, conform to ASTM B221, and be a minimum 0.06 inches thick. Exposed aluminum shall have an anodized, satin finish. Straight, single lengths shall be used wherever possible. Joints shall be kept to a minimum. Corners shall be mitered and shall have a hairline closure.
4. Glass: Glass shall be comprised of tempered glass in accordance with ANSI Z97.1 and shall conform to ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class I (clear), thickness as specified.
5. Markerboard: Markerboard shall have a porcelain enamel writing surface and a chalktray. Markerboard shall be a factory assembled unit complete in one piece, without joints whenever possible. When markerboard dimensions require delivery in separate sections, components shall be prefit at the factory, disassembled for delivery and jointed at the site. Frame shall be aluminum. Chalktray shall be the same material as the frame and extend the full length of the liquid markerboard. The markerboard shall have a heavy duty map rail with map hooks and clips for holding sheets of paper, end stops, and a tackable insert as specified below and shall extend the full length of the liquid chalkboard. Dry erase markings shall be removable with a felt eraser or dry cloth without ghosting. Each unit shall come complete with an eraser and four different color compatible dry erase markers. The size finish and color shall be as selected by the DB Contractor and accepted by the Government.
6. Continuous Map Rail: Heavy duty aluminum frame continuous Map Rail shall be 2 inch wide and have a tackable insert and shall extend the full length of the rail, and shall have map hooks

with clips for holding sheets of paper and end stops. One map hook shall be provided for each 12 inches of map rail. The size shall be indicated.

7. Tackboards: Tackboards shall consist of a minimum 1/4 inch thick natural cork laminated to a minimum 1/4 inch thick hardboard, and shall have an aluminum frame. The size shall be indicated.
8. Bulletin Boards: Bulletin boards shall have a hardwood or aluminum frame, 1/4 inch thick plywood or hardboard back; and a 1/4 inch thick, dense, smooth faced corkboard face securely cemented to the back and 1/4 inch tempered glass sliding doors. Glass shall be as specified above.

---End of Section---

SECTION 10 12 00.00 48 RECESSED DISPLAY CASE

Scope: 1. Provide recessed display case.

Warranty: 1. Include coverage of fabric surface from discoloration due to fading.

Product: 1. Recessed case: Recessed illuminated case with aluminum front with satin anodized finish and a cork back panel. Both units shall have ¼ inch tempered glass sliding doors with finger pulls, locks and keys, shelf brackets, shelf standard and three 12 inch wide adjustable ¼ inch tempered glass shelves. Size shall be as indicated.
   a. Required items:
      1) Wood box of 24 inches in depth. Exposed wood shall be stained light oak.
      2) Glass: All glass shall be tempered.
      3) Back Panel: For polyester fabric over cork.
      4) Trim: Trim shall be satin anodized aluminum.

---End of Section---

SECTION 10 14 01.0 48 – EXTERIOR SIGNAGE

Scope: 1. Dimensional Building letters and plaques.

References:1 The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASTM INTERNATIONAL (ASTM)

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
ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924/A924M	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B108/B108M	Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B26/B26M	Standard Specification for Aluminum-Alloy Sand Castings

AMERICAN WELDING SOCIETY (AWS)

AWS C1.1M/C1.1	Recommended Practices for Resistance Welding
AWS D1.1/D1.1M	Structural Welding Code - Steel
AWS D1.2/D1.2M	Structural Welding Code - Aluminum

Warranty: 1. Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

Products: 1. Modular Exterior Signage System: Exterior signage shall consist of a system of coordinated directional, identification, and regulatory type signs located where shown. Dimensions, details, materials, message content, and design of signage shall be as shown.
2. Metal Plaques: Plaques shall be United States Army Center Reserve Minuteman aluminum plaque: Provided by the Government and installed by the Contractor location of plaques shall be as shown or as directed.
3. Dimensional Building Letters
   a. Fabrication: Letters shall be fabricated from cast bronze or cast aluminum. Letters shall be cleaned by chemical etching or cleaned ultrasonically in a special degreasing bath. Letters shall be packaged for protection until installation.
   b. Typeface: Typeface shall be Helvetica medium.
   c. Size; Letter size shall be as indicated.
   d. Finish: Polished bronze or with clear coat finish shall be provided.
   e. Mounting: Threaded studs of number and size as recommended by manufacturer, shall be used for concealed anchorage. Letters which project from the building line shall have stud

spacer sleeves. Letters, studs, and sleeves shall be of the same material. Templates for mounting shall be supplied.

4. Aluminum Alloy Products: Aluminum alloy products shall conform to ASTM B209/B209M for sheet or plate, ASTM B221 for extrusions and ASTM B26 or ASTM B108/B108M for castings. Aluminum extrusions shall be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products shall conform to AWS C1.1M/C1.1.
5. Steel Products: Structural steel products shall conform to ASTM A36/A36M. Sheet and strip steel products shall conform to ASTM A1011/A1011M . Welding for steel products shall conform to AWS D1.2.
6. Cast Bronze: Components shall be fabricated with sharp corners, flat faces, and accurate profiles. Burrs and rough spots shall be removed and polished. Faces shall be finished to a uniform high luster. Cast bronze shall be in accordance with ASTM B62 7. Shop Fabrication and Manufacture
   a. Factory Workmanship: Work shall be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled shall be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Welding to or on structural steel shall be in accordance with AWS D1.1. Welding shall be continuous along the entire area of contact. Exposed welds shall be ground smooth. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practical. Items specified to be galvanized shall be by hot-dip process after fabrication if practical. Galvanization shall be in accordance with ASTM A123/A123M and ASTM A653/A653M, as applicable. Other metallic coatings of steel sheet shall be in accordance with ASTM A924/A924M. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.
   b. Dissimilar Materials: Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masoAnry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.
   c. Shop Painting: Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, shall be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete shall not be painted. Upon completion of work, damaged surfaces shall be recoated.
8. Color, Finish, And Contrast: For buildings required to be handicapped-accessible, the characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

------End of Section---

SECTION 10 14 02.00 48 INTERIOR SIGNAGE

Scope: 1. Provide specialty building directory, and interior signage.

References 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	Designation System for Aluminum Finishes
AA PK-1	Pink Sheets: Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings & Ingot

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2604	Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2	Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM C1036	Standard Specification for Flat Glass
ASTM D635	Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 COMM	Standard and Commentary Accessible and Usable Buildings and Facilities

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	Life Safety Code
NFPA 70	National Electrical Code

Extra Stock:1. The Contractor shall provide 5 percent of total extra frames and extra stock of the following: blank plates of each color and size for each sign type, pressure-sensitive letters in each color and size for each sign type, and changeable message strips for each sign type.

Products: 1. General:

a. Interior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Conform to EPA requirements for recycled materials.

b. Character Proportions and Heights: Letters and numbers on indicated signs in handicapped-accessible buildings, which do not designate permanent rooms or spaces, shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted. Suspended or projected overhead signs shall have a minimum character height of 3 inches .

c. Raised and Braille Characters and Pictorial Symbol Signs (Pictograms): Letters and numbers on indicated signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be raised 1/32 inch upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 5/8 inch in height, but no higher than 2 inches. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 6 inch minimum in height. Indicated accessible facilities shall use the international symbol of accessibility.

2. Manufacturers:

ASI Sign Systems, Inc.
8181 Jetstar Drive, Suite 100
Irving, TX 75063
800-274-7732

Interface Architectural Signage, Inc
5849 Peachtree Road
Atlanta, GA 30341
800-445-4796

APCO Architectural Sign Systems
388 Grant Street SE
Atlanta, Georgia 30312
877-988-9000

2/90 Sign Systems!
5350 Corporate Grove Blvd SE
Grand Rapids, MI 49512
800-777-4310

3. Room Identification/Directional Signage System:

a. Holder: Integrally colored injection molded high impact plastic complete with mounting system, ready for insert installation. Corners of signs shall be rounded. Wall mounting shall be double sided tape for wall mounting and Velcro or manufacturers' recommended factory applied mating strips for attachment to System Furniture. Size as indicated at the end of this section. Color: As selected.

b. Changeable Message Strip Signs: Changeable message strip signs shall consist of injection molded high impact plastic . Size of signs shall be as at the end of this section. Corners of signs shall be rounded to match frame.

c. Mounting Inserts to Holder: Double side vinyl foam tape when mounting is permanent, when inserts are subject to frequent change use 1/32 inch thick magnetic tape. Color: as selected.
d. Provide the following options as required:
   1) Split inserts
   2) Hangable slide inserts
   3) Window sign insert module.
   4) Window sign.
e. Graphics: Signage graphics for modular identification/directional signs shall conform to the following:
   1) Message shall be applied to panel using the silkscreen process. Silkscreened images shall be executed with photo screens prepared from original art. Handcut screens will not be accepted. Original art shall be defined as artwork that is a first generation reproduction of the specified art. Edges and corners shall be clean.
f. Graphics Application: Message content is specified in the Sign Schedule at the end of this section; Verify message with the Government. Typeface shall be Helvetica Medium, size as indicated. Background color shall be as selected.

4. Building Directories: Building directories shall be lobby directories surface mounted, non-illuminated, wall hung, with message strips. Where required, message content shall be as shown on drawings and schedule.
   a. Header Format: Header format shall be Helvetica Medium, uppercase. Imprint color.
   b. Door Glazing: Door glazing shall be clear acrylic sheet.
   c. Door Construction: Extruded aluminum door frame shall be of same finish as surrounding frame. Corners shall be mitered and assembled with concealed fasteners. Hinges shall be concealed continuous stainless steel, in natural anodized aluminum finish . Glazing shall be set in frame with resilient glazing channels.
   d. Door Locks: Door locks shall be manufacturer's standard, and shall be keyed alike.
   e. Fabrication: Extruded aluminum frames and trim shall be ASTM B221/B221M, 6063-T5 extruded aluminum alloy frame surrounding solid backing plate with PVC laminated to solid backing, provide holes in back plate. Finish and color shall be anodized aluminum as selected by the DB Contractor and accepted by the Government.
   f. Message Strips: Message strips shall be injection molded plastic with digital computer generated and photo silk screened typography; provide sufficient strips to fill directory, up-datable by user with book reordering and with 7 to 10 day delivery. Type style shall be Helvetica Medium, size shall be3/4 inch initial caps. Provide strips with self aligning reveal and flex and stack ability for ease of installation and removal. Imprint color as selected.

---End of Section---

SECTION 10 21 13.00 48 PLASTIC TOILET PARTITIONS

Scope:
1. Provide toilet partitions and screens; Floor-supported partitions.
2. Solid plastic shower compartment benches.

References:
1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60003	(Basic) Partitions, Toilet, Complete

Warranty:
1. Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

Products:
1. Toilet Enclosures: Toilet enclosures shall conform to CID A-A-60003, Type I, Style A, Solid Polyethylene, Finish 5, floor supported. One inch thick. Width, length, and height of toilet enclosures shall be as shown. Finish surface of panels shall be solid polyethylene, Finish 5 with 30 percent or more recycled content. Panels indicated to receive toilet paper holders or grab bars as specified in Section 10 28 13.00 48 TOILET ACCESSORIES, shall be prepared for mounting of the items required. Provide stainless steel shoes at pilasters to conceal floor-mounted anchorage. Doors shall be 2’-0” wide and handicap stall shall be a 3'-0" wide door. Color shall be as selected by the DB Contractor and accepted by the Government.
2. Urinal Screens: Urinal screens shall conform to CID A-A-60003, Type III, Solid Polyethylene, Finish 5, wall mounted. Finish surface of screens shall be solid polyethylene with 30 percent or more recycled content. Width and height of urinal screens shall be as shown. Color shall be as selected by the DB Contractor and accepted by the Government.
3. Hardware: Provide hardware for the toilet partition system that conforms to CID A-A-60003 for the specified type and style of partitions. Satin stainless steel no. 4 finish. Hardware includes: Pivot hinges, gravity type, adjustable for door close positioning; nylon bearings door latch; door strike and keeper with rubber bumper; and coat hook and bumper. Provide latching devices and hinges for handicap compartments complying with 36 CFR 1191 and stainless steel door latches that operate without either tight grasping or twisting of the wrist of the operator. Use stainless steel, tamper proof type screws and bolts. Wall mounting brackets must be continuous, full height, stainless steel, in accordance with toilet compartment manufacturer's instructions.

---End of Section---

SECTION 10 22 13.00 48 WIRE MESH PARTITIONS

Scope: 1. Provide wire mesh partitions for storage, stockroom, and security separations.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section..

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG- 973 Cold-Formed Steel Design Manual

ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M Carbon Structural Steel

Product Manufacturers:

AMICO
3245 Fayette Avenue
P.O. Box 3928
Birmingham, Ala
800-366-2642

California Wire Products Corp.
1316 Railroad St.
Corona, CA
800-486-7730
www.cawire.com

Spaceguard Products
711 South Commerce Drive
Seymour, IN
800.841.0680
www.spaceguardproducts.com

Wire Crafters
6208 Strawberry Lane
Louisville, Ky.40214
800.924.9473
www.wirecrafters.com

Products:
1. Steel Shapes, Plates, and Bars ASTM A 36/A 36M.
2. Cold-Formed Steel of AISI SG-973.
3. Wire Mesh: Carbon steel wire, welded or woven 1” x 2” mesh, intermediate crimped. (Welded not allowed in arms vault)
4. Floor Sockets: Cast or forged steel or ductile iron, adjustable, approximately 2 1/2 inches high.
5. Heavy Duty Partitions:
   a. Wire Mesh, 10 gage wire, 1" x 2" mesh.
   b. Vertical Frames, 2" x 2" x 14 gauge steel tube frame.
   c. Horizontal Frames, 1 1/4" x 1 1/4" x 1/8" steel angle frames.
   d. Structural steel angles, 2" by 2" by 14 gauge.
   e. Hinged Doors, frames shall be 1 1/4" by 1 1/4" by 3/16" angle with 2" x 1" 10 gauge rectangular steel mesh. Provide high and low lugs for padlocks on each door and frame. Provide spring loaded hinges. Provide two horizontal and one vertical flat stiffener of 1/4" by 3/4" steel. Provide two gate posts and hardware. Provide stiffeners in door panel to

prevent twisting action and allow unauthorized access into the caged area. Stiffeners should secure both corners of the swinging door opposite the hinge side

f. Door Frames, provide frames the same size and shape as the vertical frames for the mesh panels.
g. Locks, provide each door with twin lugs or holes in steel for padlock application.
h. Fabrication, standard panels of wire shall be 10 gauge 2" by 1" mesh opening, 1 1/4" by 1 1/4" by 1/8" steel angle. All ceiling panels are non-load bearing.
i. Finish, thoroughly clean ferrous metal, treat with phosphate, and paint with one coat of shop applied acrylic enamel.

Installation:

1. Wire Mesh Partitions, install plumb, level, and true to line, within a tolerance of 1/8 inch in 10 feet or the height or run of the partition, if less than 10 feet. Anchor floor baseplate to the floor with expansion anchors. Tamperproof fasteners shall be used at all bolted connections. Tamperproof fasteners shall be manufactured products designed to be nonremovable. The use of welded, peened, deformed, or damaged bolted connections is not allowed.

---End of Section---

SECTION 10 22 26.00 48 OPERABLE PARTITIONS

Scope: 1. Provide operable partitions

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References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASTM INTERNATIONAL (ASTM)

ASTM E84	Surface Burning Characteristics of Building Materials
ASTM E90	Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM E413	Classification for Rating Sound Insulation

Submittals: 1. Shop Drawings: Drawings containing complete schematic diagrams and details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

Warranty: 1. Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

Products: 1. General Requirements:
   a. The Contractor shall supply and install flat wall, manual operation, paired panels, center stacking, top supported, acoustical operable partitions as shown on the drawings including all hardware, seals, track and rollers as needed to close the specified opening. The panel shall have a minimum Sound Transmission Coefficient (STC) minimum of 48 measured in accordance with ASTM E90. The partition shall be made up of a series of rigid, flat wall panels; each panel being a one-piece assembly nominally 48 inches wide. Unless otherwise specified, the wall shall comprise the least number of panels. The mechanical seal of the panel shall actuate with a single operating action.
   b. The manual operation shall be accomplished with less than 200 ft/min force to start movement at the rate of 3.33 ft/s. A removable handle shall be used to extend and retract the bottom operable seals; vertical movement of seals shall be 2 inches. Closure to the lead wall shall be by use of a flexible bulb; final closing shall be accomplished by means of a lever exerting pressure against wall.

2. Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 year prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Government, reasonably convenient to the site. Door and partition finishes shall have a Class A rating when tested in accordance with ASTM E 84.
   a. Panel Surface Finish: Panel surface finish shall be an acoustically absorbent “wall carpet” or an acrylic backed, vinyl wall covering, Class A, Fire Resistive Grade according to ASTM E84, 24 ga. thick, bacterial resistant. Panel surface finish and color shall be as selected from manufacturer’s standard offering.
   b. Hardware: Operable partitions shall have manufacturer's standard hardware. Latching door handles shall be chrome plated, hinges shall be stainless steel.
   c. Sweep Strips: Sweep strips shall be vinyl or other material which will not crack or craze with severe usage. Sweep strip shall control STC to the specified rating.
   d. Track: Track shall be recessed and shall be of extruded aluminum or enamel finish steel. Track shall be manufacturer's standard product designed for the weight of the finished partition. Track sections shall be provided in the maximum lengths practicable and secured to structure with threaded rods. Suitable joint devices such as interlocking keys shall be provided at each joint to provide permanent alignment of track.

e. Metal Soffit: Soffit shall be provided when steel track is recessed. Soffit shall be of metal of adequate thickness to protect the ceiling from damage by door operation and shall be provided with the door manufacturer's standard neutral-color applied finish. Soffit on aluminum track shall be an integral part of the track.
f. Vinyl Restrictions: Vinyls shall contain a non-mercury based mildewcide and shall be manufactured without the use of cadmium-based stabilizers.

3. Operable Partitions: Operable partitions shall consist of top hung ball bearing carriers which support paired modular panels. Partition finish shall have a flame spread rating of not more than 25 in accordance with ASTM E84.
   a. Panels: Panels shall be constructed of minimum 16 gauge thick steel frames with minimum 22 gauge thick face panels spot welded to the frame. Panels shall be not more than 48 inches wide, except for end closure panels, and shall be full height to track. Panels shall lock in place to form a stable, rigid partition; low profile hinges shall project 1/4 inch maximum from panel edge. Panel thickness shall be minimum (3 1/2 inch nominal) and composition shall be designed to provide an STC rating of not less than 48 in accordance with ASTM E90 and ASTM E413.
   b. Seals: Top and bottom seals shall consist of a vinyl sweep mechanical seal which will expand in place or shall be accomplished by using panels which can be lowered by a removable operating device. Vertical seal between panels shall be anodized, architectural grade, aluminum extrusion with vinyl sound seal.
   c. For operable partition that do not have automatic seals Contractor shall provide 3 removable operating devices for each operable partition indicated on the drawings.

---End of Section---

SECTION 10 26 00.00 48 WALL AND CORNER GUARDS

Scope: 1. Provide wall and corner guards:

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 Designation System for Aluminum Finishes

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D256	Determining the Izod Pendulum Impact Resistance of Plastics
ASTM D543	Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D635	Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G21	Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500 Metal Finishes Manual

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J 1545 Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Color Trim

Warranty: 1. Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

Products: 1. To the maximum extent possible, corner guards, and wall guards (bumper guards) shall be the standard products of a single manufacturer and shall be furnished as detailed. Drawings show general configuration of products required, and items differing in minor details from those shown will be acceptable.

2. Resilient Material: Resilient material shall consist of high impact resistant extruded acrylic vinyl, polyvinyl chloride, or injection molded thermal plastic and shall conform to the following:
   a. Minimum Impact Resistance: Minimum impact resistance shall be 18 ft. lb/sq. inch when tested in accordance with ASTM D256, (Izod impact, ft. lbs per sq inch notched).
   b. Integral Color: Colored components must have integral color and must be matched in accordance with SAE J1545 to within plus or minus 1.0 on the CIE-LCH scales.
   c. Chemical and Stain Resistance: Materials must be resistant to chemicals and stains reagents in accordance with ASTM D543.
   d. Fungal and Bacterial Resistance Materials must be resistant to fungi and bacteria in accordance with ASTM G21, as applicable
   e. Fire Rating: Fire rating shall be Class 1 when tested in accordance with ASTM E84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less. Material shall be rated self extinguishing when tested in accordance with ASTM D635. Material shall be

labeled and tested by an approved nationally known testing laboratory. Resilient material used for protection on fire rated doors and frames shall be listed by the testing laboratory performing the tests. Resilient material installed on fire rated wood/steel door and frame assemblies shall have been tested on similar type assemblies. Test results of material tested on any other combination of door/frame assembly will not be acceptable.

f. Integral Color: Colored components shall have integral color and shall be matched in accordance with SAE J 1545 to within plus or minus 1.0 on the CIE-LCH scales.

3. Corner Guards:
   a. Resilient Corner Guards: Corner guard units shall be surface mounted type, radius formed to profile shown. Corner guards shall be [as indicated on the drawings] [extend from floor to ceiling] [be inches high]. Mounting hardware, cushions, and base plates shall be furnished. Assembly shall consist of a snap-on corner guard formed from high impact resistant resilient material, minimum 0.078 inch thick, mounted on a continuous aluminum retainer. Extruded aluminum retainer shall conform to ASTM B221, alloy 6063, temper T5 or T6. Flush mounted type guards shall act as a stop for adjacent wall finish material. Factory fabricated end closure caps shall be furnished for top and bottom of surface mounted corner guards. Flush mounted corner guards installed in fire rated wall shall maintain the rating of the wall. Insulating materials that are an integral part of the corner guard system shall be provided by the manufacturer of the corner guard system. Exposed metal portions of fire rated assemblies shall have a paintable surface.
   b. Stainless Steel Corner Guards: Stainless steel corner guards shall be fabricated of 0.0625 inch thick material conforming to ASTM A 167, type 302 or 304. Corner guards shall be [as indicated on the drawings] [extend from floor to ceiling] [be inches high]. Corner guard shall be formed to dimensions shown.
4. Wall Guards, Combination Handrail/Wall Guards and Handrails: Wall guards, combination handrail/wall guards, and handrails shall; consist of snap-on covers of high impact resistant resilient material on a continuous, extruded aluminum retainer and shall be provided with prefabricated end closure caps, inside and outside corners, concealed splices, cushions, mounting hardware and other accessories standard with the manufacturer. Extruded aluminum retainers shall conform to ASTM B221, alloy 6063, temper T5 or T6. End caps and corners shall be field adjustable to assure close alignment with handrails and wall guards. Wall guard profile shall be as indicated on D/B construction drawings.
5. Trim, fasteners and anchors: Vinyl trim, fasteners and anchors shall be provided for each specific installation as shown.
6. Finish:
   a. Aluminum Finish: Finish for aluminum shall be in accordance with AA DAF-45. Exposed aluminum shall be designation AA-C22A31 chemically etched medium matte, with clear anodic coating class II architectural coating 0.010 mm thick. Concealed aluminum shall be mill finish.
   b. Stainless Steel Finish: Finish for stainless steel shall be in accordance with NAAMM AMP 500 Manual, finish number 4.
   c. Resilient Material Finish: Finish for resilient material shall be pebble grain texture with colors in accordance with SAE J 1545. 7.
   d. Color: Color, texture and pattern shall be as selected by the DB Contractor and accepted by the Government

---End of Section---

SECTION 10 28 00.00 48 – TOILET ACCESSORIES

Scope: 1. Provide toilet accessories at toilet and locker rooms.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z535.4 Product Safety Signs and Labels

ASTM INTERNATIONAL (ASTM)

ASTM C1036 Standard Specification for Flat Glass
ASTM F2285 Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use
ASTM G21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines

Product Manufacturer:

Bobrick Washroom Equipment, Inc.;
Bradley Corporation;
American Specialties;

Regulatory Requirements:
1. Conform to 36 CFR 1191 for accessibility requirements.

Products: 1. Manufactured Units: Toilet accessories shall be provided where indicated in accordance with Schedule below. Each accessory item shall be complete with the necessary corrosion resistant mounting plates.
   a. Anchors and fasteners shall be capable of developing a restraining force commensurate with the strength of the accessory to be mounted and shall be suited for use with the supporting construction. Exposed fasteners shall [have oval heads] [be of tamperproof design] and shall be finished to match the accessory.
   b. Finishes: Except where otherwise noted, provide the following finishes for metal:
      1) Stainless Steel: No. 4 satin finish.
      2) Carbon steel, copper alloy, and brass: Chromium plated, bright.
   c. Adhesive: Two component epoxy type waterproof.
2. Keying: Supply 2 keys for each accessory.
4. Back paint components where contact is made with building finishes to prevent electrolysis.

Schedule*:* A1, Mop and Broom Holder: ASI (1315-6), Bobrick (B-224), Bradley (9986) - Strip shall be constructed of 1.31mm (18 gage) Type 302 stainless steel no. 4 satin finish. Strip shall be formed with a return flange to the wall on top and a returned flange to the wall at the bottom. Holder pieces shall be constructed from molded resilient rubber with ribbed gripping surface. Strip shall be 1200mm (36-inches) long with 6 holders.

A2, Stainless Steel Framed Mirror: ASI (0600), Bobrick (2908), Bradley (780) - Mirror, 460 x 760mm: (18 x 30 inches), shall be framed with one-piece, type 304, stainless steel angle, 19 x 19mm with continuous integral stiffener on all sides and beveled edge to hold frame tightly against mirror. Corners shall be heliarc welded, ground and polished smooth. All exposed surfaces shall be satin finish. Mirror shall be No. 1 quality 6mm (1/4-inch) tempered glass. All edges shall be protected by high impact plastic filler strips. Back of mirror shall be protected by shock- absorbing, waterproof, non-abrasive 6.4mm thick polystyrene padding. Galvanized steel back shall have integral hanging brackets for mounting on concealed rectangular wall hanger(s) and be secured with concealed Phillips-head locking screws in lower frame.

A3, Tilted Mirror: ASI (0535), Bobrick (B-293-1830), Bradley (740) - Sloping tilt mirror frame, 460 x 760mm (18 x 30 inches), shall be type 304 stainless steel with beveled front to hold frame tightly against mirror. Corners shall be heliarc welded, ground, and polished smooth. All exposed surfaces shall have satin finish with vertical grain. Mirror shall be 6.4mm tempered glass. All edges shall be protected by full-size, shock-absorbing, water-resistant, nonabrasive polystyrene padding. Back and inner stiffener frame shall be galvanized steel, one piece welded construction with slots for mounting screws and integral screw-head lock.

A4, Recessed Paper Towel Dispenser and Waste Receptacle: ASI (9467), Bobrick (B-3803), Bradley (2027) - Recessed paper towel dispenser and waste receptacle shall be type 304 stainless steel with all welded construction; exposed surfaces shall have satin finish. Door shall be 18 gage and secured to the cabinet with a concealed, full length stainless steel piano hinge and equipped with a stainless steel cable door swing limiter and two tumbler locks. Paper towel dispenser shall be capable of dispensing 600 C fold, 800 multi-fold or 1100 single-fold paper towels. Waste receptacle shall be furnished with a removable, leakproof rigid molded plastic waste container with a capacity of 24 liters (6.3 gal).

A5, Recessed Paper Towel Dispenser and Waste Receptacle ASI (0462 AD), Bobrick (B-369), Bradley (2291), - Recessed paper towel dispenser and waste receptacle shall be constructed entirely of Type 304 stainless steel, welded construction with exposed surfaces satin finish. Flange shall be drawn one-piece seamless construction. Door shall be double pan construction and equipped with a knob latch. Door shall be secured to cabinet with full-length stainless steel piano hinge. Paper Towel Dispenser shall be capable of dispensing 350 fold or 475 Multifold paper towels without use of adapters. Waste receptacle, removable for servicing, with top edges hemmed for safe handling, shall have a capacity of minimum 7.57 liters (2-gal). Recessed depth shall be maximum 100mm.

A6 and A7, Partition Mounted Double Toilet Tissue Dispenser with Toilet Seat Dispenser and Feminine Napkin Disposal For Servicing Two Toilet Compartments: (A6) ASI (0481), Bobrick (B-357), Bradley (591) and (A7) ASI (0481-HC), Bobrick (B-3571), Bradley (5911) - Partition mounted double roll toilet tissue dispenser each side shall be type 304 stainless steel with all welded construction. Exposed surfaces shall have satin finish. Toilet seat dispenser shall hold up to 1000 single or half folded toilet seat covers. Front of door shall be drawn, one piece, seamless construction. Toilet seat dispenser door shall be secured to cabinet with piano hinge equipped with a flush tumbler lock. Unit shall dispense two standard core toilet tissue rolls up to 133mm (5 1/4") in diameter on each side. Unit shall include four heavy duty, one-piece molded polyethylene spindles. Dual feminine napkin disposal shall be constructed entirely of type 302 stainless steel. Sanitary napkin dispenser door shall be secured to cabinet with a spring loaded, full length stainless steel piano hinge and equipped with international graphic symbol. Unit A7 has one side flush with the face of the toilet partition to allow for grab bar clearance.

A8, Recessed Double Toilet Tissue Dispenser with Toilet Seat Dispenser and Feminine Napkin Disposal: ASI (0482), Bobrick (B-35745), Bradley (5912). Recessed double roll toilet tissue dispenser shall be type 304 stainless steel with all welded construction. Exposed surfaces shall have satin finish. Toilet seat dispenser shall hold up to 1000 single or half-folded toilet seat covers. Front of door shall be drawn, one piece, seamless construction. Toilet seat dispenser door shall be secured to cabinet with piano hinge equipped with a flush tumbler lock. Sanitary napkin dispenser door shall be secured to cabinet with a spring loaded, full-length stainless steel piano hinge and equipped with international graphic symbol. Unit shall dispense two standard core toilet tissue rolls up to 133.4mm in diameter. Unit shall include two heavy-duty, one-piece molded polyethylene spindles.

A8-b, Recessed Toilet-Seat-Cover Dispenser, Sanitary Napkin Disposal, And Toilet Tissue Dispenser: Bobrick (B-3574) Unit shall be type 304, 22 gauge, stainless steel all welded construction, exposed surfaces shall have a satin finish. Front of door shall be drawn, one piece, seamless construction. Toilet seat dispenser door shall be secured to cabinet with piano hinge equipped with a flush tumbler lock. Unit shall dispense two standard core toilet tissue rolls up to 5.25 inches in diameter on each side. Unit shall include two heavy duty, one-piece molded polyethylene spindles. Sanitary napkin disposal shall be furnished with a removable,, leak proof, molded polyethylene receptacle with a capacity of .75 gal. Toilet seat dispenser shall hold up to 1000 single or half -folded toilet seat covers.

A9 and A10, Partition Mounted Double Toilet Tissue Dispenser with Toilet Seat Dispenser For Servicing Two Toilet Compartments: ASI (0484), Bobrick (B-347), Bradley (592) and (A10) ASI (0484-HC), Bobrick (3471), Bradley (5921) - Partition mounted double roll toilet tissue dispenser each side shall be type 304 stainless steel with all welded construction. Exposed surfaces shall have satin finish. Toilet seat dispenser shall hold up to 1000 single or half-folded toilet seat covers. Front of door shall be drawn, one piece, seamless construction. Toilet seat dispenser door shall be secured to cabinet with piano hinge equipped with a flush tumbler lock. Unit shall dispense two standard core toilet tissue rolls up to 133mm (5 1/4") in diameter on each side. Unit shall include four heavy duty, one-piece molded polyethylene spindles. Unit A10 has one side flush with the face of the toilet partition to allow for grab bar clearance.

A11, Recessed Double Toilet Tissue dispenser with Toilet Seat Dispenser: ASI (0485), Bobrick (B-3474), Bradley (5922) - Recessed double roll toilet tissue dispenser shall be type 304 stainless steel with all welded construction. All exposed surfaces shall have a satin finish. Toilet seat dispenser shall hold 500 paper covers. Door shall be one-piece seamless construction secured to cabinet with a full-length stainless steel piano hinge, and equipped with a tumbler lock. Unit shall dispense two standard core toilet tissue rolls up to 135mm in diameter. Unit shall include two one-piece molded polyethylene spindles.

A11-b, Surface Mounted Multi-Roll Toilet Tissue Dispenser: ASI (0030), Bradley (5402), Bobrick (B-4288) -Surface-Mounted Multi-Roll Toilet Dispenser shall be type 304 stainless steel with all welded construction. All exposed surfaces shall have a satin finish. Door shall be one piece seamless construction secured to cabinet and equipped with a tumbler lock. Unit shall automatically drop in place when bottom roll is depleted. Unit shall include two one-piece molded polyethylene spindles.

A11-c, Surface-Mounted Napkin Disposal and Dual Roll Toilet Tissue Dispenser: ASI (04833), Bradley (5942-11), - Surface Mounted Napkin Disposal and Dual Roll Toilet Tissue Dispenser and sanitary napkin disposal shall be type 304 stainless steel with all welded construction. Exposed surfaces shall have satin finish. Front door shall be drawn, one-piece, seamless construction, secured to cabinet with piano hinge equipped with a flush tumbler lock. Self closing disposal panel shall be secured to cabinet with a spring loaded, full -length stainless steel piano hinge and napkin disposal shall be furnished with a removable, leak proof, molded polyethylene receptacle with a capacity of 1 gal. Unit shall include two heavy-duty, one-piece molded polyethylene spindles.

A12, Surface-Mounted Soap Dispenser with Shelf: ASI (0318), Bradley (662) - Soap vessel and shelf are satin-finish stainless steel. Valve shall be corrosion resistant design. Soap container shall be removal and have a capacity of 2.4L (80 fl oz) with unbreakable refill window. Adequate adjustments/accessories shall be provided to allow dispenser to work in location indicated in the drawings.

A12-b, Lavatory-Mounted Soap Dispenser: Bradley (6324), Bobrick (B-82216)- Lavatory Mounted Soap Dispenser shall dispense liquid and lotion soaps, and synthetic detergents. Value shall be operable with one hand and with less than 5 lbs. of force to comply with barrier free accessibility. Piston and spout assembly shall be type 304 stainless steel with bright polished finish. Escutcheon shall lock to body with concealed locking mechanism that is opened only with special key provided. Spout shall rotate 360 degrees without damage to valve mechanism. Piston, spout and supply tube assembly shall be removable from top for filling and maintenance. Valve shall be equipped with plastic cylinder, stainless steel spring, U-packing seal and duckbills. Shank shall accommodate mounting thickness up to 1 inch Translucent, shatter resistant polyethylene container shall have a capacity of 20 oz.

A12-c, Surface - Mounted Soap dispenser For Liquid And Soaps And Detergents: Bobrick (B-2112) Surface Mounted Soap Dispenser shall be constructed entirely of type 304, stainless steel with exposed surfaces satin finish. Valve shall dispense liquid and lotion soaps and synthetic detergents. Valve shall be operable with one hand and with less than 5 pounds of force. Container shall be equipped with a clear acrylic soap refill-indicator window; a locked, hinged stainless steel lid for top filling; and shall have a capacity of 40 fl. oz. Unit shall have a concealed, vandal resistant mounting.

A13, Stainless Steel Utility Hook: ASI (7340), Bobrick (B-670), Bradley (9114) - Utility Hook shall be constructed entirely of type 304 stainless steel with satin finish. Flange and support arm shall be 22 gauge and equipped with a concealed, 1/16 in mounting bracket secured to a 1/16 inch wall plate with a stainless steel set screw. Fastenings and mounting plates shall be concealed.

A14, Stainless Steel Grab Bars with Concealed Mounting: ASI (3000 series), Bobrick (B-5806 series), Bradley (812 series) - Grab bar shall be constructed of type 304 stainless steel with satin finish. It shall have wall thickness of 1.31mm (18 gage) and outside diameter of 38mm (1 1/2-inches). Distance from inside of grab bar to finished wall shall be 38mm (1 1/2-inches). Flanges shall be 3.13mm (11-gage) stainless steel, 75mm (3-inch) diameter and each shall have 4 stainless steel set screws. Ends of grab bar shall pass thru flanges and be heliarc welded to form one structural unit. Flange covers shall be 22 gauge., 3 3/8" in diameter, and 1/2 in deep and shall snap over mounting flange to conceal mounting screws. grab bar shall comply with ADA/ABA guidelines for structural strength. Concealed mounting plates shall be 2.37mm (13-gage) stainless steel with 3 slotted screw holes.

A15, Recessed Soap Holder and Bar: ASI (7410-S), Bobrick (B-4390), Bradley (940) - Unit shall be constructed of type 304 stainless steel with satin finish. Soap dish and flange shall be drawn and beveled, one-piece seamless construction. Unit shall include a bar constructed of 4.8mm (3/16-inch) thick matching stainless steel. Recess depth shall be maximum 75mm.

A16, Heavy-Duty Shower Curtain Rod with Concealed Mounting: ASI (1214), Bobrick (B-207), Bradley (9539) - Unit shall be of type 304 stainless steel, 1.006mm (20-gage), with satin finish. Outside diameter shall be 25.4mm (1-inch). Flanges shall be 80mm (3 3/16-inch) maximum diameter with satin finish. Unit shall include concealed mounting brackets.

A17, Stainless Steel Curtain Hook:: ASI (1200-SHU), Bobrick (B-204-1), Bradley (9536) - Shower curtain hooks shall type 304 stainless steel. Hooks shall be usable with curtain rod specified for Item A15. Hooks shall snap open to allow placement on curtain rod.

A18, Opaque White Vinyl Shower Curtain: ASI (1200-V), Bobrick (B-204-3), Bradley (9533) - Shower curtain shall be opaque, matte white vinyl. Curtain shall include rust-proof grommets along top, one at every 150mm (6") intervals. Bottom and sides shall be hemmed. Curtain shall be 1830mm (72") high and 1778mm (70") wide.

A19, Double-Coin Recessed Napkin/Tampon Vendor: ASI (0464), Bobrick (B-4706), Bradley (4017) - Recessed napkin/tampon vendor shall combine two dispensing mechanisms in one cabinet to provide napkins or tampons at user's option. Dispensing mechanisms shall be convertible to allow the change of coin denomination without purchasing new mechanisms or removing unit from wall. Unit shall be type 304 stainless steel with all-welded construction. Cabinet shall be .85mm (22 gage). Door shall be 1.31mm (18 gage); exposed surfaces shall have satin stainless steel finish. Door shall have 22.2mm (7/8") 90 degree return edges; be secured to cabinet with a concealed, full-length, stainless steel piano-hinge; and equipped with a stainless steel cable doorstop and two tumbler locks. Recessed depth shall be maximum 165mm (6-1/2"). Each coin box shall be equipped with a tumbler lock that is keyed differently than door locks. Unit shall carry no brand-name advertising. Unit shall be equipped with double-coin mechanisms in the amount to be determined by the Government.

A19-b, Surface-Mounted Napkin / Tampon Vendor: ASI (0864), Bradley (426), Bobrick (B-2706) Recessed sanitary napkin / tampon vendor shall combine two dispensing mechanism in one cabinet to provide sanitary napkin or tampon at user's option. Dispensing mechanism shall be pre-set for 25 cent operation, but shall convert able in the field to allow the change of coin denomination without purchasing new mechanism or removing unit for the wall. Door shall be furnished with metal plates indicating specified coin denomination. Unit shall be type 304 stainless steel all welded construction. Exposed surfaces shall be satin finish. Flanges shall be drawn, one-piece, seamless construction; secured to cabinet with a full length, stainless steel piano hinge. Door shall be equipped with steel door swing limiter and concealed tumbler lock. Pull knobs shall be operable with one hand and with less than 5 lbs. of force. Each coin box shall be equipped with a tumbler lock that is keyed differently than door locks. Units shall not carry brand name advertising.

A20, Recessed Multipurpose Unit with Mirror, Paper Towel Dispenser, Shelf, and Soap Dispenser: ASI (0430), Bradley (130) - Recessed-mounted multipurpose unit shall incorporate mirror, paper towel dispenser, shelf and soap dispenser. Unit shall be type 304 stainless steel all welded construction. Exposed surfaces shall be satin finish. Mirror shall be mounted to the door secured to cabinet with a full length, stainless steel piano hinge. Door shall be equipped with a steel door swing limiter and concealed tumbler lock. Paper towel dispenser shall dispense 600 C fold or 800 multifold paper towels. Soap valve shall be operable with one hand and with less than 22.2N of force. Soap vessel shall slide out for easy refilling and have a capacity of 2.5L (80 fl oz).

A21, Stainless Steel Frame Mirror (Full Length): ASI (0600), Bobrick (B-290), Bradley (780) - Angle framed mirror,: 1830mm x 915mm (72" x 36"), shall be stainless steel with a satin finish. Mirror shall be No.1 quality, 6mm (1/4-inch) select float glass selected for silvering, electrolytically copper-plated by the galvanic process, and guaranteed for 15 years against silver spoilage. All edges protected by plastic filler strips. Back is protected by full-size, shock-absorbing, water-resistant, nonabrasive, 5mm (3/16-inch) thick polyethylene padding.

A21-b, Stainless Steel Framed Mirror: Bobrick (B-290) shall be framed with one-piece, type 304, stainless steel angle, 3/4 by 3/4 inch with continuous integral stiffener on all sides and beveled edge to hold frame tightly against mirror. Corners shall be heliarc welded, ground and polished smooth. All exposed surfaces shall be satin finish. Mirror shall be No. 1 quality 1/4 - inch tempered glass. All edges shall be protected by high impact plastic filer strips. Back of mirror shall be protected by shock absorbing, waterproof, non-abrasive 1/4 inch thick polystyrene padding. Galvanized steel back shall have integral hanging brackets for mounting on concealed rectangular wall hangar(s) and be secured with concealed Phillips-head locking screws in lower frame.

A22, Surface Mounted Roll-Paper-Towel Dispenser: ASI (2482-11), Bobrick (B-2860), Bradley (2483) - Surface mounted, roll paper towel dispenser. Push-bar or lever-handle operated. Stainless steel cabinet. Dispenses one standard core 205mm or 230mm(8" or 9") wide, up to 244M (800 feet*) long.*

A22-b, Surface Mounted Paper Towel Dispenser and Waste Receptacle: ASI (20469-9), Bradley (237-11), Bobrick (B-43949)- Surface Mounted Paper Towel Dispenser and Waste Receptacle shall be constructed entirely of Type 304, 22 gauge. Stainless steel, welded construction with exposed surfaces satin finish. Flange shall be drawn one-piece seamless construction. Door shall be secured double pan construction and equipped with a knob latch. Door shall be secured to cabinet with full stainless steel piano hinge. Paper Towel Dispenser shall be capable of dispensing 600 C-fold or 800 Multifold paper towels without use of adapters. Waste receptacle shall have a formed, one-piece, seamless removable front panel with top edge hemmed and shall be equipped with interior clips for securing furnished reusable vinyl liner. Waste receptacle shall have capacity of minimum 12 gal.

A22-c, Surface Mounted Roll-Paper Towel Dispenser And Receptacle: Bobrick (B-39619) Roll Paper Towel Dispenser shall be constructed of type 304 stainless steel with all welded construction. Exposed surfaces shall have satin finish. Door shall be secured to cabinet with a full length stainless steel piano hinge and equipped with a tumbler lock. Dispenser shall deliver a preset length of towel per stroke of lever and shall accept standard core rolls 8 inches wide. Unit shall accept stub rolls together with a new roll. When stub is used up, new roll shall automatically start to dispense. Dispenser lever shall be operable with one hand, without tight grasping, pinching, or twisting of the wrist and with less than 5 lbs. of force to comply with barrier free accessibility guidelines. waste receptacle shall be type 304, stainless steel with satin finish with edges hemmed and shall be equipped with interior clips for securing furnished reusable vinyl liner. Waste receptacle shall be secure to cabinet with a tumbler lock and have a capacity of minimum 12 gal.

A22-d, Surface-Mounted Paper Towel Dispenser: Bobrick (B-262) Surface mounted paper towel dispenser shall be constructed entirely of type 304, stainless steel, welded construction with exposed surfaces satin finish. Towel tray shall have an hemmed opening. Door shall be doubled pan construction and equipped with a tumbler lock. Door shall be secured to cabinet with full length stainless steel piano hinge. Paper towel Dispenser shall be capable of dispensing 400 C-fold or 525 Multifold paper towels without using adapters.

A22-e, Surface Mounted Waste Receptacle: ASI (0825), Bobrick (B-275) Waste Receptacle shall be type 304, 22 gauge, stainless steel all welded construction, exposed surfaces shall have satin finish. Waste receptacle shall be equipped with 4 interior hooks, have reinforced mounting screws, and shall be furnished with a heavy-gauge vinyl liner. Unit shall have a capacity of 17 gal.

A23, Folding Shower Seat: Bradley (9569), Bobrick (B-5181) Reversible shower seat shall have a frame constructed of type 304, satin finish stainless steel, that consists of square tubing and seamless tubing. Seat shall be one-piece, solid phenolic with matte finish, ivory colored, melamine surfaces, and black phenolic-resin core; secured to frame with stainless steel carriage bolts and acorn nuts. Seats shall be reversible or shall accommodate right or left seating. Shower seats shall be equipped with two mounting flanges constructed of type 304 satin finish stainless steel; a guide bracket constructed of type 304, satin finish stainless steel; and a spring constructed of type 301, stainless steel spot welded to a baseplate of type 304 heavy-gauge stainless steel. Seat shall remain in upright position when not in use. Shower seat shall comply with ADA/ABA barrier free guidelines.

A23-b, Solid Phenolic Folding Shower Seat: Bobrick (B-5191) Folding Shower Seat shall have a frame constructed of type 304, satin finish stainless steel, that consists of square tubing and seamless tubing. Seat shall be one-piece, solid phenolic laminate with matte finish, ivory colored, melamine surfaces, and black phenolic-resin core; secured to frame with stainless steel carriage bolts and acorn huts. Shower seats shall be equipped with two mounting flanges constructed of type 304, satin finish stainless steel,; a guide bracket constructed of type 304, satin finish stainless steel; and a spring constructed of type 301, stainless steel spot welded to a baseplate of type 304 heavy gauge stainless steel. Seat shall remain in upright position when not in use. Shower seat shall comply with ADA/ABA barrier free guidelines.

A24, Surface Mounted Seat Cover Dispenser: Bobrick (B-221) Surface mounted toilet seat cover shall be type 304, 20 gauge stainless steel with drawn , one piece, seamless construction; exposed surface shall have satin finish. Unit shall have a rectangular or oval opening for dispensing toilet seat covers and a concealed opening in bottom for filling. Capacity shall be 250 paper toilet seat covers.

---End of Section---

SECTION 10 44 00.00 48 – FIRE EXTINGUISHERS, CABINETS AND ACCESSORIES

Scope: 1. Provide portable fire extinguishers and cabinets. Provide mounting brackets where no cabinet is indicated.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASTM INTERNATIONAL (ASTM)

ASTM E814 Standard Test Method for Fire Tests of Penetration Firestop Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10 Standard for Portable Fire Extinguishers

UNDERWRITERS LABORATORIES (UL)

UL 711 Rating and Fire Testing Fire Extinguishers

Product Manufacturers:

1. Fire Extinguisher Cabinets (FEC)

J. L. Industries;
4450 W. 78th St. Circle
Bloomington, MN 55435,
800-554-6077

Larsen's Manufacturing Company;
7421 Commerce Lane N.E.
Minneapolis, MN 55432
800-527-7367

Potler-Roemer;
17451 Hurley Street,
City of Industry, CA 91744
800-366-3473

2. Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, and location.

Coordination:
1. Fire extinguishers shall also be provided. Fire extinguisher shall be 20 lb size minimum and shall meet NFPA 10 requirements. Coordinate size of cabinet and extinguisher. Coordinate installation of fire extinguishers prior to contract completion. Coordinate the exact location of cabinet with other work.

Quality Assurance:
1. Provide units conforming with UL 711.

Regulatory Requirements:
1. Conform to NFPA 10 for requirements for extinguishers.

Products:

1. Fire extinguishers: Fire extinguishers shall also be provided. Fire extinguisher shall be 20 lb ABC Dry Chemical fire extinguisher minimum and shall meet NFPA 10 requirements. Contractor shall determine type of extinguishers required. Coordinate size of cabinet and extinguisher. Coordinate installation of fire extinguishers prior to contract completion. Coordinate the exact location of cabinet with other work.
2. Cabinets: Trimless recessed or semi-recessed steel cabinet with baked enamel finish. Steel door shall be red baked solid type, 30 gage with white silk screened words: "Fire Extinguisher" arranged vertically. Cabinet shall be sized to accommodate a 20 lb ABC Dry Chemical fire extinguisher.

---End of Section---

SECTION 10 50 00.00 48 – METAL LOCKERS

Scope: 1. Provide single and double tier metal lockers and bench seat.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASTM INTERNATIONAL (ASTM)

ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy Coated (Galvanized) by the Hot-Dip Process

Products: 1. Sheet Steel: ASTM A653 Grade D, Coating Designation G90, stretcher leveled; to the following minimum thicknesses:

a. Body and Shelf: 24 gage
b. Door Outer Face: 16 gage
c. Door Inner Face: 20 gage
d. Door Frame: 16 gage
e. Hinges: 14 gage
f. Base: 20 gage
g. Sloping Top: 20 gage
h. Trim: 20 gage

2 Single Tiered Locker: Size shall be a minimum 12 inches wide, 15 inches deep, 72 inches high (Dust covers around the entire perimeter of the base will increase height by 6 inches to 78 inches.) Provide dust covers with sloped tops and end covers to preclude dust accumulation. End panels as required per drawing configuration. Maximum size of grouping units is three lockers per unit. Latch hook to have bevel on front upper edge to allow latch clip to ride up slope as door closes. Steel door frames of minimum 16 gauge metal with three hinges of minimum 14 gauge steel. Vertical members shall have an additional flange to form continuous door strike. Minimum gauge for top, bottom, shelves, sides, back and row ends of 24 gauge steel. Eyelet for padlock must accept a 5/16 inch padlock shank, providing a secured locking three point latching mechanism. Lockers will be sequentially numbered with a plate beginning with #1. Locker will contain a single shelf at top and wall hooks on both sides. Louvers for circulation both at top and bottom. Lockers are to be installed in the room with dust covers installed. Color shall be as selected by the Architect and accepted by the Government

3 Double Tiered Locker: Size shall be a minimum 12 inches wide, 15 inches deep, 36 inches high, 72 inches over all (Dust covers around the entire perimeter of the base will increase height by 6 inches to 78 inches.) Provide dust covers with sloped tops and end covers to preclude dust accumulation. End panels as required per drawing configuration. Maximum size of grouping units is three lockers per unit. Latch hook to have bevel on front upper edge to allow latch clip to ride up slope as door closes. Steel door frames of minimum 16 gauge metal with three hinges of minimum 14 gauge steel. Vertical members shall have an additional flange to form continuous door strike. Minimum gauge for top, bottom, shelves, sides, back and row ends of 24 gauge steel. Eyelet for padlock must accept a 5/16 inch padlock shank, providing a secured locking three point latching mechanism. Lockers will be sequentially numbered with a plate beginning with #1. Locker will contain a single shelf at top and wall hooks on both sides. Louvers for circulation both at top and bottom. Lockers are to be installed in the room with dust covers installed. Color shall be as selected by the Architect and accepted by the Government

4. Locker Benches: Stationary free standing type; bench top of laminated maple species wood, stained, sealed and varnished; pedestals of chrome steel 17 1/2 inches high.

Fabrication: 1. Locker Unit:

a. Mounting: Surface mounted and free standing.
b. Base: Metal base, 4 inches high.

c. Top: Sloped metal with closures.
d. Locking: Equipped for built-in with master key cylinder locks.
e. Ventilation Method: Louvered top and bottom frame and top and bottom of door.

---End of Section---

SECTION 10 55 00.00 48 – POSTAL SPECIALTIES

Scope: 1. Provide postal specialties acceptable to postal authorities.

Products: 1. Mailboxes: Mailboxes shall be U.S. Postal Service approved. Mailboxes, materials, sizes, construction, and installation shall comply with U.S. Postal Service regulations and shall be fully approved by the U.S. Postal Service.

a. Materials: Quantities and arrangement of mailboxes shall be as indicated on the drawings. Mailboxes shall be rear-loading type with sheet aluminum removable rear covers strengthened with formed sheet aluminum stiffeners. Framework supporting compartment doors shall be fabricated from high strength extruded aluminum alloy. Compartment doors shall be fabricated from high strength extruded aluminum alloy, with a minimum of 1/8 inch thickness, and swing on concealed hinge pins. When closed, the door shall interlock with frame member along hinge side and shall be precision fitted to preclude prying. Doors shall be reinforced vertically along both sides and near center with integral ribs. Locks on individual compartment doors shall be springlatch type lock actuated by a cam type lock with two change keys per lock and a minimum of 1000 available key changes. All locks within project shall be keyed differently. Compartment construction shall be double-walled high strength sheet aluminum alloy with vertical stiffeners of formed aluminum. Finish shall be as indicated. Mail box manufacturer shall furnish aluminum channel type card holders with pressure sensitive backing to accommodate 7/16 inch by 2 1/2 inch cards for individual and/or unit names.

---End of Section---

SECTION 10 56 13.00 48 – STORAGE SHELVING

Scope: 1. Metal Storage Shelving.

Quality Assurance:

1. Manufacturer Qualifications: Firm with not less than 3 years of production experience, whose published literature clearly indicates general compliance of products with requirements of this section.
2. Installer Qualifications: Firm specializing in metal storage shelving installation with not less than 2 years of experience in installation of metal storage shelving and pallet racks similar to that required for this project.
3. Single Source Responsibility: Provide material produced by a single manufacturer for each shelving unit type.

Warranty: 1. Special Project Warranty: Submit a written warranty, executed by the Contractor, Installer and the Manufacturer, agreeing to repair or replace shelving units which fail in materials or workmanship within the specified warranty period. This warranty shall be in addition to and not a limitation of other rights the Government may have against the Contractor under the Contract Documents. Warranty period is 2 years after the date of Substantial Completion.

Maintenance:

1. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions. Include precautions against materials and methods which may be detrimental to finishes and performance.
2. Replacement Materials: After completion of work, deliver not less than 2 of each type, color, and pattern of metal storage shelving, exclusive of material required to properly complete installation. Furnish 2% of accessory components as scheduled. Furnish replacement materials from same production run as materials installed. Package replacement materials with protective covering, identified with appropriate labels.

Products: 1. Product Manufacturers
:

Penco Products Inc.;
1820 Stonehenge Drive
Greenville, NC 27858
800.562.1000
www.pencoproducts.com

Republic Storage Systems Co., Inc.;
3743 Boettler Oaks Dr.
Uniontown, OH 44685
800.477.1255
www.republicstorage

2. Metal Storage Shelves:
   a. General: Minimum 20 gauge cold-rolled steel sheet metal, washed to receive powder coated baked enamel finish, higher gauge where indicated to provide appropriate loading capacity. Shelving shall meet the requirements of ANSI MH28.1.
   b. Open Shelving: Provide extra heavy-duty (Penco Class 2), 900 pound capacity open shelving units consisting of four upright corner pilasters, slotted to receive clips clipped together with shelves as indicated. Provide cross-braces laterally and at ends as required for stability with intended load. Shelves adjustable 38 mm on center. Provide 48 inches wide by 87 inches high units, unless otherwise indicated on drawings or in specifications. Provide 5 shelves of standard 24 and 32 inch depth.

c. Lateral Cross Braces: Minimum 12 gauge, 1 inch wide steel band, formed and punched at each end, capable of bolting to T sections. Provide one pair of cross braces for every three sections of under 30 inches; two pairs for every two sections 30 inches and over.
d. Bases: Channel-shaped to engage upright T sections with spring fasteners, minimum 20 gauge for 3 inch base, minimum 18 gauge for 6 inch base.
e. Finish: Provide units in finishes and colors from manufacturer's standard grey.

---End of Section---

SECTION 10 75 00.00 48 FLAGPOLES

Scope: 1. Provide Ground mounted flagpole systems.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M-36 Corrugated Metal Culvert Pipe.

ASTM INTERNATIONAL (ASTM)

ASTM B241/B241M Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

Product Manufacturers:

1. Manufacturers

American Flags Express
12577 W. Custer Ave.
Butler, WI 53007
262.783.4800
www.flagsexpress.com

Concord American Flagpole
P. O. Box 2449
4150-A Kellway Circle
Addison, Texas 75001
800.527.3902
www.concordamericanflagpole.com

Ewing Flagpoles., Inc.;
2316 Delaware Avenue #283
Buffalo, NY 14216
877.291.4917
www.ewingflagpole.com

2. Shop Drawings: Indicate detailed dimensions, base attachment details, anchor requirements, and imposed loads.
3. Samples: Submit two samples 4” x 4” in size illustrating pole material, color, and finish.

Products:
1. Aluminum: ASTM B241/B241M, 6063 alloy, T6 temper.
2. Pole Configuration: Ground Mounted, tapered shaft, internal halyard with winch.
3 Components and Accessories:
   a. Finial Ball: Stainless steel, 3” diameter.
   b. Truck Assembly: Cast aluminum revolving, stainless steel ball bearings, non-fouling.
   c. Flag: provided by others
   d. Winch: An internal winch operated by a removable handcrank. The winch contains an automatic brake system to permit locking of the flag in any position.
   e. Winch Box: Aluminum, with built-in hinge and lock assembly, attached to pole with tamper proof screws inside box. Provide two keys to operate the lock.
   f. Halyard: Stainless steel aircraft cable with two chrome plated bronze swivel snaphooks, plastic covered counterweight and beaded sling.

g. Primer: As recommended by the flagpole manufacturer.

4. Mounting Components: Foundation to be sized based on local conditions.
   a. Foundation Tube Sleeve: AASHTO M-36, corrugated 16 gage steel, galvanized, depth as recommended by the flagpole manufacturer.
   b. Pole Base Attachment: Flush aluminum base with base cover.
   c. Lighting Ground Rod: 12 inch long copper rod, 0.188 inch diameter.
   d. Lightning Ground Cable: Copper No. 6 AWG, soft drawn.
5. Finishes: Selection to be made from manufacturer's standard.

---End of Section---

SECTION 11 13 00.00 48 LOADING DOCK EQUIPMENT

Scope: 1. Provide commercial and industrial loading dock equipment.

Submittals: 1. Shop Drawings: Truck Levelers; Drawings with complete wiring, schematic diagrams, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detail drawings shall show proposed layout and anchorage of equipment and appurtenances. Detail drawings shall show; method of mounting and anchoring; and location of control stations and disconnect switches.
2. Product Data: Truck Levelers; Data including a complete list of equipment and materials, manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions.

Warranty: 1. Provide manufacturers 10 year warranty.

Products: 1. Surface Mounted Truck Leveler: 10ft x 15ft, 60,000lb capacity and a 36-inch lift, Model TL-515 as manufactured by Advanced Lifts, Inc. or equal
2. Dock Bumpers shall be high impact resistant molded or laminated rubber with angles and rods, hot dipped galvanized (ASTM A123).
   a. Width: 4 inch.
   b. Vertical Height:12 inch.
   c. Length:18 inch.
3. Attachment Hardware: Galvanized bolts and expansion shields.
4. Touch-up Primer: Organic zinc paint, minimum 70 percent solids content.

---End of Section---

SECTION 11 30 00.00 48 RESIDENTIAL EQUIPMENT

Scope:
1. Provide refrigerator and microwaves at break rooms.
2. Provide undercounter refrigerator at Family Support room.

References:
1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 250	UL Standard for Safety Household Refrigerators and Freezers
UL 923	Standard for Microwave Cooking Appliances

Products:
1. Refrigerator: UL 250, refrigerator with frostproof top or side by side freezer, minimum 20 cubic feet, automatic defrost, two vegetable bottom baskets, four adjustable shelves, two door shelves and minimum 12 egg container in the door, separate interior shelves, multiple door shelves, and door mounted ice and water dispenser. Provide data identifying Energy Star label for refrigerator. For refrigerator with top freezer, provide reversible (left swing and right swing interchangeable) doors. Provide four fixed rollers or adjustable leg levelers. Refrigerator shall be white.
2. Microwave Oven: UL 923, built-in with black glass window door, minimum 1.5 cubic feet capacity, automatic oven light, browning element, 10 power levels, automatic temperature controllers, minimum two automatic memory levels, digital time controllers, and electronic touch-control panel. Microwave shall be white.
3. Undercounter Refrigerator: UL 250, undercounter refrigerator, corrosion resistant inner lining with automatic defrost freezer, minimum 5 cubic feet total. Provide minimum one ice cube tray, removable shelves, automatic interior light, adjustable cold. Refrigerator shall be white

Execution:
1. Installation: Install kitchen equipment in accordance with manufacturers' instructions and NFPA 70.

---End of Section---

SECTION 11 52 13.00 48 PROJECTION SCREENS

Scope: 1. Provide motorized and manual projection screens for classroom, meeting room, and office applications.

Reference: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORIST (AATCC)

AATCC TM 30 Test Method: Antifungal Activity Assessment on Textile Materials: Mildew and Rot Resistance of Textile Materials

ASTM INTERNATIONAL (ASTM)

ASTM D6413 Vertical Flame Test for Flame Resistance of Textiles

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701 Standard Methods of Fire Tests for Flame-Resistant Textiles and Films.

Quality Assurance:

1. Single Source Responsibility: Obtain each type of projection screen required from a single manufacturer as a complete unit, including necessary mounting hardware and accessories.
2. Coordination of Work: Coordinate layout and installation of projection screens with other construction supported by, or penetrating through partition.

Products: 1. Motorized Projection Screen: Recessed mounted motorized projection screen shall have 120V motor that is lubricated for life, quick reversal type, has overload protector, integral gears, and preset accessible limit switches. Recessed mounted projection screens shall have an operable closure door and access panel. Screen shall be flame retardant, mildew resistant, and glass beaded or white matte. Bottom of screen fabric shall be weighted with metal rod. Roller shall be a rigid metal at least 3 inch diameter mounted on sound absorbing supports. Motor will be end mounted design. Screen shall have a 3 position control switch to stop or reverse screen at any point. The switch shall be installed in a flush electrical box with cover plate, location(s) as shown on the electrical drawings. All conduit and wiring from the control switch to the projection screen shall be furnished and installed by the Contractor. Ceiling recessed case shall be extruded aluminum or wood with metal lined motor compartment. Screen shall be UL listed. The size shall be as shown in the drawings.

2. Projection Screen Surfaces:
   a. Measurement of Gain of Screen Viewing Surface: Measure gain of screen viewing surface against that of a magnesium carbonate surface by means of a photogoniometer using test methods to determining effect of reflected light at various viewing angles on screen surfaces. Ratings of 1.0 refer to those viewing surfaces having a reflectivity equal to the magnesium carbonate surface.
   b. Material and Viewing Surface of Front Projection Screens: Obtain screens manufactured from mildew- and flame-resistant fabric. Matte-White Viewing Surface: Peak gain of not less than 0.9, and gain of not less than 0.8 at an angle of 50 degrees from the axis of the screen surface, without black masking borders.

c. Fire Performance Characteristics: Provide projection screen fabrics identical to those materials that have undergone testing and passed requirements for flame resistance as indicated below:
   1) NFPA 701 per small-scale test: ASTM D6413.1 for test method.

---End of Section---

SECTION 12 20 00.00 48 WINDOW TREATMENT

Scope: 1. Provide window coverings.
   a. Horizontal blinds.
   b. Blackout Shades.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701 Methods of Fire Tests for Flame-Resistant Textiles and Films

Warranty 1. Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided

Products: 1. General: Window treatment shall be provided, complete with necessary brackets, fittings, and hardware. Equipment shall be mounted and operated as indicated. Windows to receive a treatment shall be completely covered. The Contractor shall take measurements at the building and shall be responsible for the proper fitting and hanging of the equipment
2. Horizontal Blinds: Each blind, including hardware, accessory items, mounting brackets and fastenings, shall be provided as a complete unit produced by one manufacturer. All parts shall be one color unless otherwise shown, and match the color of the blind slat. Steel features shall be treated for corrosion resistance.
   a. Horizontal Blinds: Provide horizontal blinds with 1 inch slats. Blind units must be capable of nominally 180 degree partial tilting operation and full-height raising. Blinds must be inside or outside mount. Tapes for 1 inch slats must be braided polyester or nylon.
   b. Head Channel and Slats: Head channel shall be aluminum corrosion-resistant finish nominal 0.024 inch for 1 inch slats. Provide slats of aluminum, not less than 0.1 inch thick, and of sufficient strength to prevent sag or bow in the finished blind. Provide a sufficient amount of slats to assure proper control, uniform spacing, and adequate overlap. Enclose all hardware in the headrail.
   c. Controls: The slats shall be tilted by a transparent tilting wand, hung vertically by its own weight, and shall swivel for easy operation. The tilter control shall be of enclosed construction. Moving parts and mechanical drive shall be made of compatible materials which do not require lubrication during normal expected life. The tilter shall tilt the slats to any desired angle and hold them at that angle so that any vibration or movement of ladders and slats will not drive the tilter and change the angle of slats. A mechanism shall be included to prevent over tightening. The wand shall be of sufficient length to reach to within five feet of the floor.
   d. Intermediate Brackets: Intermediate brackets shall be provided for installation of blinds over 48 inches wide and shall be installed as recommended by the manufacturer.
   e. Bottom Rail: Provide bottom rail made of corrosion-resistant steel with factory applied finish. Provide closed oval shaped bottom rail with double-lock seam for maximum strength. Bottom rail and end caps to match slats in color.
   f. Braided Ladders Provide braided ladders of 100 percent polyester yarn, color to match the slat color. Space ladders 15.2 slats per foot of drop in order to provide a uniform overlap of the slats in a closed position.
   g. Hold-Down Brackets: Universal type hold-down brackets for sill or jamb mount shall be provided.
3. Light Filtering Shades: Provide light filtering window shades to conform with the following:
   a. Roller tube must be extruded aluminum or steel. Diameter, wall thickness, and material to be selected by the manufacturer to accommodate the shade size. Provide roller idler assembly of molded nylon and zinc-plated steel pin. Sliding pin must allow easy installation and removal of roller. Fabric must be connected to the roller tube with double sided

adhesive specifically developed to attach coated textiles to metal to eliminate horizontal impressions in fabric or attached with a spline lock system.

b. Fascia must be L-shaped aluminum extrusion to conceal shade roller and hardware that snaps onto end caps without requiring exposed fasteners of any kind. Fascia can be mounted continuously across two or more shade bands.

c. End caps must be stamped steel with universal design suitable for mounting to window mullions. Provide size compatible with roller size. End cap covers must match fascia/headbox finish.

d. Provide hardware that allows for field adjustment or removal of shade roller tube and other operable hardware component or adjustment of motor without requiring removal of brackets and end or center supports. Provide hardware system that allows for operation of multiple shade bands by a single operator. Connectors must be offset to assure alignment from the first to the last shade band. Provide shade hardware constructed of minimum 1/8 inch thick plated steel or heavier as required to support 150 percent of the full weight of each shade.

e. Manual Operated Chain Drive Hardware must provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset must be adjustable for future change. Provide positive mechanical engagement of drive mechanism to shade roller tube. The drive bracket must be fully integrated with all accessories. Drive chain must be #10 stainless steel chain rated to 90 lb. minimum breaking strength.

f. Motors must be hard-wired, wired into the building electrical system. The position of the motor and electrical connection must be left or right side of roller

4. Room Darkening Shades: Provide room darkening (black-out) window shades designed to eliminate all visible light gaps when shades are fully closed, and conform with the following:

a. Roller tube must be aluminum, controlled by webbing tape or crank operated gear box with steel rods. Provide shop fabricated light traps, consisting of a head box to house the shade roller, and U-shaped channels to serve as guides for the shade along the sides and to receive the bottom edge of the shade along the sill.

b. Provide light trap made of sheet steel having a minimum thickness of 22 gauge or anodized, extruded, aluminum. The legs of the channels must be not less than 1-3/4 inches long and separated by the minimum distance that will permit free operation of the shade. Edges of light trap coming into contact with the shade cloth must be smooth pile light seal. The exposed face of the head box must be hinged or removable for access to the shade roller. The interior or unexposed surfaces of the light trap must have a finish coat of flat black enamel. The exposed portions of the light trap must have a factory-applied priming coat of gray paint.

c. Cloth must be of type for blackout purposes. Make the shade from a single piece of canvas duck cloth laminated to vinyl. When not finished with a selvage, the vertical edges of the shade must be bound or hemmed using a high-grade thread. Make needle holes lightproof by applying a suitable filler.

d. Fit the bottom edge of the shade with a steel operating bar. Shades will engage positively with bottom rail through operating bar or chain pull. Paint bars with flat black enamel. Make pull cords of No. 4 braided nylon or beaded chain having not less than 175 pounds breaking strength.

---End of Section---

SECTION 12 48 00.00 48 RUGS AND MATS

Scope:
1. Provide entrance mats system for building entrances.
2. Provide maintenance mat at copier machines.

Product:
1. Entrance Mats: Recessed mat system shall be equal to M2 - PEDIMAT AA; as manufactured by Construction Specialties, Inc, 6696 Route 405 Highway, Muncy, Pennsylvania 17756 800-233-8493 or equal.
   a. Frame: **S**hall be a ¾ min deep recessed aluminum frame in 6063-T5 aluminum alloy with 1/4" wide exposed surface. Frame shall be supplied in mill finish. Provide a flush transition from the entryway door threshold to the mat surface.
   b. Rails: Aluminum - ASTM B 221, alloy 6063-T5, 6063-T6 for extrusions.
   c. Tread inserts: Inserts to be carpet, and shall meet the Carpet and Rug Institute's standard for indoor air quality. Fibers shall include a minimum of 100, 12 mil monofilament fibers per square inch and colorfast, solution-dyed nylon. Color: as selected.
2. Maintenance Mat: Clear vinyl mat, cleats on back to prevent slipping, sized for the type of carpet its used on, edges shall be tapered.

---End of Section---

SECTION 13 34 19.00 48 PRE-ENGINEERED STRUCTURES

Scope: 1. Pre-engineered metal building designed in accordance with MBMA Low Rise Building Systems Manual

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ALUMINUM ASSOCIATION (AA)

AA ADM	Aluminum Design Manual
AA ASD-1	Aluminum Standards and Data

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA),

AAMA/WDMA/CSA 101/I.S.2/A440	North American Fenestration Standard/Specification for windows, doors, and skylights (NAFS)

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	Steel Construction Manual
AISC 341	Seismic Provisions for Structural Steel Buildings
AISC 360	Specification for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121	Standard Definitions for Use in the Design of Steel Structures
AISI SG03-3	Cold-Formed Steel Design Manual Set

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
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
ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A193/A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A463/A463M	Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A475	Standard Specification for Zinc-Coated Steel Wire Strand
ASTM A500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A501	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A529/A529M	Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A572/A572M	Standard Specification for High-Strength Low-Alloy Columbium-
ASTM A606	Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A755/A755M	Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A792/A792M	Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM A992/A992M	Standard Specification for Structural Steel Shapes
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B221/B221M	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B695	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C1363	Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
ASTM C273/C273M	Shear Properties of Sandwich Core Materials
ASTM C518	Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C553	Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C612	Mineral Fiber Block and Board Thermal Insulation
ASTM C665	Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM C991	Flexible Glass Fiber Insulation for Metal Buildings
ASTM C1289	Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D522	Mandrel Bend Test of Attached Organic Coatings
ASTM D523	Standard Test Method for Specular Gloss
ASTM D714	Standard Test Method for Evaluating Degree of Blistering of Paints
ASTM D822	Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1308	Effects of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D1621	Standard Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM D1622/D1622M	Apparent Density of Rigid Cellular Plastics

ASTM D1667	Standard Specification for Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D2244	Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2247	Testing Water Resistance of Coatings in 100 Percent Relative Humidity
ASTM D2794	Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3363	Film Hardness by Pencil Test
ASTM D4214	Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D6226	Standard Test Method for Open Cell Content of Rigid Cellular Plastics
ASTM DEFONLINE	ASTM Online Dictionary of Engineering Science and Technology
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96	Standard Test Methods for Water Vapor Transmission of Materials
ASTM E119	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E136	Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E1592	Test Method For Structural Performance of Sheet Metal Roof and Siding System by Uniform Static Air Pressure Difference
ASTM E1646	Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Air Pressure Difference
ASTM E1680	Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems
ASTM E283	Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F1852	Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM F3125/F3125M	Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions
ASTM F436	Hardened Steel Washers
ASTM F436M	Hardened Steel Washers (Metric)
ASTM F844	Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM G152	Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M Structural Welding Code - Steel
AWS D1.3/D1.3M Structural Welding Code - Sheet Stee

INTERNATIONAL CODE COUNCIL (ICC)

ICC Building Code International Building Code (IBC)

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA MBSM Metal Building Systems Manual

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500 Metal Finishes Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252 Standard Methods of Fire Tests of Door Assemblies
NFPA 80 Standard for Fire Doors and Other Opening Protectives

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA RoofMan The NRCA Roofing Manual

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793 Architectural Sheet Metal Manual, 7th Edition

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 15 Steel Joist Shop Primer
SSPC Painting Manual Good Painting Practice, Steel Structures Painting Manual, Volume 1
SSPC SP 2 Hand Tool Cleaning

STEEL WINDOW INSTITUTE (SWI)

SWI AGSW Architect’s Guide to Steel Windows

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 Safety and Health Requirements Manual

UNDERWRITERS LABORATORIES (UL)

UL 580 UL Standard for Safety Tests for Uplift Resistance of Roof Assemblies
UL Bld Mat Dir Building Materials Directory

General: 1. The metal building system covered under this specification shall be provided by a single manufacturer and shall include all components and assemblies that form a building. Structural Standing Seam Metal Roofing System, when specified, shall be furnished as part of a single manufacturer's system.

2. Building Configurations and Building Systems: Buildings shall have vertical walls and gable roofs. Roof slope shall be as shown on the drawings. Buildings shall be single-span structures with one of the following framing systems: self-framing, column with single-span or continuous trusses, continuous beam frames, column with rigid frame, rigid frame (tapered beam or plate girder), tapered trussed girder rigid frame, or rigid frame. Exterior doors, windows, overhead doors louvers, and foundations shall be included in the metal building system. Building shall be a manufacturer's advertised product, except that dimensions shall be not less than those indicated, but exceeding the indicated dimensions only by the amount of the closest standard size thereto. The minimum inside clear dimensions shall be as shown on the drawings. Eave height shall be measured from the top of the finished floor to the intersection of the insides of the roof and sidewall sheets. The clear opening between the finished floor and the bottom of the roof steel shall be as indicated. A metal building system consists of an integrated set of mutually dependent components and assemblies that form a building including primary and secondary framing, covering, roofing, and accessories, which are manufactured to permit inspection onsite prior to assembly or erection. A metal building system does not include foundations, mechanical equipment, fire protection, electrical, etc.

Qualifications:

1. Manufacturer: Metal building shall be the product of a recognized steel building systems manufacturer who has been in the practice of manufacturing steel buildings of the size and complexity of the building shown on the contract drawings, for a period of not less than 5 years. The manufacturer shall be chiefly engaged in the practice of designing and fabricating metal building systems. Provide engineering services by an authorized currently licensed engineer in the geographical area where construction will take place, having a minimum of four years experience as an engineer knowledgeable in building design analysis, protocols and procedures for the "Metal Building Systems Manual" (MBMA MBSM); ASCE 7, the building code in the geographic area where the construction will take place, and ASTM E1592
2. Installer: Erector shall have specialized experience in the erection of steel building systems for a period of at least 5 years, and at least 2 years experience in the erection of metal buildings of the size and complexity shown and provided by the selected manufacturer. The erector shall furnish temporary guys and bracing where needed for squaring, plumbing, and securing the structural framing against loads acting on the exposed framing, such as wind loads and seismic forces, as well as loads due to erection equipment and erection operation. Structural members shall not be field cut or altered. Welds, abrasions, and surfaces not shop primed or galvanized shall be primed after erection.
3. Manufacturer's Representative: A representative of the metal building manufacturer, who is familiar with the design of the building supplied and experienced in the erection of metal buildings similar in size to the one required under this contract, shall be present at the job site during construction from the start of the structural framing erection until completion of the installation of exterior covering to assure that the building meets the specified requirements.

Design Requirements:

1. The metal building system shall be designed by the system manufacturer as a complete system.

Design Conditions:

1. Loading combinations and definitions shall be in accordance with ASCE 7. Loading criteria as set out by MBMA Metal Building Systems Manual shall apply only where specifically stated by this specification.
2. Dead Load: The dead load shall consist of the weight of the structural frame and all other materials of the building system.
3. Collateral Loads: A minimum collateral load of 5 psf shall be applied to the entire structure to account for the weight of additional permanent materials other than the building system, such as sprinklers, mechanical systems, electrical systems, hung partitions, and ceilings. This allowance does not include the weight of hung equipment weighing 50 lb or more. Equipment loads of 50

lb or more shall be investigated and the structure (frame, purlins, girts) shall be strengthened as required. The Contractor is responsible for providing the Building Manufacturer the magnitude and approximate location of all concentrated loads greater than 50 lb.

4. Roof Live Loads: Roof live loads shall be determined and applied in accordance with ASCE 7.
5. Roof Snow Loads: Roof snow load shall be computed and applied in accordance with ASCE 7.
6. Roof Wind Uplift Loads: The design uplift wind pressures for the roof system shall be computed and applied in accordance with ASCE 7. The design uplift force for each connection assembly shall be that pressure given for the area of the connection assembly, and multiplied by the safety factor of 2.25 when two or more fasteners are in each connection. Roof panel shall be tested in accordance with ASTM E 1592 for structural rigidity. Test assembly must be a minimum of 24' long.
7. Thermal Loads: Roof panels shall be free to move in response to the expansion and contraction forces resulting from a total 200 degree F temperature range during the life of the structure.
8. Auxiliary Loads: Auxiliary (dynamic live) loads such as superimposed loads resulting from building machinery, craneways, and vehicles shall be as shown in the drawings. The Contractor shall verify that the auxiliary loads shown on the drawings exceed the loads imposed by the equipment supplied.
9. Concentrated Loads: Concentrated loads shall be applied at locations indicated on the drawings. The roof panels and concealed anchor clips shall be capable of resisting a 200 lb concentrated load at midspan on a 12 inch wide section of deck.
10. Seismic Loads: Seismic loads shall be computed in accordance with UFC 3-310-04 "Seismic Design of Buildings".
11. Drift Provision: Lateral deflections, or drift at the roof level of a structure in relation to the floor or slab on grade, caused by deflection of horizontal force resisting elements shall be calculated based on a 50 year mean recurrence interval and shall not exceed h/125.
12. Foundations: Foundations shall be designed for an allowable soil bearing pressure and a minimum bottom of footing depth below final exterior grade elevation according to project specific geotechnical report, a factor of safety of 1.5 for overturning, sliding and uplift, and a concrete compressive strength as specified in Section 03 30 00.00 48 CAST-IN-PLACE CONCRETE.
13. Structural Members and Connections: Structural steel members and their connections shall be designed in accordance with AISC 360. Aluminum structural members and their connections shall be designed in accordance with AA ADM. Framed openings shall be designed to structurally replace the covering and framing displaced. The allowable live load deflection of roof elements shall not exceed 1/180 of the span. Members with openings in their webs shall be designed with consideration of the additional stresses which will result due to the openings. Deflections of the steel framing above and along the side of rolling door openings shall be limited to a maximum of 1/2 of the allowable movement in the telescoping top roller of the doors to ensure proper operation of the doors.
14. Roofing and Siding Design: Steel or aluminum roofing and siding shall be designed in accordance with MBMA Metal Building Systems Manual. Section modulus and moment of inertia of aluminum sheet shall be determined for actual cross section dimensions by the conventional methods for actual design stresses and by effective width concept for deflection in accordance with AA ADM. Maximum deflection for wall and roof panels under full dead and live and/or wind loads shall not exceed 1/180 of the span between supports. The design analysis shall establish that the roof when deflected under dead plus live loads, will not result in a negative gradient. Maximum deflections shall be based on sheets continuous across two or more supports with sheets unfastened and fully free to deflect. In addition to the loads indicated above, the roof decking shall be designed for a 200 lb concentrated load at midspan on a 12 inch wide section of deck. Wall panels are not permitted for diaphragms or shear walls. The methods for resisting lateral forces shall be cross-bracing, or wind columns.
    a. Wall Panels: Maximum deflection for wall panels under full wind loads shall not exceed 1/180 of the span between supports. Wall panels are not permitted for diaphragms or shear walls. The methods for resisting lateral forces shall be cross-bracing, rigid frames, or wind columns.

b. Roof Panels: The panel deflection under applied dead load plus live load and/or wind load shall not exceed 1/180 time the span between supports; deflections shall be based on roof panels being continuous across two or more supports, the specified fastener spacing, and the ability of the unfastened roof panel to rotate freely on the support. The design analysis shall establish that the roof when deflected under dead plus live or snow loads, will not result in a negative gradient.
c. Gutters And Downspouts: Gutters and downspouts shall be designed according to the requirements of SMACNA Arch. Manual for storms which should be exceeded only once in 5 years, with adequate provision for thermal expansion and contraction.
d. Louvers: Louvers shall be fixed-blade type designed with insect screens, for a minimum net open area of 50 percent free air square feet, to be rainproof, and to resist vibration when air is passed at the rate of 6.5 feet per second.
e. Ventilators: Continuous roof ventilators shall be ridge mounted gravity type, designed for a minimum capacity of 100 cubic feet of air per minute for each 10 foot section based on a wind velocity of 5 miles per hour and an exterior-interior temperature differential of 10 degrees F and without screens in place.
f. Grounding and Lightning Protection: Grounding and lightning protection shall be provided as specified in Section 26 41 13.00 48 LIGHTNING PROTECTION.

Design Analysis:

1. The Contractor shall obtain the services of a licensed Professional Engineer to design the foundations, structure, roof and siding.

Warranties: 1. The Metal Building System (roofing, siding, and related components provided as part of the system) shall be warranted as described below against material and workmanship deficiencies, system deterioration caused by ordinary exposure to the elements and service design loads, leaks and wind uplift damage. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

Prime Contractor's Weathertightness Warranty:

1. The Metal Building System shall be warranted by the Contractor on a no penal sum basis for a period of five years against materials and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The Metal Building System covered under this warranty shall include, but is not limited to, the following: framing and structural members, roofing and siding panels and seams, interior or exterior gutters and downspouts, accessories, fasteners, trim, flashings and miscellaneous building closure items such as doors and windows (when furnished by the manufacturer), connectors, components, and fasteners, and other system components and assemblies installed to provide a weathertight system; and items specified in other sections of these specifications that become part of the metal building system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks and wind uplift damage shall be repaired as accepted by the Government. See the attached Contractor's written warranty for issue resolution of warrantable defects. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and/or system manufacturer, which shall be submitted along with Contractor's warranty. However, the Contractor is ultimately responsible for this warranty. The Contractor's written warranty shall be as outlined in attached WARRANTY FOR METAL BUILDING SYSTEMS, and start upon final acceptance of the facility. The Contractor shall provide a separate bond in an amount equal to the installed total metal building system cost in favor of the owner (Government) covering the Contractor's warranty responsibilities effective throughout the five year Contractor's warranty period for the entire metal building system as outlined above.

Manufacturer's Materials and System Weathertightness Warranties:

1. The Contractor shall furnish, in writing, the following manufacturer's material warranties to the Government which cover all Metal Building System components:
   a. A manufacturer's 20 year material warranty warranting that the specified aluminum, zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel will not rupture, structurally fail, fracture, deteriorate, or become perforated under normal design atmospheric conditions and service design loads. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed securement system, including fasteners and coil material.
   b. A manufacturer's 20 year exterior material finish warranty on the factory colored finish warranting that the finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of eight, as determined by ASTM D 4214 test procedures; or change colors in excess of five CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to replacing the defective coated material.
   c. Roof Manufacturer’s 20 Year Weathertightness warranty.

Products:

1. Framing and Structural Members: Steel 1/8 inch or more in thickness shall conform to ASTM A36/A36M, ASTM A529/A529M, ASTM A572/A572M, or ASTM A992/A992M. Uncoated steel less than 1/8 inch in thickness shall conform to ASTM A606, ASTM A1008/A1008M, or ASTM A1011/A1011M. Galvanized steel shall conform to ASTM A653/A653M, G 90 coating designation, 0.045 inch minimum thickness. Aluminum-zinc coated steel shall conform to ASTM A792/A792M, AZ 55 coating designation, 0.045 inch minimum thickness. Aluminum sheet shall conform to ASTM B209M ASTM B209; 0.032 inch minimum thickness. Aluminum structural shapes and tubes shall conform to ASTM B221/B221M. Structural pipe shall conform to ASTM A53/A53M, ASTM A500, ASTM A501, or ASTM B221/B221M. Holes for structural connections shall be made in the shop.
2. Roofing and Siding: Roofing and siding shall be either steel or aluminum and shall have a factory color finish.
   a. Roofing: Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope unless otherwise approved. Width of sheets with interlocking ribs shall provide not less than 16 inches of coverage in place. Panel shall match roof panels specified in Section Section 07 61 14.00 48 HYDROSTATIC (WATER-TIGHT) STANDING SEAM METAL ROOFING SYSTEM (HS-SSMRS). Roof Assemblies will be designed in accordance with ASCE 7 and ASTM E 1592.
   b. Siding: Length of sheet shall be sufficient to cover the entire height of any unbroken height of wall surface unless otherwise approved. Width of sheets with standard overlapping trapezoidal panels with gasketed fasteners shall provide not less than 16 inches of coverage in place. Siding shall have interlocking ribs for securing adjacent sheets. Siding shall be fastened to framework using concealed fasteners.
   c. Steel Panels: Roofing and Siding shall be zinc-coated steel conforming to ASTM A653/A653M, G 90 coating designation; aluminum-zinc alloy coated steel conforming to ASTM A792/A792M, AZ 55 coating; or aluminum-coated steel conforming to ASTM A463/A463M, Type 2, coating designation T2E5. Panels shall be 0.024 inch thick minimum.
   d. Aluminum Panels: Roofing and Siding shall be aluminum alloy conforming to ASTM B209/B209M, temper as required for the forming operation, minimum 0.032 inch thick.
   e. Factory Color Finish: Wall and roof panels shall have a factory applied polyvinylidene fluoride finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall be as selected by the architect and accepted by the Government. The exterior coating shall be a nominal 1 mil thickness consisting of a topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 0.2 mil thickness. The interior finish shall consist of the manufacturer's recommended thickness primer coating.

f. Accessories: Flashing, trim, metal closure strips and curbs, fascia, caps, diverters, and similar metal accessories shall be the manufacturer's standard products. Exposed metal accessories shall be finished to match the building finish. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the roofing or siding and shall not absorb or retain water.

3. Wall Liners: Wall liners shall be 0.024 inch thick minimum for aluminum or 0.018 inch thick minimum for steel. Matching metal trim shall be provided at base of wall liner, at top of wall liner, around openings in walls and over interior and exterior corners. Wall liners shall have manufacturer's standard finishes. Colors shall be selected from manufacturer's standard finishes.
4. Fasteners: Fasteners shall be as recommended by the manufacturer to meet the design strength requirements.
5. Windows: Windows shall be as specified in Section 08 51 13.00 48 ALUMINUM WINDOWS.
6. Doors:
   a. Hinged Doors: Hinged doors and frames shall receive a galvanic coating and factory primer and shall conform to the requirements of Section 08 11 13.00 48 STEEL DOORS AND FRAMES. Exterior doors shall have top edges closed flush and sealed against water penetration. Hardware shall be as specified in Section 08 70 00.00 48 DOOR HARDWARE.
   b. Overhead Rolling Doors: Overhead rolling doors shall conform to the requirements of Section 08 33 23.00 48 OVERHEAD ROLLING DOORS. Hardware shall be as specified in Section 08 70 00.00 48 DOOR HARDWARE.
7. Insulation: Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 75 degrees F in accordance with ASTM C518. Roof and wall insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Insulation including facings shall have a flame spread not in excess of 25 and a smoke developed rating not in excess of 50 when tested in accordance with ASTM E84. Contractor shall comply with EPA requirements for Recycled / Recovered Materials.
   a. Rigid Board Insulation:
      1) Polyisocyanurate: Polyisocyanurate insulation shall conform to ASTM C1289, Type I, Class 2 (having a minimum recovered material content of 9 percent by weight of core material in the polyisocyanurate portion). For impermeable faced polyisocyanurate (Ex: aluminum foil) the maximum design R-value per 1 inch of insulation used shall be 1.27.7.2.
      2) Polystyrene: Insulation shall conform to ASTM C578, Type IV
      3) Blanket Insulation: Blanket insulation shall conform to ASTM C991.
      4) Mineral Fiber: Insulation shall conform to ASTM C612.
   b. Insulation Retainers: Retainers shall be type, size and design necessary to adequately hold the insulation and to provide a neat appearance. Metallic retaining members shall be nonferrous or have a nonferrous coating. Nonmetallic retaining members, including adhesives used in conjunction with mechanical retainers or at insulation seams, shall have a fire resistance classification not less than that permitted for the insulation.
8. Sealant: Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubber like consistency.
9. Gaskets and Insulating Compounds: Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.
10. Vapor Retarder:
    a. Vapor Retarders as Integral Facing: Insulation facing shall have a permeability of 0.02 perm or less when tested in accordance with ASTM E96. Facing shall be white reinforced polypropylene Kraft laminate (PSK). Facings and finishes shall be factory applied.

b. Vapor Retarders Separate from Insulation: Vapor retarder material shall be polyethylene sheeting conforming to the requirements of ASTM D4397. A single ply of 10 mil polyethylene sheet; or, at the option of the Contractor, a double ply of 6 mil polyethylene sheet shall be used. A fully compatible polyethylene tape shall be provided which has equal or better water vapor control characteristics than the vapor retarder material. A cloth industrial duct tape in a utility grade shall also be provided to use as needed to protect the vapor retarder from puncturing.
c. Vapor Retarder of wall will be securely attached and sealed with the vapor retarder of the roof assembly.

11. Shop Priming: Ferrous surfaces shall be cleaned of oil, grease, loose rust, loose mill scale, and other foreign substances and shop primed. Primer coating shall be in accordance with the manufacturer's standard system, except that for ferrous surfaces to be installed in structures without heating and air-conditioning, the primer shall be SSPC-Paint 215 (Type I – Red Oxide).

---End of Section---

SECTION 14 24 00.00 48 HYDRAULIC ELEVATORS

Scope: 1. Provide pre-engineered hydraulic passenger elevators.
2. Project requirements: See Section 01 20 00.00 48 for Project Specific Requirements.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M Structural Welding Code-Steel

AMERICAN SOCIETY OF CIVIL ENGINEERS/STRUCTURAL ENGINEERING INSTITUTE

ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures
ASCE/SEI 24 Flood Resistant Design and Construction

ASME INTERNATIONAL (ASME)

ASME A17.1 Safety Code for Elevators and Escalators
ASME A17.2 Guide for Inspection of Elevators, Escalators, and Moving Walks Includes Inspection Procedures for Electric Traction and Winding Drum Elevators, Hydraulic Elevators, and Escalators and Moving Walks
ASME A17.3 Safety Code for Existing Elevators and Escalators

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

NEMA LD 3 High Pressure Decorative Laminates www.nema.org)

NATIONAL ELEVATOR INDUSTRY, INC. (NEII)

NEII-1 Building Transportation Standards and Guidelines, including the Performance Standards Matrix for New Elevator Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 National Electrical Code
NFPA 72 National Fire Alarm and Signaling Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines

Submittals: 1. Shop Drawings: Provide assembly and arrangement of elevators, accessories, and elevator components. Show location of elevator machine in elevator machine room (MR) or machinery space (MS). Show location of elevator controller in elevator machine room or elevator control room (CR). Provide details for materials and equipment, including but not limited to operating and signal fixtures, doors, door and car frames, car enclosure, controllers, motors, guide rails

and brackets, layout of hoistway in plan and elevation, and other layout information and clearance dimensions.

2. Product Data: Provide manufacturers' product data for all elevator components, including but not limited to the following: elevator controller, hydraulic pump unit, hydraulic pump and motor, hydraulic cylinder, hydraulic piping and fittings, car and hall fixture buttons and switches, cab and machine room or control room communication devices, door operator, door protection system, car roller guides, and buffers. For data sheets, provide document identification number or bulletin number, published or copyrighted prior to the date of contract bid opening. Provide controller manufacturer's published procedures for performance of each and all testing required by ASME A17.1/CSA B44.
3. Design Data
   a. Reaction Loads: Provide calculations by registered professional engineer for reaction loads imposed on building by elevator system. Demonstrate calculations complying with ASME A17.1/CSA B44
   b. Heat Loads: Provide calculations from elevator manufacturer, or by registered professional engineer, for total anticipated heat loads generated by all of the elevator equipment.
   c. Emergency Power Systems: Where the facility does have an emergency power system, confirm the elevators that will be connected to the emergency power system. Confirm the complete emergency power system and sequence of operation for all elevators, including operation of the elevator lobby manual selection switch. Provide wiring diagrams for building emergency power interface with elevator controls. For elevators not supplied by an emergency power system, provide manufacturers' product data for auxiliary power systems.
2. Welders' Requirements: Comply with AWS D1.1/D1.1M, Section 5. Include certified copies of field welders' qualifications. List welders' names with corresponding code marks to identify each welder's welding work
3. Maintenance Control Program (MCP):
   a. For each elevator, prepare and provide a written Maintenance Control Program (MCP) that complies with ASME A17.1/CSA B44 Section 8.6, including written documentation that details the test procedures for each and every test that is required to be performed by ASME A17.1/CSA B44. Assemble all MCP documentation, and supporting technical attachments, in a single MCP package and provide in both electronic and hard copy. Assemble entire hard copy MCP in 3-ring binders. For each elevator provided, the MCP must include only documentation and instruction that apply to the elevator specified.
   b. For each elevator, provide an additional, separate binder that includes all maintenance, repair, replacement, call back, and other records required by ASME A17.1/CSA B44. The records binder must be kept in the elevator mechanical room, maintained by elevator maintenance and service personnel, and be available at all times to authorized personnel.
   c. Provide detailed information regarding emergency service procedures and elevator installation company personnel contact information. Provide a listing of all tools to be provided to the Contracting Officer as components of the elevator system.

Quality Assurance

1. Qualification: Provide a designed and engineered elevator system by an elevator contractor regularly engaged in the installation of elevator systems. Provide elevator components manufactured by companies regularly engaged in the manufacture of elevator components. Utilize only licensed and certified elevator personnel for the installation, adjusting, testing, and servicing of the elevators.
   a. Elevator Contractor's Elevator Technicians: For elevator installations in the United States, including United States territories, perform all elevator related work under the direct guidance of a state certified elevator technician with a minimum of three years of experience in the installation of elevator systems of the type and complexity specified in the contract documents. Provide an endorsement letter from the elevator manufacturer, certifying that the elevator specialist is qualified. All elevator technicians must carry a current certification issued by one of the following organizations:
      1) National Association of Elevator Contractors (NAEC)

2) National Elevator Industry Education Program (NEIEP)

2. Manufacturers' Technical Support: Provide elevator components from manufacturers that provide factory training and online and live telephone elevator technical support to any elevator installation, service, and maintenance contractor. Provide elevator components from manufacturers that guarantee accessibility to all replacement and repair parts and components to any elevator installation, service, and maintenance contractor. Use only elevator component manufacturers that provide current published price lists for all elevator parts and components.
3. Operation and Maintenance Data: Assemble all shop drawing and product data material into O&M Data Packages in accordance with Article SUBMITTALS. Provide two complete O&M Data Packages in hard copy and two complete electronic O&M data packages on separate CDs, in PDF format. Provide all O&M Data Packages to Contracting Officer. Include controller diagnostic documentation and software as required under Article CONTROL EQUIPMENT.
4. Wiring Diagrams: Provide complete wiring diagrams and sequence of operations, which show electrical connections and functions of elevator systems. Provide one set (11 inch by 17 inch minimum size) of wiring diagrams, with individual sheets laminated in plastic and assembled in binder, to be stored in the machine room or control room cabinet. Provide one additional hard copy set and two complete electronic sets on separate CDs, in PDF format. Provide all wiring diagram sets to the Contracting Officer. Coded diagrams are not acceptable unless fully identified.
5. Machine Room/Control Room Cabinet: For storage of O&M Data Packages and Wiring Diagrams, provide locking metal cabinet with a minimum size of 20 inch W by 12 inch D by 30 inch H. Cabinet must be sized large enough to accommodate all O&M Data and hardware required in paragraphs OPERATION AND MAINTENANCE DATA and WIRING DIAGRAMS. Secure cabinet to machine room or control room wall.

New Installation Service

1. Provide elevator warranty service in accordance with the manufacturer's maintenance plan, warranty requirements and applicable safety codes, for a period of 12 months after the date of acceptance by Contracting Officer. Perform this work during regular working hours. Provide supplies and parts to keep elevator system in operation. Perform service only by factory trained personnel. Provide minimum Monthly services to include repairs, adjustments, greasing, oiling, and cleaning. Provide service log in elevator machine room or control room and update minimum Monthly, throughout the one-year warranty period.
2. Provide 24-hour emergency service, with one hour on-site response time, during this period without additional cost to the Government.
   a. Provide elevator mechanic to support QEI Certified Elevator Inspector in the periodic six-month and the annual Category 1 elevator certification inspection and testing. Perform Category 1 inspection and testing no greater than 30 days prior to the end of the warranty period. Perform all elevator certification testing in the presence of QEI Certified Elevator Inspector.
   b. In conjunction with the testing noted above, test systems for Emergency Power Operation, Earthquake Emergency Operation, and Hospital Emergency Commandeering Service Operation, as applicable. Schedule so that testing does not interfere with building operations.

Fire Protection System

1. Coordinate interface between building fire protection system and elevator controls.
2. Additional fire protection requirements are located in: Division 21, 26 and 28.
   a. Fire Alarm Initiating Devices: Fire alarm initiating devices are specified in Division 28, including conduit and wiring from each detector to fire protection addressable modules in elevator machine room or control room.
   b. Fire Sprinklers: Provide fire sprinklers in accordance with all applicable safety codes and with Division 21. Provide shutoff valve, check valve, and non-adjustable, zero time-delay flow switch, in each sprinkler line immediately outside of each machine room, control room,

and hoistway, as applicable. Provide inspectors' test valve for periodic testing of flow switch and shunt trip disconnect.

1) Pipe sprinkler piping serving these spaces in a series manner with no laterals. Locate inspectors' test connection at the end of pipe runs such that operation of the test connection will purge air from system piping.

3. Shunt Trip Disconnect: Provide flow switches specified in paragraph FIRE SPRINKLERS to comply with ASME A17.1/CSA B44 and NFPA 72 for shunt trip of the main line power supply. For each elevator, provide control wiring connecting the flow switch to a shunt trip equipped circuit breaker located in the elevator machine room or control room. Upon flow of water, flow switch will instantaneously cause opening of the shunt-trip circuit breaker and remove power from the elevator. Flow switch must also send a signal to fire alarm control panel to indicate water flow condition.

Elevator Description

1. Provide elevator system that complies with ASME A17.1/CSA B44 in its entirety, ASME A17.2 in its entirety, and additional requirements specified herein. Provide elevator system that meets or exceeds the NEII-1 Ride Quality Performance Standards Matrix (RQPSM). Comply with the RQPSM "Intermediate Performance" criteria.
2. Provide and install elevators in accordance with 36 CFR 1191 - ABAAS, ICC IBC, IEEE C62.41, NFPA 70 and NFPA 101 requirements.

Products:

1. Cab Enclosure and Hoistway Entrance Assemblies:
   a. Provide finishes as listed below:
      1) Floor; [carpet][vinyl composition tile][vinyl sheet tile][_____].
      2) Walls; [prefinished steel][laminated plastic on plywood][stainless steel][_____]. Provide each cab wall with equally spaced and equally sized wall panels. All wall panel fasteners must be concealed.
      3) Wall trim; [prefinished steel][stainless steel][_____].
      4) Accessories; Provide hand rails on full length of back wall and side walls of elevator cab.
      5) Car doors, car door returns, and wall reveals; [prefinished steel panels][stainless steel][_____].
      6) Ceilings; [supported][prefinished steel panels][anodized aluminum][eggcrate][_____].
      7) Ceiling frame; [prefinished steel][stainless steel][anodized aluminum][_____].
      8) Hoistway Entrance Assembly Material and Finishes; [prefinished steel][stainless steel][_____].
2. Control Equipment: Enclose all elevator control equipment in factory-primed and baked-enamel coated sheet-metal cabinets with ventilation louvers and removable or hinged doors. Mount cabinets at a height of 10 inches above machine room or control room finish floor.
   a. Motor Control Equipment: Provide elevator motor control with electronic, soft-start motor starter.
   b. Elevator Microprocessor Controller:
      1) For each individual elevator controller, and for each group controller, provide a microprocessor controller that complies with the following paragraphs. Provide controller(s) package that includes all hardware and software required for the installation, maintenance, and service of the elevator, in its' entirety. Provide verification of technical support service that the controller manufacturer provides to any licensed elevator installation, service, and maintenance company.
         a) Provide an elevator controller from a manufacturer that provides comprehensive factory training to include controller installation, adjustment, service, and maintenance. The training must be identified as available to any licensed elevator contractor. Provide verification of an established and documented training schedule, with pricing, for factory training classes that manufacturer has provided for a minimum period of one year prior to contract award date.
         b) The elevator controller must be identified as available for purchase and installation by any licensed elevator contractor. All components, parts, diagnostic tools, and

software must be available for purchase and installation and use by any licensed elevator contractor; "exchange-only" provisions for the purchase of spare parts are not acceptable. The elevator controller manufacturer must publish an industry competitive price listing for all controller parts, diagnostic tools, and software.

c) Provide verification of telephone and internet based technical support service that the elevator controller manufacturer provides to any licensed elevator installation, service, and maintenance company at an industry competitive price. The service must include live telephone based technical support for installation, adjustment, maintenance, and troubleshooting of the elevator controller and related elevator components. The service must be available during standard working hours.

d) Provide an elevator controller that is designed to automatically reestablish normal elevator operation following any temporary loss of power, regardless of duration.

2) Elevator Controller Interface Cabinet: For each individual elevator microprocessor controller, provide a separate elevator control cabinet with an integrated human interface system. For group elevator installations, a single cabinet and interface system with full access to each elevator controller may be utilized. The separate controller interface cabinet must be supplied by the elevator controller manufacturer and include a minimum 12 inch wide keyboard and a minimum 10 inch monitor. The elevator controller interface cabinet must comply with arc-flash protection requirements of NFPA 70E and UFC 3-560-01.

3) Elevator Microprocessor Human Interface: The interface system must provide complete elevator controller interface capability and must include the elevator controller manufacturer's comprehensive package of installation and diagnostic software. The microprocessor interface system must provide unrestricted access to all parameters, all levels of adjustment, and all flags necessary for installation, adjustment, maintenance, and troubleshooting of each elevator and for the elevator group. All software programming must be stored in non-volatile memory. The elevator controller fault log must provide non-volatile memory fault log storage of all faults, trouble calls, and fault history for a minimum of one year and the ability to download or print the fault log. The controller interface must also provide the capability to display and diagnose trouble calls, faults, and shutdowns. Expiring software, degrading operation, and "key" access controls are not acceptable.

4) Software and Documentation: Provide three copies of the manufacturer's maintenance and service diagnostic software, with complete software documentation, that will enable the same level of unrestricted access to all controllers of the same make and model, regardless of the installation date or location. Provide signed certification, from the manufacturer's corporate headquarters, that guarantees that the microprocessor software and access system will not terminate the unlimited and unrestricted access at any future date.

5) Elevator Controller Certification: For elevator installations in the United States, including United States territories, provide an elevator microprocessor controller that has a current certificate of safety code compliance issued by the Technical Standards and Safety Authority (TSSA), Toronto, Canada.

3. Operating Panels Signal fixtures and Communications Cabinets: For all panels and fixtures, provide identical and uniform panel and fixture design, material, finish, and components for all elevators. For all panels and fixtures, legibly and indelibly identify all buttons, devices, and all operating positions for each device. Use engraving and backfilling, or photo etching, for button and device designations. Do not use attached signs. Provide elevator manufacturers' standard grade for all key switches unless otherwise specified. All illuminating panels and fixture components must utilize LED lighting for energy efficiency.

a Car and Hall Buttons: For all cab and landing fixture buttons, provide industry-standard, vandal resistant push buttons with positive-stop assembly design. Buttons must be minimum 3/4 inch diameter, satin-finish stainless steel, with illuminating LED halo.

b Passenger Car-Operating Panel : Provide each car with [one] [two] car operating panel[s] that contains operation controls and communication devices. Provide exposed, flush

mounted buttons for the controls identified in subparagraph PASSENGER CONTROLS. Provide a lockable service cabinet for the controls listed in subparagraph SERVICE CONTROLS. Use engraving and backfilling or photo etching for button and switch designations. Do not use attached signs.

c Passenger Controls: In addition to ASME A17.1/CSA B44 requirements, provide the following operating controls, identified as indicated:
1) Illuminating car-call buttons identified to correspond to landings served by the elevator.
2) "DOOR OPEN" and "DOOR CLOSE" buttons. For front and rear openings at the same floor, include the identification "F" and "R" for each opening.
3) Red, illuminating "ALARM" button.
4) Key-operated "Independent Service" switch.
5) "Help" communication device to include communication between elevator cab and elevator machine room or control room.

d Service Controls: In addition to ASME A17.1/CSA B44 requirements, provide the following operating controls, identified as indicated:
1) Provide a key-operated, three-position switch for "In car Inspection Operation" and "Hoistway Access". The center switch position will provide normal, automatic operation.
2) "Car Light" switch.
3) "Car Fan" switch with two speed settings identified.
4) 120-volt ac 60 Hz single-phase duplex electrical outlet of ground-fault-circuit-interrupt (GFCI) design.

e Certificate Window: Provide a minimum 4 inch wide by 6 inch high certificate window for elevator inspection certificate. Locate window in the Service Controls door of the Car Operating Panel.

f Emergency Signaling Devices: Provide an audible signaling device, operable from the Car Operating Panel button marked "ALARM". The audible signaling device must have a sound pressure rating between 80 and 90 dBA at 10 ft. Provide battery backup power capable of operating the audible signaling device for at least one hour.

g Elevator In-Car Position Indicators: For all elevators, provide illuminating position indicator in the Car Operating Panel.

h Elevator In-Car Direction Indicators: For 2-stop elevator installations, provide visual direction indicators and audible car arrival signal in the elevator car door jamb, in accordance with ABA Standards. Visual indicators must be visible from the hall call fixture.

i Hall Call Landing Fixtures: Provide a hall call fixture adjacent to each elevator. Provide a single push-button for terminal landings and dual push-buttons, up and down, at intermediate landings.

j Designated Landing Hall Call Fixture
1) Location of COMMUNICATION MEANS FAILURE (CMF) Visual Signal: When required by ASME A17.1/CSA B44, provide an elevator CMF audible and illuminating signal, and reset switch, in the FEO Designated Landing hall call fixture. Mount the signal and reset switch at a minimum of 7 inches above the "UP" hall call button.
2) COMMUNICATION MEANS FAILURE (CMF) Visual and Audible Signal Operation: Provide a CMF visual and audible signal system that conforms to ASME A17.1/CSA B44. Provide continuous verification of operability of the telephone line and immediate activation of audible and visual signals when verification means determines that the telephone line is not functioning. Provide illumination of visual signal at one second intervals. Provide a minimum of 65 dBA audible signal at 30 second intervals.
3) Firefighters' Emergency Operation Phase I Switch and Visual Signal: When required by ASME A17.1/CSA B44, provide an elevator Firefighters' Emergency Operation Phase I switch and illuminating visual signal in the FEO Designated Landing hall call fixture. Provide FEO Phase I visual signal that is designed with intermittent, flashing, illumination when actuated by the machine room, control room, or hoistway fire alarm initiating device. Locate FEO Phase I key switch above the CMF visual signal with a minimum of 6 inches vertical between the centerlines of the CMF signal and the FEO Phase I key

switch. Locate FEO Phase I visual signal directly above the Phase I switch. In addition, locate Elevator Corridor Call Station Pictograph at top of hall call fixture.

k Elevator Car Position and Direction Indicators and Car Arrival Signal: For elevator installations with three or more stops, provide a separate hall landing fixture that includes the visual elevator position indicator, visual direction indicators, and audible car arrival signal, in accordance with ABA Standards.

l Designated Landing Elevator Identification Fixture: For duplex and group elevator installations, provide a separate elevator identification fixture for each elevator, with identification engraved and backfilled with a contrasting color. Number elevators from left to right, as seen during primary approach from building main entrance to elevator lobby. For multiple elevator groups, begin numbering with group that is closest to the building main entrance.

m Emergency or Standby Power: When emergency or standby power is provided for elevator operation, provide an elevator emergency power visual indicator that conforms to ASME A17.1/CSA B44. Locate the visual signal in the Firefighters Emergency Operation fixture for each simplex elevator and for each elevator group. When an emergency power selector switch is required, provide switch in a separate, flush mounted fixture located at the designated level, in view of all elevator entrances.

4. Car Door Equipment

a Car Door Operator: Provide elevator door operator equipment and circuitry that is designed and installed as discreet communication. Serial communication must not be used for this system.

b Infra-red Curtain Unit: Provide Infra-red Curtain Unit (ICU) with multiple infra-red beams that protect to the full height and width of the door opening. Provide door nudging operation.

5. Passenger Elevator Guides Platforms and Enclosure

a Roller Guides: Provide coil-spring loaded roller guide assemblies in adjustable mountings on each side of car and counterweight frames in accurate alignment at top and bottom of frames.

b Car Enclosure Wall Panels, Return Panels, Doors, Entrance Columns, and Transom: Provide 14 Gauge minimum [prefinished steel][stainless steel] cab wall panels and entrance components. Use same material and finish for all hoistway and car entrance assemblies. Apply sound-deadening material on exterior of all cab wall panels.

c Car Enclosure Top: Provide reinforced, 12 gauge minimum steel car enclosure top. Provide hinged emergency exit with lock that complies with the seismic risk zone 2 or greater design requirements of ASME A17.1/CSA B44. Locate emergency exit hinge towards the rear of the elevator cab. Design and configure the elevator cab interior ceiling to provide convenient and unobstructed access to, and use of, emergency exit from inside the elevator cab.

d Car Door: Provide 16 gauge minimum [prefinished steel][stainless steel] car doors of sandwich construction with flush surfaces on car and landing sides. Provide a minimum of 2 door guide assemblies per door panel, one guide at leading and one at trailing door edge with guides in the sill groove their entire length of travel.

e Car Entrance Sill: Provide one piece cast nickel silver, stainless steel, or white bronze entrance sill(s). Set sills level and flush with floor finish. Use same material for hoistway and car entrance sills.

f Cab Finish Floor: Provide cab finish floor with top of finish floor flush with the cab sill.

g Car Fan: Provide 2-speed fan for car enclosure forced ventilation. Fan must be mounted in the car enclosure top.

h Car Lighting: Utilize LED lighting for elevator car interior illumination. Provide a minimum of 10 foot-candles, measured at all areas of the car enclosure floor. Provide automatic car lighting operation that will turn off car lights after 3 minutes of inactivity. Car lights must automatically turn on upon actuation of an elevator car or hall call.

i Car Protection Pads and Hooks: Provide fire retardant, hanging car protection pads that provide protection for all car interior wall panels. Provide permanently installed studs in car that are designed for hanging the car protection pads in the car.

6. Passenger Elevator Hoistway Doors and Entrances: Provide hoistway entrance assemblies with a minimum 1-1/2 hour fire rating. Use same material and finish for all hoistway and car entrance assemblies.
   a. Hoistway Entrance Frames: Provide 14 gage minimum [prefinished carbon sheet steel][stainless steel] hoistway entrance frames. Solidly grout uprights of entrance ways to height of 5 feet.
   b. Hoistway Entrance Sills: Provide one-piece cast nickel silver, stainless steel, or white bronze entrance sills. Set top of landing sill flush with top of finish floor. Solidly grout under full length of sill. Use same material for all hoistway and car entrance sills.
   c. Hoistway Entrance Doors: Provide [hollow metal][stainless steel] non-vision construction hoistway entrance doors with flush surfaces on car and landing sides. Provide a minimum of 2 door guide assemblies per door panel, one guide at leading edge and one at trailing edge with guides in the sill groove the entire length of door travel. Use same material and finish for all hoistway and car entrance assemblies.
   d. Hoistway Entrance Door Track Dust Covers: Provide sheet metal hoistway door track dust covers at each landing. Dust covers must cover top and hoistway side of door locks and door roller tracks, and extend the full width of the door track and associated hardware. Dust cover sections will not exceed 3 feet in length.
3. Hoistway Equipment
   a. Car Guide Rails and Fastenings: Provide T-section type guide rails for car. Paint rail shanks with one coat of black enamel.
   b. Pit Equipment and Support Channels: Provide rail-to-rail pit channels to serve as mounting surface for main guide rails [, hydraulic cylinder]and car buffers. Method of installation of channels, brackets and buffer mounts must be such that pit waterproofing is not punctured.
   c. Pit "STOP" Switch: Provide push-to-stop/pull-to-run type pit "STOP" switch.
   d. Traveling Cables: Suspend traveling cables by means of self-tightening webbed devices or internal suspension members.
   e. Hoistway Pit Ladder : Provide continuous horizontal rungs for the full height of the pit ladder.

Special Operation and Control

1. Provide the following special operations and control systems.
   a. Keys for Elevator Key Switches: Provide a minimum of twelve keys per unique cylinder used on all key switches for a single elevator. If there is more than one elevator, additional keys will not be required unless there are additional unique lock cylinders. Provide keys with brass or fiberglass tags marked "PROPERTY OF THE U.S. GOVERNMENT" on one side with function of key or approved code number on the other side.
   b. Firefighters' Emergency Operation (FEO): Provide FEO equipment and signaling devices. The designated level for the FEO Phase I key operated switch is the [ground][_____] floor. In the FEO Phase I fixture, provide FEO Operating Instructions.
      1) Firefighters' Emergency Operation (FEO) Key Box: Provide flush mounted, locking, FEO Key Box of a minimum size of 5 inch W by 9 inch H by 1.5 inch D. Install at a height of 6 feet above floor level and directly above the FEO Phase I key switch. Provide box equipped with lock that uses the FEO K1 key.
   c. Hoistway Access Operation: Provide hoistway access operation with switches at top and bottom terminal landings. Locate switch 6 feet above floor level, within 12 inches of elevator hoistway entrance frame or with the ferrule exposed when located in the elevator entrance frame.
   d. In-Car Inspection Operation: Provide In-Car Inspection Operation.
   e. Independent Service: Provide exposed key-operated switch in car operating panel to enable independent service and simultaneously disable in-car signals and landing-call responses. Provide indicator lights that automatically illuminate during independent service. For duplex or group operation, if one car is removed from group another car will respond to its hall calls.

f. Selective Door Operation: For elevator with one or more rear openings at same level as front opening, provide full-selective operation with car and door operating buttons clearly marked for front and rear openings, front and rear car button for each such floor, and front and rear "DOOR OPEN" and "DOOR CLOSE" buttons. Only door for which the button was operated opens or closes.
g. Elevator Emergency Power Operation: Provide elevator emergency power operation for [all elevators] [elevator 1,2,3...]. Coordinate power supply and control wiring to accomplish initiation and operation of elevators on emergency power.

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Execution 1. Installation: Elevators and equipment shall be installed in accordance with ASME A17.1 and manufacturer's recommendation. Guide rails shall be set plumb and parallel and attached to guide rail brackets secured to building structure . Steel shim plates shall be used for aligning equipment. Guide rail sections shall be joined together in accordance with ASME A17.1. Guide rails shall be thoroughly cleaned and made smooth before elevator is put into operation. During installation all stainless steel shall be protected.

a. Casing, Cylinder And Plunger Unit: A steel casing minimum 8 inches larger in diameter than the cylinder sealed at bottom with steel plate or concrete plug shall be complete with provisions to accommodate a single wall or double wall cylinder. Casing shall be accurately positioned, plumbed and set to accept the cylinder. The cylinder shall be protected from corrosion by totally enclosing the cylinder with a separate schedule 80, polyvinyl chloride jacket or with a high density, fused polyethylene coating, recommended by the manufacturer. Area between casing and cylinder wall shall be filled with washed dry sand after cylinder has been accurately located. Top of casing shall be sealed. The work of boring the well and setting the cylinder shall be coordinated with construction of concrete pit. This paragraph only applies to elevators types that use this type of cylinder.
b. Elevator Wiring: Wiring shall be provided for electrically-operated items of elevator equipment to comply with requirements of NFPA 70 and Division 26 ELECTRICAL. For control and signal circuits wire shall be minimum No. 18 AWG. For power and lighting circuits wire shall be minimum No. 12 AWG. Work light fixtures equipped with 150 watt incandescent lamps and ground duplex receptacles shall be provided at top and bottom of car. Work light fixtures and traveling cable junction boxes shall be located to provide illumination at junction boxes. Wiring shall terminate in junction boxes. Wires shall be identified and shall match symbols shown on wiring diagrams. Control and signal wires shall be brought to accessible numbered terminal blocks on the controller. Intra-panel wiring shall be flame-resistant type.
c. Traveling Cables: Cables shall terminate at numbered terminal blocks in car and machine room. Traveling cable shall be provided with a separate shielded circuit for communication system and hang to obtain proper size of loop. Traveling cable shall be provided with 10 percent spare conductors for each car.
d. Painting And Pipe Color Code Marking: Except for factory-finished items and corrosion-resistant items, machined surfaces shall be painted as specified in Section 09 90 00.00 48 PAINTS AND COATINGS. Color Code marking of piping shall be as specified in Section 09 90 00.00 48 PAINTS AND COATINGS.
e. Testing: Testing shall be in accordance with requirements of ASME A17.1and ASME A17.2.2; and as specified below. The Contractor shall conduct a complete test of the system. After the system has passed all tests, the Contractor shall notify the Government in writing, 30 days prior to the time of performing the acceptance test, that the system is complete and is ready for final acceptance testing. The Contractor after receiving written approval from the Government will conduct a complete acceptance test of the system. The Contractor shall provide the services of an elevator inspector, employed by an independent testing company to inspect the elevators, witness the final testing and certify the elevators. The inspector shall meet all qualification requirements of ASME QEI-1 and shall be certified in accordance with ASME QEI-1. The Contractor shall provide an elevator certificate signed by the inspector for each elevator. The certificate shall be provided to the Government within 30 day after the completion of all testing.

f. Testing Period: Each elevator shall be tested with the specified rated-load in car continuously for a period of 35 percent of the duty time. During the test run the car shall be stopped at all floors in both directions of travel for a standing period of 10 seconds per floor. A manual test of the final limits (UP and DOWN overtravel) shall also be performed.
g. Speed Load Testing: The actual speed of elevator car in both directions of travel shall be determined with the rated-load and with no-load in the elevator car. Actual measured speed of car with the rated-load in the UP direction shall be within 5 percent of rated speed. The maximum difference in actual measured speeds obtained under the various conditions outlined shall not exceed 10 percent of the total difference between the UP and DOWN speeds.
h. Car Leveling Testing: Elevator car-leveling devices shall be tested for accuracy of landing at all floors with no-load in car, with symmetrical load in car and with the rated-load in car in both directions of travel.
i. Temperature Rise Testing: Temperature rise of hydraulic pump motor, motor drive, exciter and booster shall be conducted during the full-load test run for minimum one hour. Under these conditions, temperature rise of equipment shall not exceed the requirements established in NEMA MG 1 Chapter 12. Test shall be started when all parts of equipment are within the temperature required by NEMA at time of starting tests.
j. Insulation-Resistance Testing: Insulation-resistance testing shall be performed to ensure that the complete elevator wiring systems will be free from short circuits and grounds. Electrical conductors shall have an insulation-resistance of not less than 1 megohm between each conductor and ground, and not less than 1 megohm between each conductor and all other conductors. Prior to testing, provisions shall be made to prevent damage to electronic devices.
k. Framed Instructions: Two sets of instructions shall be typed and framed under glass or in laminated plastic, and posted side-by-side in the elevator room where directed before acceptance of elevator systems. First set of instructions shall include wiring and control diagrams showing the complete layout of elevator system. Second set of instructions shall include the condensed operating instructions describing preventive maintenance procedures, the methods for checking the elevator system for normal safe operation, and the procedures for safely starting and stopping the elevator system.
l. Operator Training: Contractor shall conduct a formal training course for operating Government personnel which shall include care, lubrication, adjustment and maintenance of elevator equipment. Training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. Field instructions shall cover all of the items contained in the operating and maintenance instructions, including demonstrations of routine maintenance operations. Government shall be notified at least 14 days prior to date of starting the training course.

---End of Section ---

SECTION 21 13 13.00 48 WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION

Scope:
1. Provide fire sprinkler protection in all areas of the building. The system shall be designed in accordance with NFPA 13, except that the design density and area of coverage will be in accordance with UFC 3-600-01 for all hazard classifications.
2. Provide wet chemical fire sprinkler protection for the exhaust hood over cooking equipment, and exhaust duct serving the hood.
3. Contractor shall comply with anti-terrorism standards in accordance with UFC 4-010-01.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47/A 47M	Ferritic Malleable Iron Castings
ASTM A 53/A 53M	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 135/ASTM A135M	Electric-Resistance-Welded Steel Pipe
ASTM A 536	Ductile Iron Castings
ASTM A 795/A 795M	Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 88/B 88M	Standard Specification for Seamless Copper Water Tube

AMERICAN SOCIETY OF SANITATION ENGINEERS

ASSE 1013	Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers
ASSE 1015	Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast
AWWA C606	Grooved and Shouldered Joints

ASME INTERNATIONAL (ASME)

ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, 250
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.18	Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.3	Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	Gray Iron Threaded Fittings, Classes 125 and 250
ASME B16.9	Factory-Made Wrought Steel Buttwelding Fittings

FM GLOBAL (FM)

FM App Guide	Approval Guide – Updated Online

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	Installation of Sprinkler Systems
NFPA 24	Installation of Private Fire Service Mains and Their Appurtenances
NFPA 101	Life Safety Code
NFPA 1963	Fire Hose Connections

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

UNDERWRITERS LABORATORIES (UL)

UL Fire Prot Dir	Fire Protection Equipment Directory
UL Bld Mat Dir	Building Materials Directory – Updated Online

Submittals:

1. Shop drawings and calculations shall be prepared by the sprinkler system designer and reviewed by the fire protection specialist. The fire protection specialist must review the shop drawings, hydraulic calculations and material submittals. The shop drawings must bear the Review Stamp of the fire protection specialist.
2. Shop drawings, product data and calculations shall be developed under the supervision of the fire protection specialist. The fire protection specialist shall place their registered professional engineer stamp on all drawings and the cover sheet for the product data and calculations prior to submittal to the Government.
3. Prepare shop drawings in accordance with the requirements for "Plans" as specified in NFPA 11, "Working Plans" as specified in NFPA 13, and "Shop Drawings" as specified in NFPA 72. Drawings shall be the same size as the contract drawings or minimum 24 by 36 inches. Unless otherwise noted, floor plans shall be drawn to a scale not less than 1/8" = 1'-0". Show data essential for proper installation of each system. Show details, plan view, elevations and sections of the systems supply and piping. Show piping schematic of systems supply, devices, valves, pipe and fittings. Show point to point electrical wiring diagrams. Submit drawings stamped by the fire protection specialist.
4. Submittal preparer's qualifications and general responsibilities.
   a. Fire Protection Specialist – An individual who is a registered professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveying (NCEES) and has relevant fire protection engineering experience.
   b. Sprinkler System Designer – The sprinkler system designer shall be certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Water-Based Systems Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7.
5. Maintenance Data: Submit maintenance data and parts lists for fire protection materials and products. Include this data, product data, shop drawings, approval drawings, approval calculations, certificate of installation in maintenance manual.
6. Certificate of Installation: Submit certificate upon completion of fire protection piping work which indicates that work has been installed, flushed and tested in accordance with NFPA 13, and also that system is operational, complete, and has no defects.

Training:

1. The fire protection specialist and the manufacturer's representative shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a minimum of two (2) hours.

Products:

1. Manufacturer:
   a. Grinnell.
   b. Reliable.
   c. Viking.

2. Underground Ductile Iron Piping: AWWA C151/A21.51 , C104/A21.4.
   a. Fittings: AWWA C110/A21.10, C111/A21.11.
3. Black or Zinc Coated Steel with Threaded Ends: ASTM 53, ASTM A 135, or ASTM A 795, type E or S, Grade A, used for piping 2" and smaller. Use of galvanized is restricted to applications allowed by UFC 3-600-01.
   a. Fittings/Unions: ASME B 16.4, Class 150, zinc coated threaded end connection for galvanized pipe.
4. Copper Tubing: ASTM B 88, type L or M, used for piping 2" and smaller.
   a. Fittings: ASME B16.22.
5. Black or Zinc Coated Steel Type E or S, Grade A: ASTM A 53, ASTM A 135, or ASTM A 795, used for piping 2-1/2" and larger. Use of galvanized is restricted to applications allowed by UFC 3-600-01.
   a. Fittings: Grooved joints, ASTM A 47, Grade 32510.
   b. Fittings: Flanges, ASME B16.1, Class 150.
6. Pipe in which threads or grooves are cut shall be Schedule 40, or shall be U.L. Listed to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut.
7. Pipe Hangers and Supports: UL listed or FM approved.
8. Valves: UL listed or FM approved.
9. Fire Department Connection: Flush type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a polished brass finish. Inlets shall have 2-1/2" threaded ends per NFPA.
10. Sprinkler Heads:
    a. Sprinkler heads shall be UL 199, UL 1767 (quick response) with 165º links. Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Temperature classifications shall be as required for hazard occupancy. Extended coverage sprinklers shall not be used. Sprinkler coverage not to exceed 225 square feet for light hazard or 130 square feet for ordinary hazard occupancies.
    b. Sprinkler Head Types:
       1) Concealed Sprinkler: Chrome plated standard or quick response type.
       2) Recessed Sprinkler: Chrome plated standard or quick response type.
       3) Flush Sprinkler: Chrome plated standard or quick response type.
       4) Upright Sprinkler: Brass standard or quick response type.
       5) Sidewall Sprinkler: Chrome plated standard or quick response type.
       6) Dry Sprinkler: Chrome plated pendant or sidewall.
       7) Pendant Sprinkler: Chrome plated standard or quick response.
11. Sprinkler Cabinet: Provide spare sprinkler heads in accordance with NFPA 13, and shall be contained in a suitable metal or plastic cabinet.
12. Waterflow Alarm: Waterflow alarm shall be electrically operated, exterior-mounted, waterflow alarm bell shall be provided and installed in accordance with NFPA 13. Waterflow alarm bell shall be rated 24 VDC and shall be connected to the Fire Alarm Control Panel (FACP).
13. Alarm Initiating and Supervisory Devices:
    a. Sprinkler waterflow indicator switch shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms caused by transient flow surges.
    b. Sprinkler pressure waterflow alarm switch shall have a maximum service pressure rating of 175 psi. There shall be two SPDT (Form C) contacts factory adjusted to operate at 4 to 8 psi.
    c. Valve supervisory (tamper) switch shall be tamper resistant and arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.
14. Backflow Prevention Assembly: Double-check backflow prevention assembly complying with ASSE 1015. Unit shall have maximum 6 psi drop at water demand flow rate. Reduced pressure principle backflow prevention assembly complying with ASSE 1013.

Execution: 1. Installation and field acceptance testing shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and the following:
   a. Protection of piping against earthquake damage.

b. Pendent Sprinklers: Drop nipples to pendent sprinklers shall consist of minimum 1 inch pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 12 inches. Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid.
c. Upright Sprinklers: Riser nipples or “sprigs” to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches in length shall be individually supported.
d. Reducers: Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where reduction in size is less than ½ inch.
e. Backflow Prevention Assembly Forward Flow Test: Each backflow prevention assembly shall be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13.

--- End of Section ---

SECTION 21 21 03.00 48 WET CHEMICAL EXTINGUISHMENT SYSTEM

Scope: 1. Provide range hood wet chemical for extinguishment system in accordance with NFPA 17A and NFPA 96. System components shall be listed in the UL Fire Prot Dir or FM Approved Guide.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

FM GLOBAL (FM)

FM App Guide	Approval Guide – Updated Online

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 17A	Wet Chemical Extinguishing Systems
NFPA 96	Ventilation Control and Fire Protection of Commercial Cooking Equipment

UNDERWRITERS LABORATORIES (UL)

UL Fire Prot Dir	Fire Protection Equipment Directory

Submittals: 1. Shop Drawings for all piping, nozzles, valves, fittings, remote pull stations, etc. Scaled shop drawings showing hood type and equipment layouts required.

Products: 1. Standard Products: System components shall be the standard products of a manufacturer regularly engaged in the manufacturing of products that are of similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years before bid opening. The 2-year experience shall include installations of systems under similar circumstances and of similar size. Systems shall be supported by a service organization.

2. Piping Components:
   a. Pipe and Fittings: Pipe and fittings shall be Schedule 40 stainless steel. Stainless steel tubing may be used in accordance with manufacturer's recommendations. Galvanized pipe shall not be used.
   b. Nozzles: Nozzles shall be stainless steel and shall be equipped with an integral strainer to prevent matter inside the distribution piping from clogging the nozzle orifice. Each nozzle orifice shall be provided with a seal to protect the nozzle from clogging by grease or other obstructions. This seal shall detach upon actuation.
   c. System Controls: Each system shall be actuated by fusible link and by a remote manual actuation station connected to the extinguishing system release mechanism by cable.
   d. Wet Chemical: The wet chemical shall not have an adverse effect on stainless steel during exposure periods of up to 24 hours.
   e. Identification Signs: Identification signs shall be located at each remote manual actuation station.

Execution: 1. Installation shall be performed by the installation technician in accordance with system manufacturer's instructions.

--- End of Section ---

SECTION 21 30 00.00 48 FIRE PUMPS

Scope: 1. Provide fire pump associated with wet pipe fire suppression system.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

FM GLOBAL (FM)

FM App Guide	Approval Guide - Updated Online

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 20	Installation of Stationary Pumps for Fire Protection

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	Program Detail Manual for Certification in the Field of Fire Protection Engineering (Field Code 003) Subfield of Automatic Sprinkler System Layout

UNDERWRITERS LABORATORIES (UL)

UL 448	Safety Centrifugal Stationary Pumps for Fire-Protection Service
UL Fire Prot Dir	Fire Protection Equipment Directory

Submittals:
1. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, and location and size of each field connection for each fire-pump and pressure-maintenance-pump unit.
2. Product Data: Submit manufacturer's technical product data, including current accurate pump characteristic performance curves with selection points clearly indicated, weights, furnished specialties and accessories, and installation and start-up instructions.
3. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to fire pumps. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field installed.
4. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
5. Maintenance Data: Submit maintenance data and parts list for each fire pump, driver, control, and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual.
6. Operation and Maintenance Manuals.

Training: 1. The fire protection specialist and the manufacturer’s representative shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a minimum of two (2) hours.

Products:
1. Manufacturer:
   a. Aurora Pump; Unit of General Signal.
   b. Fairbanks Morse Pump Corp.
   c. ITT Fluid Technology Corp.; ITT A-C Pump Unit.

2. Fire Pump: Pump shall be electric driven centrifugal horizontal split case, or vertical fire pump rated at not less than 150 percent of flow capacity and not less than 65 percent of net pressure. Pump shall meet requirements of UL 448.
   a. Fire Pump Controller: Automatic type, UL or FM approved, mounted in a NEMA, type 2 drip-proof enclosure.

3. Fire Pump – Diesel Driven: Skid mounted UL and FM listed diesel engine driven fire pump, jockey pump, controller backflow preventer, valves and accessories. Size shall be rated at not less than 150 percent of flow capacity and not less than 65 percent net pressure. Engine size, batteries, fuel tank, pressure relief valve and exhaust muffler shall be in accordance with applicable NFPA requirements.
   a. Fire Pump Controller: Automatic type, UL or FM approved.
   b. Fire pump skid, fuel tank, valves, controller, etc. shall all be located in weather-proof enclosure provided by same manufacturer as the fire pump.
4. Pressure Maintenance Pump: Pump shall be electric driven centrifugal type, horizontal shaft.
   a. Pressure Maintenance Pump Controller: Automatic and manual starting/stopping equipped with MANUAL-OFF-AUTOMATIC switch, mounted in a NEMA, type 2 drip proof enclosure.
5. Manifold Test Header: ASME B 16.5, Class 150 flanged inlet connection. Hose valves shall be UL or FM approved, with 2-1/2" fire hose threaded ends, per NFPA. The number of valves shall be per NFPA 20, and equipped with cap and chains.

Execution: 1. Installation, flushing and field acceptance testing shall be in accordance with the applicable provisions of NFPA 20 and manufacturer requirements.

--- End of Section ---

SECTION 22 11 23.00 48 PLUMBING PUMPS

Scope: 1. Provide plumbing pumps associated with plumbing systems.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)

Submittals: 1. Shop Drawings: Detail assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   a. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
2. Product Data: For each type and size. Include rated capacities; performance curves; furnished specialties; shipping, installed, and operating weights; and accessories.
3. Operation and Maintenance Manuals.

Products: 1. Manufacturer:
   a. Aurora Pump Co.
   b. Bell & Gossett.
   c. Hydromatic.
   d. Peabody Barnes.
   e. Weil Pump Co.
   f. Weinman Pump LFE Corp.
   g. Zoeller.
2. Inline Recirculation Pumps:
   a. Horizontal, oil lubricated, 125 psi working pressure, 225 degrees continuous water temperature. Bronze or stainless steel construction, steel shaft, mechanical seal, aquastat, and timeclock.
3. Submersible Sump Pumps:
   a. Cast iron shell, bronze impeller, stainless steel shaft, ceramic mechanical seal, factory sealed lubricated ball bearings. Hermetically sealed motor with overload protection. Wide differential float operated mercury switch for Simplex pump controls. NEMA 250, Type 1 enclosure, with three (3) mercury float switches in NEMA 250, Type 6 enclosures for Duplex pump controls, and fiberglass sump.

--- End of Section ---

SECTION 22 13 00.00 48 SANITARY, WASTE, VENT, AND STORM SPECIALTIES

Scope: 1. Includes sanitary and storm drainage piping system specialties.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASME INTERNATIONAL (ASME)

ASME A112.14.1	Backwater Valves
ASME A112.6.3	Floor and French Drains
ASME A112.21.2M	Roof Drains
ASME A112.36.2M	Cleanouts

INTERNATIONAL CODE COUNCIL (ICC)

ICC Plumbing Code	International Plumbing Code (IPC)

Products: 1. Manufacturer – Drainage System Specialties:
   a. Ancon Inc.
   b. Josam Mfg. Co.
   c. Smith (Jay R.) Mfg. Co.
   d. Tyler Pipe Industry.
   e. Wade Div. Tyler Pipe.
   f. Watts Drainage Products.
   g. Zurn Industries, Inc.
2. Manufacturer – Trench Drain Systems:
   a. ACO Polymer Products, Inc.
   b. MEA/Josam.
   c. Polydrain Inc.
   d. Quazite Corp.
   e. Zurn Flo-Thru.
3. Special Valves:
   a. General: Special valves required for drainage piping systems include the following types:
      1) Backwater Valves: Cast-iron body, bronze combination backwater and shear gate assembly. Provide ends to suit piping material; cleanout cover to permit removal of interior parts.
4. Drainage System Specialties:
   a. Vent Flashing: Provide vent flashing of same manufacture and compatible with the roofing system.
   b. Cleanout Plugs: Cast-bronze or brass, threads complying with the Code.
   c. Floor Cleanouts: Cast-iron body and frame; cleanout plug; adjustable round top.
      1) Nickel-Bronze Top: Flush, scoriated style. Use in floors in “finished” rooms.
      2) Cast-Iron Top: Flush scoriated. Use in floors in “non-finished” rooms - mechanical equipment rooms, storage rooms, etc.
   d. Wall Cleanouts: Cast-iron body adaptable to pipe with cast-bronze or brass cleanout plug; stainless steel cover including screws.
   e. Floor Drains: Provide floor drains and shower drains. Floor drains subject to drying shall be provided with trap primers.
      1) Floor drains in finished floors, other than troweled concrete, and in showers and janitor’s receptors, with Nikaloy strainer.
      2) Floor drains in finished floors, marked BWV shall be same as above except with backwater valve.
      3) Floor drains in troweled concrete with clamping ring and cast-iron top.
   f. Roof Drains: Provide roof drains as specified herein.

1) Roof drain shall be cast-iron body and combined flashing collar and gravel stop, aluminum dome, with the following features:
   a) Underdeck clamp.
   b) Extension for roof deck insulation. Extension shall be 2” less than roof deck insulation thickness.
   c) Sump receiver.
   d) Expansion joint.
   e) Vandal-proof dome.
   f) Bottom outlet, inside calk.

g. Downspout Nozzle: Rough bronze body with threaded inlet and loose flange.

5. Trench Drains:
   a. Trench drain gutters shall be precast pre-sloped interlocking polymer concrete trench drain system 4” channel width with flush slotted formed galvanized steel grating rated for loads of 10 ton wheel load at slow to moderate speed.

--- End of Section ---

SECTION 22 15 00.00 48 GENERAL SERVICE COMPRESSED AIR EQUIPMENT

Scope: 1. Provide general service compressed air equipment, including factory packaged UL listed tank mounted duplex air compressors, inlet filter, receiver, dryer, aftercooler, and filter regulator units associated with the compressed air system. Refrigerated dryer use only when process requires.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASME INTERNATIONAL (ASME)

ASME BPVC VIII Boiler and Pressure Vessel Code : Section VIII, Division 1 ; Pressure Vessels

Submittals: 1. Product Data: Submit manufacturer's technical product data for each type and size, including rated capacities of selected model indicated, weights (shipping, installed, and operating), operating characteristics, furnished specialties, and accessories.
2. Operation and Maintenance Manuals.
3. Equipment Checklist.

Products: 1. Manufacturer – Duplex Air Compressor:
a. Atlas Copco Compressors, Inc.
b. CompAir, Ltd.
c. Curtis-Toledo, Inc.
d. Gardner Denver, Inc.
e. General Air Products, Inc.
f. Ingersoll-Rand Company; Air Compressor Group.
g. Kaeser Compressors, Inc.
h. Powerex.
2. Manufacturer – Aftercooler, Dryer, Filter Regulator:
a. Arrow Pneumatics, Inc.
b. Curtis-Toledo, Inc.
c. Hankison International.
d. Ingersoll-Rand Company; Air Compressor Group.
e. Pneumatech, Inc.
f. Saylor-Beall Manufacturing Company.
g. Van Air Systems, Inc.
h. Zeks Air Drier Corporation.
3. Manufacturer – Hose Reels:
a. Duro.
b. Grace.
c. Samson.
4. Lubricated Air Compressors, Duplex Units:
a. Compressors: Two-stage, lubricated, with lubricated compression chamber and crankcase. Tank mounted with combined high discharge-air temperature and low lubrication-oil pressure switch, submerged gear-type oil pump, and oil filter, belt guards totally enclosing pulleys and belts, intercoolers between stages of two-stage units.
b. Receiver: ASME construction steel tank, 200 psig minimum pressure rating.
c. Miscellaneous Devices: Safety valves, discharge-air pressure gages, pressure regulators, and shutoff valves.
5. Control Panels:
a. Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
b. Mounting and Wiring: Factory installed and connected as an integral part of equipment package.
c. Enclosure: NEMA ICS 6, Type 12 control panel, unless otherwise indicated.

d. Motor Controllers: Full-voltage, combination-magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device. Control voltage: 120 volt ac or less, using integral control power transformer. Motor Overload Protection: Overload relay in each phase. Starting Devices: Hand – off – automatic selector switch in cover of control panel, plus pilot device for automatic control. Automatic control switches to alternate lead-lag compressors for duplex air compressors.
e. Instrumentation: Include receiver pressure gage, discharge-air pressure gage, air-filter maintenance indicator, hour meter, compressor discharge-air and coolant temperature gages, and control transformer.

6. Air Inlet Filters:
   a. Combination inlet filter-silencer, suitable for remote installation, for each air compressor.
   b. Construction: Weather-proof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
   c. Capacity: Match capacity of air compressor, with collection efficiency of 99 percent retention of particles larger than 10 microns.
7. Aftercoolers:
   a. Aftercoolers, Air Cooled: Size units to cool compressed air in compressor-rated capacities to 10 degrees F above summertime maximum ambient temperature.
8. Refrigerant-Type Dryers: (Provide only when process requires, typically controls and painting).
   a. Noncycling, air-cooled, electric-motor-driven unit with steel enclosure and capability to deliver 35 degrees F, 100 psig air at dew point. Include automatic ejection of condensate from airstream, step-down transformers, disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.
9. Accessories:
   a. Safety valves, automatic drain valves, pressure regulators, and compressed air filters.

--- End of Section ---

SECTION 22 34 00.00 48 DOMESTIC WATER HEATERS

Scope: 1. Provide commercial gas water heaters associated with plumbing systems.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.10.1	Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less
ANSI Z21.10.3	Gas Water Heaters Vol. III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous
ANSI Z21.22	Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1	Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1005	Water Heater Drain Valves

ASME INTERNATIONAL (ASME)

ASME BPVC VIII D1	Boiler and Pressure Vessel Code: Secion VIII Pressure Vessels, Division 1 – Basic Coverage
ASME BPVC IX	Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ASME CSD-1	Controls and Safety Devices for Automatically Fired Boilers

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	National Fuel Gas Code

NSF INTERNATIONAL (NSF)

NSF 61	Drinking Water System Components – Health Effects

Submittals: 1. Shop Drawings: Detail assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   a. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
2. Product Data: For each type and size. Include rated capacities; performance curves; furnished specialties; shipping, installed, and operating weights; and accessories.
3. Operation and Maintenance Manuals.

Warranty: 1. Furnish three (3) year limited warranty for tank leakage.

Products:
1. Manufacturer – Commercial Gas-Fired Water Heaters:
   a. Ace Buehler, Inc.
   b. A.O. Smith, Consumer Products Div.
   c. Bradford-White.
   d. Lochinvar.
   e. PVI Industries, Inc.
   f. Rheem Water Heater Div., City Investing Co.
   g. Ruud Water Heater Div., City Investing Co.
   h. State Industries.
2. Manufacturer – Stack Dampers:
   a. Ameritherm.
   b. Heat-Napper.
   c. Johnson Control Co.
3. Gas Fired Water Heaters:
   a. Gas fired water heater, 150 psi working pressure, magnesium anode rod, ¾" tapping for relief valve, glass lining, automatic gas shutoff, pilot safety shutoff, AGA certified draft hood. Insulate tank with vermin-proof glass fiber insulation, baked enamel finish on outer jacket. Provide drain valve, pressure and relief valve, gas pressure regulator, pilot gas regulator, and thermostat. Furnish three (3) year limited warranty. Comply with ASHRAE 90.1 for energy efficiency.
4. Stack Damper for Water Heater Vent:
   a. Damper: Provide a thermally actuated damper with bi-metallic damper. AGA approval required.
5. Expansion Tanks:
   a. Steel, pressure rated tank construction, butyl-rubber diaphragm, air precharge, 150 psi working pressure.
   b. Comply with ASME B1.20.3 and NSF 61 construction requirements.

--- End of Section ---

SECTION 22 42 00.00 48 PLUMBING FIXTURES

Scope: 1. Provide plumbing fixtures. Fixtures shall be water conservation type. Coordinate rough-in and final fixture connection. Install fixtures at heights indicated by the Architect and in accordance with the Code.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRAITON (NARA))

36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities

INTERNATIONAL CODE COUNCIL (ICC)

ICC Plumbing Code International Plumbing Code (IPC)

Submittals: 1. Submit shop drawings and include a copy of shop drawings in O&M Manuals.

Products: 1. Manufacturers:
a. Vitreous China and Enameled Cast Iron Fixtures: American Standard, Eljer, Kohler, Sloan.
b. Trim: American Standard, Chicago Faucet, Delta-Delux, Elkay, Josam, Kohler, Speakman, Stern, Symmons, T & S Brass, Zurn.
c. Water Closet Seats: American Standard, Bemis, Beneke, Church, Kohler, Olsonite.
d. Chair Carriers: Josam, Jay R. Smith, Wade, Watts, Zurn.
e. Stainless Steel Sinks: Elkay, Just.
f. Shower Heads/Fittings: American Standard, Chicago Faucet, Delta-Delux, Eljer, Kohler, Leonard, Speakman, Symmons.
g. Water Coolers/Drinking Fountains: Elkay, Halsey Taylor, Haws, Oasis.
h. Flush Valves: Aquavantage, Sloan, Zurn.
i. Service Sinks; Laundry Tubs: Fiat, Jonespec, Mustee, Stern Williams, Swan, Zurn.
j. Safety Showers/Emergency Eyewash: Bradley, Chicago Faucet, Encon, Guardian, Haws, Speakman.
k. Interior Hose Bibbs and Mixing Faucets: Chicago Faucet, T & S Brass, Zurn.
l. Exterior Wall Hydrants and Wall Faucets: Josam, Jay R. Smith, Wade, Woodford, Zurn.
m. Thermostatic Mixing Valves: Guardian, Leonard, Powers, Symmons.
n. ADA Insulation Kit: Handi Lavguard, Plumberex, Truebro.

2. Plumbing Fixtures and Trim:
a. Lavatories: Wall hung or countertop lavatory, white vitreous china with backsplash, 4” faucet centers. Single lever handle faucet, 0.5 gpm aerator, grid, stops, supplies, and ADA insulation kit.
b. Water Closets: Wall hung vitreous china elongated water closet, top spud, flush valve, open front seat.
c. Urinals: Wall hung vitreous china, flush valves, one-piece wall hangar bracket.
d. Cabinet Shower: Free-standing fiberglass reinforced plastic stall, terrazzo or plastic receptor, curtain rod, trim, pressure balancing mixing valve and shower head.
e. Electric Water Coolers: Wall hung water cooler, self-contained with bottle filler and electronic fill sensor. The unit shall be complete with cabinet, mounting frame, push bar controls, stainless steel bowl, bubbler, refrigeration system, air cooled. Cabinet shall be stainless steel.
f. Sinks: Single/two-compartment, self-rimmed, stainless steel sink, faucet, aerator, strainer, P-trap, tailpiece, supplies, stops, all chrome plated.
g. Washfountain: Semi-circular 3-, 4-, 5-station foot operated, stainless steel bowl, access panel, spray head, factory pre-piped.
h. Service Sinks: Floor mounted service sink. 24” x 24” square, faucet with pail hook, atmospheric vacuum breaker spout. 5’-0” length of hose and fittings.

i. Emergency Shower/Eyewash: Floor mounted combination emergency shower/eyewash, with 10” shower heads, and bowl for eyewash. Stainless steel pullrod, stainless steel push flag, tailpiece, supplies, stops, and P-trap. Provide tempering valve for blending water and flow switch activated strobe light and horn.
j. Interior Hose Bibb: Chrome plated hose bibb with vacuum breaker, hose thread outlet, lock shield cap and removable handle. Shutoff valve in cold water line.
k. Interior Mixing Faucet: Chrome plated inside mixing faucet with vacuum breaker, hose thread outlet, pail hook, and adjustable side arms. Shutoff valve in hot and cold water lines.
l. Exterior Wall Hydrant: Non-freeze type wall hydrant, spout with backflow preventor, loose key, hose thread outlet, chrome plated. Provide shutoff valve in cold water line.

--- End of Section ---

SECTION 23 05 29.00 48 HANGERS AND SUPPORTS

Scope: 1. Provide hangers and supports for mechanical systems piping and equipment.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1107	Packaged Dry, Hydraulic-Cement Grout (non-shrink)
ASTM A 36	Carbon Structural Steel

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	Pipe Hangers and Supports – Materials, Design and Manufacture
MSS SP-69	Pipe Hangers and Supports – Selection and Application

Products:
1. Manufacturer:
   a. Carpenter Patterson.
   b. Grinnell.
   c. Michigan Hanger.
2. Hangers and supports shall be in accordance with MSS Standards and manufacturer's published information.
3. Specific support per the following chart:

Hanger/Supports	MSS Type No.
Non insulated pipe hangers	1, 2, 3
Insulated pipe hangers	1, 3, 6, 7, 9, 10, 11
Pipe saddle supports	36, 37
Pipe roller	43, 44, 45, 46
Vertical pipe clamps	8, 42
Concrete inserts	18
Beam clamps	19, 20, 21, 23, 25, 27, 30
Steel brackets	31, 32, 33
Side beam brackets (wood)	34
Protection saddles	39
Protection shields	40, length recommended by mfr.

4. Steel Plates, Shapes and Bars: Complying with ASTM A 36.
5. Grout: ASTM C 1107, Grade B, 5000 psi strength.

Execution: 1. Maximum hanger spacing and minimum rod size pipe per the following schedule:

Pipe Size	Steel	Copper	Min. Rod Diameter & Max. allow. Load	
½" & ¾"	7'	5'	3/8"	610 lbs.
1" & 1-1/4"	6'	5'	3/8"	610 lbs.
1-1/2"	9'	8'	3/8"	610 lbs.
2"	10'	8'	3/8"	610 lbs.
2-1/2"	11'	9'	½"	1130 lbs.
3" & larger	12'	10'	½"	1130 lbs.
			¾"	2710 lbs.
			7/8"	3770 lbs.

2. Provide hangers for cast iron soil pipe at 5 ft. intervals, except 10 ft. intervals where 10 ft. lengths are used.
3. Provide hangers at 32 inch intervals for plastic pipe.
4. Anchor clamp per the following schedule:

Pipe Size	Clamp Size
1” and smaller	1-1/4” x 3/16”
1-1/4” thru 2-1/2”	1-1/4” x ¼”
3” – 4”	1-1/2” x ¼”
5” – 6”	2” x ¼”

--- End of Section ---

SECTION 23 05 48.00 48 VIBRATION ISOLATION

Scope:

1. Provide vibration isolation products for mechanical systems and equipment per manufacturer's recommendations and industry standards.

Products:

1. Manufacturer:
   a. Mason Industries Type W.
   b. Peabody Noise Control Inc. Type NPD.
   c. Vibration Eliminator Co. Type 200N.
   d. Vibration Mounting & Controls Shearflex.
2. Equipment Vibration Pads: Pads of corrugated oil resistant neoprene or stabilized fiberglass with neoprene jacket capable of loads up to 50 psi. Where the equipment base doesn't provide a uniform load surface, use a pad with a steel plate bonded to the top.
3. Neoprene-In-Shear Support: Neoprene cylinders with provision for bolting to equipment and structure if required.
4. Spring Mounting: Free standing with sound deadening pads and leveling bolts. Spring diameter-to-compressed operating spring height ratio – 1 to 1. Spring loaded minimum additional available travel – 50% of rated deflection.
5. Neoprene and Spring Support: Combination spring and double deflection neoprene element in series. Spring diameter to compressed operating spring height ratio of 0.8 or greater. Spring loaded minimum additional available travel 50% of rated deflection. Spring diameter and hanger box hole large enough to permit hanger rod to swing through a 30 degree arc before contacting the box.
6. Piping and Equipment Spring Hanger: Combination spring and double deflection neoprene hanger in series. Precompressed by the manufacturer to the rated deflection to keep piping or equipment at a fixed elevation during installation. Spring diameter to compressed operating spring height ratio of 0.8 or greater. Spring loaded minimum additional travel 50% of rated deflection. Spring diameter and hanger box hole large enough to permit hanger rod to swing through a 30 degree arc before contacting the box.
7. Equipment Beams and Rails: Steel support members tailored to cradle the machine, with built-in isolator mounting brackets to minimize equipment mounting height. Minimum beam height-to-length ratio 8% but not less than 4".
8. Air Compressor Braided Hose: Flexible stainless steel hose and braided cover with carbon steel ends. 2-1/2" pipe size and smaller – male nipples. 3" pipe size and larger – 150 pound ASA flanges. Pipe sizes up to and including: 1-1/2" pipe-12" long, 3" pipe-18" long, 6" pipe-24" long, 8" pipe and over-36" long. Use lengths as required. Install horizontally, where possible, on the equipment side of shutoff valves.
9. Neoprene Pump Connector: Flexible neoprene connectors manufactured from multiple plies of nylon tire cord fabric and neoprene. No steel wire or rings for pressure reinforcement. Connector 2" and smaller threaded ends. 2-1/2" and larger – floating steel 150 pound ASA flanges minimum pressure rating 150 psi at 220 degree F connector configuration straight line and 90 degree elbow. Connectors with two sphere design, elbow connectors with one sphere forming for corner of the joint itself.
10. Thrust Restraints: Horizontal thrust restraints consisting of spring element and neoprene pad. Spring diameter minimum .8 of spring operating distance. Minimum additional spring travel before going solid 50% of rated deflection. Spring element preadjusted a factory to limit maximum motion to ¼".
11. Vertical Piping Anchor and Guide Isolators: Acoustical pipe anchor and guide isolators consisting of telescopic arrangement of two sizes steel tubing separated by minimum ½" thickness of heavy duty neoprene and duct or neoprene isolation material. Vertical restraints by similar method to prevent vertical travel in either direction. Allowable loads on the isolation material not to exceed 500 psi with a balanced design for equal resistance in any direction.

12. Ductwork Spring Isolator Hangers: Spring type isolation hangers. Spring diameter minimum .8 of spring operating height. Minimum additional spring travel before going solid 50% of rated deflection. Spring diameter and hanger box lower hole large enough to permit hanger rod to swing through 30 degree arc before contacting box. Spring precompressed at factory by manufacturer. Furnish eye bolts to attachment to ductwork straps.

--- End of Section ---

SECTION 23 05 53.00 48 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

Scope:
1. Provide identification devices for mechanical systems and equipment. Devices shall include the following:
   a. Painted Identification Materials.
   b. Plastic Pipe Markers.
   c. Valve Tags.
   d. Valve Schedule with Frames.
   e. Engraved Plastic-Laminate Signs.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

   AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

   ANSI A13.1 Standard for the Identification of Pipes

Products:
1. Manufacturer:
   a. Brady (W.H.) Co., Signmark Div.
   b. Seton Name Plate Corp.
2. Painted Identification Materials
   a. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes complying with recommendations of ANSI A13.1 for piping and similar applications.
   b. Stencil Paint: Standard exterior type stenciling enamel; black.
   c. Identification Paint: Standard identification enamel of colors complying with ANSI A13.1.
3. Plastic Pipe Markers
   a. Flexible, semi-rigid, permanent and color coded complying with ANSI A13.1.
   b. Minimum information indicating flow direction arrow and identification of fluid being conveyed
4. Valve Tags:
   a. Brass Valve Tags: Provide 1-1/2 inch 18-gauge polished brass valve tags for all valves.
   b. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate valve tags for all valves.
   c. Valve Tag Fasteners: Manufacturer's standard solid brass chain or solid brass S-hooks.

Execution:
1. Provide engraved plastic laminate sign on or near each major item of mechanical equipment and each operational device. Signs to be fastened by mechanical means.
2. Pipe Identification: Identify piping on each piping system. Include arrows to show normal direction of flow. Comply with ANSI A13.1 for lettering size, colors, and viewing angles of identification devices.

--- End of Section ---

SECTION 23 05 93.00 48 TESTING, ADJUSTING AND BALANCING

Scope: 1. Provide testing and balancing services for all air distribution systems, hydronic distribution systems and associated equipment. The work shall include setting of speed and volume flow for systems, recording data, conducting tests, and submitting reports.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC Compliance: Comply with AABC's Manual MN-1 "National Standards for Total System Balance", as applicable to mechanical air and hydronic distribution systems, and associated equipment and apparatus.

TESTING ADJUSTING AND BALANCING BUREAU (TABB)

TABB Compliance: Comply with the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) – TAB Procedural Guide as endorsed by Testing, Adjusting and Balancing Bureau (TABB) as applicable to mechanical air and hydronic distribution systems, and associated equipment and apparatus.

SMACNA 1780 (2002) HVAC Systems - Testing, Adjusting and Balancing, 3rd Edition.

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Compliance: Comply with NEBB's "Procedural Standards for Testing, Adjusting, and Balancing (TAB) of Environmental Systems" as applicable to mechanical air and hydronic distribution systems, and associated equipment and apparatus.

Products: 1. Testers Qualifications: Firm certified by National Environmental Balancing Bureau (NEBB), or a firm certified by the Testing Adjusting and Balancing Bureau (TABB), or a member of Associated Air Balance Council (AABC) in those testing and balancing disciplines similar to those required for this Project, who is not Installer of system to be tested and is otherwise independent of Project.

2. Industry Standards: Perform TAB in accordance with the requirements of the TAB procedural standard recommended by the TAB trade association pertaining to measurements, instruments, and testing, adjusting, and balancing. Comply with all recommendations and suggested practices contained in the TAB procedural standards. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practical. Where new procedures or requirements have been published or adopted by the body responsible for the TAB Standard used, the requirements and recommendations contained in these procedures and requirements are mandatory.

--- End of Section ---

SECTION 23 07 00.00 48 MECHANICAL INSULATION

Scope: 1. Provide insulation for all air distribution, hydronic systems, and plumbing systems in building.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY OF HEATING, REFRIGERATION AND AIR CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1	Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1126	Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM C 1136	Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C 1290	Flexible Fibrous Glass Blanket Insulation Used to Externally Insulation HVAC Ducts
ASTM C 533/C534M	Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	Mineral Fiber Pipe Insulation
ASTM C 552	Cellular Glass Thermal Insulation
ASTM C 553	Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 591	Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 610	Molded Expanded Perlite Block and Pipe Thermal Insulation
ASTM C 612	Mineral Fiber Block and Board Thermal Insulation
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials

Products:
1. Manufacturer:
   a. Armstrong World Industries, Inc.
   b. Knauf Fiberglass.
   c. Owens-Corning Fiberglass Corp.
2. Pipe Insulation Materials:
   a. Fiberglass Pipe Insulation: ASTM C 547, Type I, rigid with integral jacket.
   b. Flexible Elastomeric Pipe Insulation: ASTM C 534, Type I.
3. Ductwork Insulation Materials:
   a. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Type IA, 3 lbs./cu.ft. rated to 400 degrees F with integral all-service paper backed foil vapor barrier.
   b. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type II, Class B-6, 1 lb./cu.ft. with integral foil vapor barrier.
   c. High Temperature Mineral Wool Batt Insulation: ASTM C 592.
4. Equipment Insulation Materials:
   a. Rigid Fiberglass Equipment Insulation: ASTM C 612, 3 lbs./cu.ft. rated to 400 degrees F.
   b. Flexible Fiberglass Equipment Insulation: ASTM C 533, Type II, 1-1/2 lbs./cu.ft. Provide vapor barrier for cold equipment.
   c. Flexible Elastomeric Equipment Insulation: ASTM C 534, Type II.
5. Underground Insulation Material:
   a. Extruded expanded polystyrene, Styrofoam ASTM C 578, type VII, 60 psi compressive strength board insulation.

Execution: 1. Cold Piping and Fittings:
a. Flexible elastomeric or fiberglass per following schedule. Install per manufacturer's instructions and industry standards. Protect insulation in high abuse areas such as Mechanical Rooms and Janitors Closets with PVC jacketing.
b. Cold Pipe Insulation Thickness (inch) (Based on Conductivity of 0.21 to 0.27 (BTU-inch)/(Hr.-sq.ft. -DegF))

	PIPE SIZE (inch)				
SERVICE	**<1**	**1 to <1½**	**1½ to <4**	**4 to <8**	**8 & larger**
Domestic Cold Water (a)	1.0	1.0	1.5	1.5	1.5
Chilled Water (Interior)	1.0	1.0	1.5	1.5	1.5
Chilled Water (Exterior)	2.0	2.0	2.0	2.5	2.5
Rainwater Conductor (b)	1.0	1.0	1.0	1.0	1.0
Refrig. Suction (c) 40-55 deg F (Interior)	1.0	1.0	1.5	1.5	1.5
Refrig Suction (c) 40-55 deg F (Exterior)	2.0	2.0	2.0	2.5	2.5
Cooling Coil Drain Pan Waste (a)	0.5	0.5	0.5	0.5	N/A

(a) May be fiberglass or equal "R" value of flexible elastomeric.
(b) Includes drain body, rise to drain, horizontal pipes, and vertical pipes only within 18 inches of drain body.
(c) May be fiberglass or flexible elastomeric, except where exposed to weather it shall be flexible elastomeric painted, or metal jacketed fiberglass.

2. Hot Piping and Fittings:
a. Piping schedule hereinafter shall be insulated per same method as specified for cold pipes.
b. Hot Pipe Insulation Thickness – Fiberglass (inch) (Based on Conductivity of 0.22 to 0.30 (BTU-inch)/(Hr.-sq.ft.-DegF) for temperatures to 140 DegF and 0.25 to 0.29 BTU-inch/Hr.sq.ft-DegF for temperatures 141 DegF to 200 DegF)

	PIPE SIZE (inch)				
FLUID TEMP. RANGE	**1**	**1 to 1.5**	**1.5 to < 4**	**4 to <8**	**8 & larger**
Heating Systems					
Hot Water Supply & Return					
105 to 140 deg F	1.0	1.0	1.5	1.5	1.5
141 to 200 deg F	1.5	1.5	2.0	2.0	2.0
Domestic Hot Water (a)					
105 to 140 deg F	1.0	1.0	1.5	1.5	1.5
141 to 200 deg F	1.5	1.5	2.0	2.0	2.0

(a) Flexible elastomeric acceptable.

3. Ductwork System Insulation
a. Insulate the following metal ductwork:
1) All HVAC system's supply ductwork, except ductwork exposed in conditioned spaces.
2) HVAC system's return air ductwork, except ductwork located in ceiling return plenums, and return ductwork exposed in conditioned spaces.
3) HVAC plenums and unit housings not pre-insulated at factory.
4) 100% exhaust and relief ductwork 10 ft. from building exit.

5) Outdoor air intake ductwork and mixed air ductwork between exterior air entrance and supply fan or HVAC unit inlet.
6) Relief air ductwork between main return duct and relief outlet.
7) HVAC supply and return ductwork located outside of building (include metal jacket covering).
8) HVAC supply and return sound attenuators.
9) Combustion air intake ductwork.
10) All 100% exhaust or relief ductwork in unheated spaces or attics.

b. Insulate each ductwork system with one of the following types and thicknesses of insulation:
1) Rigid fiberglass; thickness shall comply with ASHRAE 90.1. Increase thickness by 0.5 inches from 90.1 minimum in machine, fan and equipment rooms. Supply and return ductwork located in unconditioned spaces shall be insulated per ASHRAE 90.1. Increase insulation thickness by 1 inch from 90.1 minimum for ductwork located outside of building. Protect all ductwork outside of building with PVC jacketing.
2) Flexible fiberglass;thickness shall comply with ASHRAE 90.1. Application limited to concealed locations.

c. Range hood exhaust duct penetration through a combustible structure shall be protected with a 22 gauge sheet metal sleeve insulated with 1 inch mineral wool batt.

4. Equipment Insulation:
a. Hot and Cold Equipment: Insulate the following hot and cold equipment.
1) Water chillers (insulate in accordance with manufacturer's instructions).
2) Refrigeration equipment.
3) Drip pans under cooling coils equipment.
4) Chilled and hot water expansion tanks.
5) Air separators.
6) Chilled and hot water pumps.
7) Domestic water booster pumps.
8) Boilers (not pre-insulated at factory).
9) Duct mounted reheat coils.

b. Insulate each item of equipment specified above with 2 inch thick fiberglass or equivalent flexible elastomeric insulation.

c. Surfaces of cold equipment to be insulated with 1 inch thickness of flexible elastomeric insulation.

5. High Temperature Equipment and Materials:
a. Application Requirements: Insulate the following high temperature equipment and materials:
1) Breechings between heating equipment outlet and stack or chimney connection (except for factory insulated breechings).
2) Stacks (except for triple wall or factory insulated stacks).
3) Emergency generator exhaust pipe and muffler.

b. Insulate each item specified above with high temperature fiberglass 3 inch thick, with temperature rating suitable for system temperatures.

--- End of Section ---

SECTION 23 09 00.00 48 HVAC INSTRUMENTATION AND CONTROLS

Scope:
1. Furnish and install a complete Electronic Direct Digital Control (DDC) system of temperature controls for all HVAC systems and equipment.
2. System designed for fail safe operation of HVAC equipment.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500	Test Methods for Louvers, Dampers and Shutters

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	Code for Electricity Metering

ASME INTERNATIONAL (ASME)

ASME B40.1	Gauges – Pressure Indicating Dial Type – Elastic Element

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA ANSI/EIA/TIA 232-F	Interface Between Data Technical Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std. 142	IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	Industrial Control and Systems
NEMA ST 1	Specialty Transformers (Except General-Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code
NFPA 90A	Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 508	Industrial Control Equipment
UL 555S	Leakage Rated Dampers for Use in Smoke Control Systems

Submittals:
1. Shop Drawings: Submit shop drawings for each control system, containing the following information:
   a. Ten (10) copies of shop drawings of the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturer's catalog data sheets and installation instructions. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A

complete written Sequence of Operation, as well as a hard copy graphical depiction of the application control programs, shall also be included with the submittal package.

b. Schematic flow diagram of system showing all appropriate HVAC system components. Include flow characteristics (C_v values) and shutoff pressure ratings for the hydronic system valves.
c. Label each control device with setting address or adjustable range of control.
d. Wiring Diagrams for each electrical control device.
e. Provide complete system power, interlock and control wiring diagrams.
f. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.
g. Provide details of control panel, monitor readouts, including control points, instruments, and labeling.
h. Upon completion of the work, provide a complete set of drawings and application software on storage media. Drawings shall be provided as Micro Station compatible data log files.

2. Product Data: Submit manufacturer's specifications and engineering data sheet for each control device furnished, including installation instructions and start-up instructions.
3. Maintenance Data: Submit maintenance data and spare parts lists for each type of control device and for the total BTCS.
4. Manufacturer's Data: Brochures containing control drawings and wiring diagrams, cuts of all control equipment and all control descriptions and sequences. Include leakage and flow characteristics charts for automatic dampers. Provide installation instructions and start-up instructions.
5. "As-Built" shop drawings, descriptive literature and parts lists for use by Owner’s operating personnel.
6. Factory Quality Certification: The manufacturer of the Temperature Control System shall provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing). The intent of this specification requirement is to assure that the products from the Temperature Control System Manufacturer are delivered through a Quality System and Framework that will assure consistent quality in the products delivered for this project. Product literature provided by the Temperature Control System Manufacturer shall contain the ISO-9001 Certification Mark from the applicable registrar.
7. Operation and Maintenance Manuals.

Training: 1. Provide training for maintenance and operations personnel.

Products: 1. Manufacturer for all control system components and software shall be one of the following:
   a. Automated Logic.
   b. Johnson Controls.
   c. Alerton.
   d. Siebe.
   e. Honeywell.
   f. Siemens.
   g. American Automatrix.
   h. Novar.
2. Electronic DDC Control System for HVAC systems.
   a. DDC control including local DDC controllers for air handling units, hydronic pumping systems, and VAV terminal units in training facilities and office buildings. Provide central DDC computer control station for each building.
3. Electrical control wiring in metal conduit.
4. Electric motor actuated dampers shall include minimum 16 gage galvanized steel frames and blades. Include blade edge and tip seals.
   a. Leakage allowed: 6 cfm per square foot at 4 inches w.g.
   b. Leakage allowed for all locations that communicate with the exterior: 3 cfm/s.f. at 1 inch w.g.
   c. Parallel blade for two-position control, opposed blade for proportional control.
   d. Electronic actuators to be electronic direct controlled type and shall include electronic overload sensing circuitry.

5. Electric actuated control valves shall be positive positioning with polished stainless steel stem spring return.
   a. Valves to be rated for 125 psi and 240°F.
   b. Valves sized for minimum 7.5 foot water gage pressure drop.
6. Room sensor/thermostats shall be 1000 platinum resistance temperature detector, or sealed thermistor type.
   a. Locking covers.
7. Duct thermostats shall be minimum 8 foot sensing element type, adjustable to 5°F of discharge temperature.
   a. Low temperature thermostats shall be 2-pole with two sets of C contacts.
8. Relative humidity sensors shall have bulk polymer resistance sensing elements.
   a. 0 to 100% relative humidity range.
   b. Temperature range 25°F to 130°F.
   c. Accuracy with 3%.
   d. 4-20 mA output transmitter.
9. Thermowells shall be constructed of Series 300 stainless steel with threaded brass plug.
10. Pipe temperature sensors shall be 10,000 OHM platinum, RTD type, and accuracy to 0.5°F. Suitable for insertion into thermowells
11. Carbon monoxide sensor/monitors shall be microprocessor based with 0-500 ppm range. Nitrogen dioxide sensor/monitors shall be microprocessor based with 0-10 ppm range. Sensors to be UL and CSA certified.
12. DDC system to be BACnet or LONworks compatible.
    a. Computer to be a state-of-the-art PC with minimum 8 gigabyte RAM, 500 gigabyte hard drive, 2.5 gigahertz Intel Dual-Corei5 or greater processor, video card, DVD R/W drive, and 19 inch flat panel monitor. Provide software as required for computer to monitor, control, program and expand the HVAC control system. Alternatively a laptop may be provided in lieu of a desktop computer. Coordinate and confirm preference with user. Laptop workstation shall include connecting ports at all thermostats, AHU controller, chiller controller or network controllers. Laptop shall be similar to the DDC computer but may have a slower processor (2.0 gigahertz minimum) and smaller display (minimum of 15 inches). Laptop may be provided with an external DVD drive and onboard integrated graphics.
    b. Software shall be provided to provide set point control and monitoring of HVAC functions.
    c. Local DDC controllers shall be stand alone capable with 32 bit processor. 24 volt, 3 amp maximum digital output; thermistor 10,000 OHM, universal input; 4-20 mA analog electronic output.
    d. Application software to include time scheduling, optimum start/stop, source temperature optimization and space temperature control.

Execution:
1. Control of VAV air handling units through local DDC controller and building central computer.
   a. Remote static pressure control of supply and return fan VFD.
   b. 2-way modulating control of hot water and chilled water coils through discharge thermostat.
   c. Economizer control.
   d. Unoccupied control to include fan cycling to satisfy space thermostat.
2. VAV terminal unit DDC control interlocked with reheat coil 2-way control valve.
3. Primary/secondary pump or variable primary controls for hot water heating system. Pressure sensor control of secondary pump VFD. 2-way control valve at duct reheat coils. Provide differential pressure device at least on one remote coil or location. More locations may be required depending on piping arrangement..
4. Primary/secondary or variable primary pump controls for chilled water system. VFD control of secondary pump through pressure sensor at least one chilled water coil location. More locations may be required depending on piping arrangement.
5. Kitchen make-up exhaust fans interlocked with kitchen make-up unit.
6. Garage make-up unit and exhaust fan control through manual switch, carbon monoxide sensors, and NO_2 monitors.
7. Boiler control through boiler manufacturer control panel. Combustion air intake damper interlock with boiler control panel.
8. DDC analog and digital points shall be included for all HVAC system and equipment parameters for Training Facilities and Office Buildings.

9. All instrumentation and control devices on the control panels, in the control panels, and in the system shall be permanently labeled with engraved or stamped tags. The tags shall be mechanically fastened with screws, chains, or wires. All tags shall match the device numbers shown on the approved control schematics.
10. Provide a block diagram showing the network and connected control devices and workstation. Identify the network type.
11. Damper actuators shall have 150% of the torque recommended by the damper manufacturer.
12. Provide On-Off-Auto switches for each digital output which controls a device. These switches shall be mounted in the field control panel.
13. Provide Minimum-Maximum-Auto switches, or Auto-Manual switches with adjustable manual output override, for each analog output. The status of these shall be available to the panel for further processing.
14. Provide access to the VAV terminal unit via a portable workstation/tester port at the associated thermostat.
15. Provide access to the entire control system via a portable workstation/tester port at all AHU, chiller, or network controllers.
16. Motor control safety devices such as smoke detectors, freezestats, overpressure switches shall be wired to the DDC controller for shutdown and alarm and hard wired to the motor controller for shutdown.
17. VAV terminal units shall be equipped with discharge temperature sensor. The sensed discharge air temperature shall be available at the thermostat and at the workstation.
18. Provide a minimum of one relative humidity sensor per air handler system. The humidity reading shall be available at the workstation graphic.
19. Valve actuator position shall be available at the controller and at the workstation graphic.
20. Damper actuator position shall be available at the controller and at the workstation graphic.
21. Provide air flow monitoring station on outdoor air and exhaust to track building pressure.

--- End of Section ---

SECTION 23 21 13.00 48 PIPING

Scope: 1. Provide piping for hot water heating, chilled water, domestic water, compressed air, natural gas, refrigerant, sanitary drainage, and storm drainage systems.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 105/A 105M	Carbon Steel Forgings for Piping Applications
ASTM A 47/A 47M	Ferritic Malleable Iron Castings
ASTM A 53/A 53M	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 74	Cast Iron Soil Pipe and Fittings
ASTM A 536	Ductile Iron Castings
ASTM B 88	Seamless Copper Water Tube
ASTM B 280	Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM D 2661	Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2655	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2996	Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM F 876	Crosslinked Polyethylene (PEX) Tubing
ASTM F 877	Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems
ASTM F 1760	Coextruded Poly (Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content

ASME INTERNATIONAL (ASME)

ASME B16.18	Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.29	Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings – DWV
ASME B31.1	Power Piping
ASME B31.5	Refrigeration Piping

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C 104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
AWWA C 151	Ductile-Iron Pipe, Centrifugally Cast

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	National Fuel Gas Code

Products:
1. Black Steel Pipe and Galvanized Steel Pipe: ASTM A 53, ASTM A 105, Standard Schedule.
   a. Fittings: Flanges, welded, cast iron, malleable iron ASTM A 47 to match connecting pipe.
2. Copper Pipe and Tube: ASTM B 88 Type L and K.
   a. Fittings: ASME B 16.18, 16.22, 16.26.
3. Cast Iron Pipe:
   a. Hubless cast iron soil pipe, CISPI 301 with coupling CISPI 310.
4. Plastic Pipe:
   a. Polyvinyl Chloride DWV, ASTM D 2665, ASTM F 1760. Contractor shall comply with EPA requirements for recycled/recovered materials.
   b. Crosslinked Polyethylene (PEX) Piping, ASTM F 877.
   c. Acrylonitrile – Butadiene – Styrene (ABS) DWV, ASTM D 2661.
   d. Crosslinked Polyethylene (PEX) Tubing, ASTM F 876.
5. Grooved End Steel Pipe: ASTM A 53:
   a. Fittings: Ductile iron ASTM A 536.
6. Ductile Iron Pipe: AWWA C 151.
   a. Fittings: AWWA C 104.

Execution:
1. Services:
   a. Black Steel:
      1) Natural gas (inside building).
      2) Hot water heating.
      3) Chilled water.
      4) Compressed air
   b. Galvanized Black Steel:
      1) Natural gas (exterior and above grade).
   c. Type L Copper Pipe:
      1) Hot water heating 3 inches and less.
      2) Domestic hot and cold water (inside building).
      3) Hot water heating run-outs to duct and variable volume terminal unit reheat coils.
      4) Compressed air.
      5) Cooling coil drain pan condensate piping.
   d. Type K Copper Pipe:
      1) Domestic cold water (below grade or in concrete slab) 3 inches and less.
   e. Type ACR Copper Tubing:
      1) Refrigerant
   f. Hubless Cast Iron Pipe:
      1) Storm water drainage 10 inches and less.
      2) Above ground drain, waste and vent 10 inches and less.
   g. Grooved End Pipe:
      1) Hot water heating 3 inches and larger.
      2) Chilled water 3 inches and larger.
   h. Ductile Iron Pipe:
      1) Underground water service larger than 3 inches.
   i. Plastic PVC or ABS DWV:
      1) Above ground drain, waste and vent.
      2) Below ground drain, waste and vent.
      3) Below ground storm.
      4) Above ground storm.
   j. Plastic PEX Piping:
      1) Domestic hot and cold water (inside building).
      2) Domestic cold water (below grade or in concrete slab) 3 inches and less.
   k. Plastic PEX Tubing with factory oxygen barrier.
      1) Radiant floor heating.

--- End of Section ---

SECTION 23 21 14.00 48 VALVES

Scope: 1. Provide valves for hot water heating, chilled water, domestic water, natural gas systems.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASME INTERNATIONAL (ASME)

ASME B 31.1	Power Piping
ASME B 31.9	Building Services Piping

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-67	Butterfly Valves
MSS SP-70	Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	Gray Iron Swing Check Valves, Flanges and Threaded Ends
MSS SP-72	Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

Products:
1. Gate Valves 2 Inch and Smaller: Class 150, solid disc, copper silicon alloy stem brass packing gland, Teflon impregnated packing.
2. Gate Valves 2-1/2 Inch and Larger: Class 125, flanged ends, solid disc, Teflon impregnated packing.
3. Ball Valves: 150 psi, full port chrome plated brass ball, Teflon seats and seals. Solder ends for cold service, threaded for hot water service.
4. Plug Valves 2 Inch and Smaller: 150 psi, lubricated plug, semi-steel body, threaded ends.
5. Plug Valves 2-1/2 Inch and Larger: 175 psi lubricated plug type, semi-steel body, flanged ends.
6. Globe Valves 2 Inch and Smaller: Class 150, threaded ends, copper silicon alloy stem, Teflon impregnated packing.
7. Globe Valves 2-1/2 Inch and Larger: Class 125, OSY bronze mounted, Teflon impregnated packing.
8. Butterfly Valves 3 Inch and Larger: 200 psi cast iron body, EPDM liner, nickel plated ductile iron or aluminum bronze disc, stainless steel stem.
   a. Lever operators with locks.
9. Swing Check Valves 2 Inch and Smaller: Class 150, horizontal swing, pattern with bronze disc, threaded ends.
10. Swing Check Valves 2-1/2 Inch and Larger: Class 125 with bronze disc, flanged ends.
11. Wafer Check Valves: Class 250, cast iron body, stainless steel trim, lapped bronze seat.
    a. Stainless steel torsion spring.
12. Lift Check Valves 2 Inch and Smaller: Class 125, cast iron body, stainless steel spring, Teflon disc, threaded ends.

Execution:
1. Services:
   a. Ball Valves – Shutoff and Balancing:
      1) Domestic cold, hot and recirculating water piping 3” and smaller.
      2) Water supply fill and makeup connections from domestic water system.
      3) Hot water heating piping 3” and smaller.
      4) Chilled water piping 3” and smaller.
      5) Compressed air piping
   b. Cast Iron Gate Valves – Shutoff:
      1) Chilled water piping larger than 3”.
      2) Hot water heating piping larger than 3”.
      3) Domestic cold, hot and recirculating pipe larger than 3”.

c. Globe Valves – Throttling:
   1) Chilled water piping larger than 3”.
   2) Hot water heating piping larger than 3”.
   3) Domestic cold, hot and recirculating pipe larger than 3”.
d. Butterfly Valves - Shutoff:
   1) Chilled water piping larger than 3”. (Option)
   2) Hot water heating piping larger than 3”. (Option)
e. Check Valves – Swing – Horizontal Piping:
   1) Domestic cold, hot and recirculating water piping.
   2) Hot water heating piping.
   3) Chilled water piping.
f. Plug Valves - Balancing:
   1) Hot water heating piping larger than 3”.
   2) Chilled water piping larger than 3”.
g. Check Valves – Wafer and Lift:
   1) Vertical piping – same services as horizontal check valves.

--- End of Section ---

SECTION 23 21 23.00 48 PUMPS

Scope: 1. Includes inline, vertical inline, base mounted end suction, and base-mounted vertical split case pumps.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 584 Copper Alloy Sand Castings for General Applications

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)

Submittals: 1. Product Data: Submit manufacturer's pump specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.
2. Operation and Maintenance Manuals.

Products: 1. Manufacturer:
a. Amtrol Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett ITT; Fluid Handling Div.
d. Dunham-Bush, Inc.
e. Grundfos Pumps Corps.
f. Taco, Inc.
2. In-Line Circulator Pumps
a. Horizontal mount, radially split case, oil-lubricated, designed for 125 psi working pressure, and 225 deg. F (107 deg. C) continuous water temperature.
b. Body: Cast iron, with suction and discharge gauge tappings.
c. Shaft: Hardened alloy steel.
d. Bearings: Oil-lubricated bronze journal bearings.
e. Seal: Mechanical, with carbon seal ring and ceramic seat.
f. Motor: Non-overloading at any point on pump curve, open, drip-proof, oil-lubricated journal bearings, resilient mounted construction, built-in thermal overload protection on single phase motors.
g. Couplings: Self-aligning, flexible couplings.
h. Impeller: ASTM B 584, cast bronze, hydraulically and dynamically balanced, and keyed to shaft.
3. Vertical In-Line Circulator Pumps:
a. Vertical, in-line, centrifugal, flexible-coupled, single-stage, radially split case design. Include vertical-mounting, bronze-fitted design and mechanical seals rated for 125-psig (860-kPa) minimum working pressure and a continuous water temperature of 225 deg F (107 deg C).
b. Body: Cast iron, with threaded companion flanges, drain plug at low point of volute, and threaded gage tappings at inlet and outlet connections.
c. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, and keyed to shaft.
d. Shaft: Ground and polished stainless-steel shaft with bronze sleeve.
e. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
f. Motor: Non-overloading at any point on pump curve, open drip-proof, oil lubricated bearings. Directly mounted to pump casing and with lifting and supporting lugs in top of motor enclosure.

4. Base Mounted End Suction Pumps:
    a. Horizontal mount, single stage, end suction, flexible coupling, designed for 175 psi working pressure.
    b. Casing: Cast iron, 125 psi ANSI flanges, tappings for gauge and drain connections.
    c. Shaft: Steel with replaceable shaft sleeve.
    d. Seal: Mechanical, with carbon seal ring and ceramic seat.
    e. Motor: Open, Drip-proof, regreasable ball bearings.
    f. Impeller: ASTM B 584, cast bronze, hydraulically and dynamically balanced, keyed to shaft and secured with locking screw.
5. Base-Mounted Vertical Split Case Pumps:
    a. Horizontal mount, single stage, vertical split case, designed for 175 psi working pressure.
    b. Casing: Cast iron, 125 psi ANSI flanges, tappings for gauge and drain connections.
    c. Shaft: Steel with replaceable shaft sleeve.
    d. Seal: Mechanical, with carbon seal ring and ceramic seat.
    e. Motor: Open, Drip-proof, regreasable ball bearings.
    f. Impeller: ASTM B 584, cast bronze, hydraulically and dynamically balanced, keyed to shaft and secured with locking screw.

--- End of Section ---

SECTION 23 31 13.00 48 METAL DUCTWORK

Scope: 1. Provide rectangular and round metal ductwork for air distribution systems.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	Installation of Air Conditioning and Ventilation Systems
NFPA 96	Ventilation Control and Fire Protection of Commercial Cooking Operations

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA	HVAC Duct Construction Standards – Metal and Flexible

UNDERWRITERS LABORATORIES (UL)

UL 181	Factory Make Air Ducts and Air Connectors

Products:
1. Sheet Metal: Galvanized sheet steel complying with ASTM A 653/A 653M with G90 zinc coating.
2. Black-Steel Sheets: Cold-rolled sheets per ASTM A 366/ A 366M.
3. Stainless Steel: Stainless steel complying with ASTM A 167, Type 302.
4. Aluminum Sheets: Sheets complying with ASTM B 209, Alloy 3003, Temper H14.
5. Flexible spiral-wound spring steel, greater of minimum 1" thick insulation complying with UL 181 or the thickness required to comply with ASHRAE 90.1.
6. Miscellaneous Materials: Provide all required fittings, connectors, sealants, and supports conforming with highest industry standards.

Execution: 1. Installation of all ductwork, fittings, supports, and miscellaneous components shall conform to SMACNA "HVAC Duct Construction Standards."

--- End of Section ---

SECTION 23 33 00.00 48 DUCTWORK ACCESSORIES

Scope: 1. Provide ductwork accessories to serve ductwork systems of air distribution.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AIR CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 880 Air Terminals

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A Installation of Air Conditioning and Ventilation Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA HVAC Duct Construction Standards – Metal and Flexible

UNDERWRITERS LABORATORIES (UL)

UL 555 Fire Dampers
UL 555S Combination Fire/Smoke Dampers

Products: 1. Manufacturer – Fire and Smoke Dampers:
   a. Cesco.
   b. Greenheck.
   c. Ruskin.
2. Manufacturer – Sound Attenuators:
   a. Aerosonics.
   b. Commercial Acoustics.
   c. Industrial Acoustics Corporation.
   d. Ruskin.
   e. United McGill Corporation.
3. Fire and Fire/Smoke Dampers: Galvanized steel, 16 gauge dampers shall comply with UL Standard 555 and 555S. Fire/smoke dampers to be electric operated.
4. Duct Hardware: All test holes and quadrant locks by one manufacturer.
5. Duct Access Doors: Provide access door at each item installed in ductwork, including smoke dampers, fire/smoke dampers, hydronic coils, VAV terminals, etc.
6. Flexible Connections: Provide flexible connection where ductwork connects to vibration isolated equipment.
7. Sound Attenuator: 22 gauge galvanized steel in accordance with ASHRAE recommendations. Inorganic filler material, inert, vermin and moisture proof. Combustion rating tested in accordance with ASTM E 84 and NFPA 255.

Execution: 1. Installation of fire and fire/smoke dampers shall be in accordance with manufacturer's recommendations and NFPA 90A.

--- End of Section ---

SECTION 23 34 00.00 48 FANS

Scope: 1. Provide fans of type and size required for project.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 210 Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

AIR CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 430 Central Station Air Handling Units

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 National Electrical Code

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA HVAC Duct Construction Standards – Metal and Flexible

UNDERWRITERS LABORATORIES (UL)

UL 705 Power Ventilators

Submittals: 1. Product Data: Submit manufacturer's technical product data for fan, including specifications, capacity ratings, fan performance curves with operating point clearly indicated, gauges and finishes of materials, dimensions, weights, accessories furnished, and installation instructions.
2. Maintenance Data: Submit maintenance instructions, including lubrication instructions, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals.

Products: 1. Manufacturer:
a. PennBarry.
b. Cook.
c. Greenheck.
2. Axial Fans: Provide vane axial fans with fixed or adjustable pitch blades. Cast aluminum hub and blades to be 356-T6 aluminum, anodized finish. Motors to be high efficiency, cast iron with minimum 56,000 hours B-10 life.
3. Centrifugal Power Ventilators: Provide pre-fabricated, belt-driven or direct-driven centrifugal power ventilator. Aluminum weatherproof hoods. Gravity backdraft damper, bird screen, and disconnect switch. Prefabricated roof curb by same manufacturer.
4. Propeller Fans: Provide belt-driven or direct-driven propeller fans consisting of fan blades, hub, housing, motor, drive assembly, and accessories.
5. In-line Centrifugal Fans: Provide belt driven or direct drive in-line centrifugal fans including backward inclined aluminum fan wheel, aluminum housing, motor, drive assembly, and accessories.

--- End of Section ---

SECTION 23 35 16.00 48 OVERHEAD VEHICLE TAILPIPE EXHAUST SYSTEM(S)

Scope: 1. Provide complete and operational overhead vehicle exhaust system. Exhaust systems shall provide adequate air quantities and appropriate velocities for vehicles served.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 210	Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code
NFPA 90A	Installation of Air Conditioning and Ventilation Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA	HVAC Duct Construction Standards – Metal and Flexible

Submittals: 1. Product Data: Submit manufacturer's technical product data for exhaust systems, including specifications, capacity ratings, fan performance curves with operating point clearly indicated, gauges and finishes of materials, dimensions, weights, accessories furnished, and installation instructions.
2. Maintenance Data: Submit maintenance instructions, including lubrication instructions, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals.

Products: 1. Manufacturer:
a. Graco.
b. Car-Mon.
c. Plymovent.
d. Monoxivent
2. Ductwork:
a. Ductwork shall be constructed of minimum gauge thickness as required in SMACNA Duct Construction Standards. Ductwork shall be round with lock seams.
b. Fittings shall be constructed as required by SMACNA Duct Construction Standards.
c. Cleanout shall be provided on the end of the main ductwork opposite the end of the fan suction connection.
d. Flexible connectors shall be used at fan suction and discharge connection.
e. Duct sleeves shall be provided for all ductwork 15 inch diameter and smaller, passing through floors, walls, ceilings or roofs.
3. Exhaust Hose System:
a. Tailpipe adaptors shall be tapered cone type, with spring clips.
b. Flexible exhaust hose shall be approved heat resistant wire reinforced glass fiber and silicone tubing.
c. Exhaust hose suspension system shall suspend the flexible tubing overhead, when not in use. The suspension system shall be counter weighted, motorized type.
4. Dampers shall be circular disk type with quadrant locking device or blast gate type. Damper shall be made of stainless steel, blast gate dampers shall be two-piece construction.

5. Fans:
    a. Fans shall be ducted utility type, with V-belt drives, designed for 150 percent of capacity. Fans shall have guards, vibration isolation support, non-overloading characteristics. Fan impellors shall be spark resistant construction, and coated with neoprene, epoxy, or phenolic resin to resist corrosion.
    b. Sound power levels shall be obtained according to AMCA 300.

--- End of Section ---

SECTION 23 36 00.00 48 AIR TERMINAL UNITS

Scope: 1. Provide variable air volume air terminal units for supply air heating, cooling, and control.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AIR CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 410	Forced Circulation Air Cooling and Air Heating Coils
AHRI 880	Terminal Units

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	Installation of Air Conditioning and Ventilation Systems

UNDERWRITERS LABORATORIES (UL)

UL 181	Factory-Made Air Ducts and Connectors

Submittals:
1. Product Data: For each type of product indicated submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, furnished specialties, sound-power ratings, and accessories.
2. Operation and Maintenance Manuals.

Products:
1. Manufacturer:
   a. Anemostat.
   b. Krueger.
   c. Metalaire.
   d. Titus.
2. Provide self-contained variable volume terminal units sized to deliver required air flow across a 0.3" to 3.0" pressure loss. Case to be 20 gauge galvanized steel internally lined fiberglass complying with UL 181 and NFPA 90A.
3. Damper actuator shall be factory mounted 24 volt electric motor driven, spring return.
4. Reheat coils shall be copper tubing with aluminum fins.
5. Maximum radiated and discharge NC (noise criteria) of 30 through whole CFM range per ARI Standard 885-90.

--- End of Section ---

SECTION 23 37 00.00 48 AIR OUTLETS AND INLETS

Scope: 1. Provide diffuser, registers, grilles and gravity intake/relief ventilators to meet project requirements.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 70 Method of Testing for Rating the Performance of Air Outlets and Inlets

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A Installation of Air Conditioning and Ventilation Systems

UNDERWRITERS LABORATORIES (UL)

UL 181 Factory-Made Air Ducts and Air Connectors

Products: 1. Diffusers, Registers and Grilles: Provide supply, return, and exhaust diffusers, registers and grilles for configurations to fit project. Select materials, finish, and CFM flow rate within manufacturer's recommendations and industry design standards.
2. Intake and Relief Ventilators: Provide pre-fabricated intake or relief gravity ventilator, hooded type with extended throat, curb mounted to meet project requirements. Aluminum construction with bird screen covering intake/relief area. Provide damper in throat of roof curb.

--- End of Section ---

SECTION 23 38 13.00 48 RANGE HOOD

Scope: 1. Provide range hood.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 96 Standard for Ventilation Control & Fire Protection of Commerical Cooking Operations

NATIONAL SANITATION FOUNDATION (NSF)

UNDERWRITERS LABORATORIES (UL)

Products: 1. Manufacturer:
   a. Captive Aire System.
   b. Gaylord Industries.
   c. Greenheck.
2. Hood shall be constructed of polished stainless steel.
3. Provide stainless steel self-draining extractor inserts with grease extraction efficiency of 90%.
4. Provide spring loaded, fusible link (280ºF) type fire damper in hood outlet.
5. Hood shall be U.L. listed and be in accordance with NSF and NFPA 96.
6. Provide wet chemical fire extinguisher system. System shall have duct nozzle, plenum nozzles and down nozzles, micro switch and normally open contacts for connection to the shunt trip breaker, fusible link, and dry chemical. Wet chemical system shall comply with requirements of Section 21 21 03.00 48 WET CHEMICAL EXTINGUISHMENT SYSTEM.

--- End of Section ---

SECTION 23 40 00.00 48 AIR CLEANING DEVICES

Scope: 1. Provide air filtration equipment for Project air handling units.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.2	Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

UNDERWRITERS LABORATORIES (UL)

UL 586	High Efficiency, Particulate, Air Filter Units
UL 900	Standard for Air Filter Units

Products: 1. For air handlers, a combination of cartridge type MERV 8 pre-filters and MERV 13 final filters when measured in accordance with ASHRAE 52.2 shall be used. Each filter shall consist of non-woven cotton fabric media, media support grid and enclosing frame. The filter shall be listed by UL as Class II. Provide manometer-type filter gauge at each filter bank.

--- End of Section ---

SECTION 23 51 00.00 48 BREECHING AND STACKS

Scope: 1. Types of breeching and stacks include type B, double wall gas vents, positive pressure breeching and stack, fabricated metal breeching. Direct venting for condensing heating equipment shall be used and includes combustion air intake and exhaust vent.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.66 Automatic Vent Damper Devices for Use with Gas-Fired Appliances

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211 Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

Products: 1. Manufacturer:
a. Ameri-Vent (AMPCO).
b. Industrial Chimney.
c. Metal-Fab.
d. Schebler Co.
e. Selkirk Metalbestos.
f. Van-Packer Co.

2. Type B Double Wall Gas Vent:
a. General: Provide double wall gas vent, UL-listed for Type B, consisting of double wall metal construction pipe sections and fittings and accessories required for complete installation. Construct inner pipe of aluminum and outer pipe of galvanized steel.

3. All Steel Positive Pressure Double Wall Stacks:
a. General: Provide double wall positive pressure breechings and stacks with 2” thick high temperature fiber insulation between inner and outer walls. Inner wall shall be constructed of 304 stainless steel

4. Combustion Air and Exhaust Vent for Condensing Heating Equipment:
a. Combustion Air: Schedule 40 PVC per ASTM D 1784.
b. Exhaust Vent: Schedule 40 CPVC or stainless steel per UL 1738.

--- End of Section ---

SECTION 23 52 00.00 48 HEATING BOILERS AND ACCESSORIES

Scope: 1. Includes gas fired hot water boilers and hydronic system accessories for hot water heating systems.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.13	Gas-Fired Low-Pressure Steam and Hot Water Boilers

ASME INTERNATIONAL (ASME)

ASME BPV Sec IV	Boiler and Pressure Vessel Code; Section IV, Recommended Rules for the Care and Operation of Heating Boilers
ASME BPV Sec IX	Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPV Sec VIII Div 1	Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 – Basic Coverage
ASME CSD-1	Control and Safety Devices for Automatically Fired Boilers

HYDRONICS INSTITUTE DIVISION OF GAMA (HYI)

HYI-005	I=B=R Ratings for Boilers, Baseboard Radiation and Finned Tube (Commercial)
HYI-400	Radiant Floor Heating

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA 54	National Fuel Gas Code

UNDERWRITERS LABORATORIES (UL)

UL 795	Commercial-Industrial Gas Heating Equipment

Submittals: 1. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and size of each field connection.
   a. Provide wiring diagrams for power, signal and control systems, and differentiate between manufacturer installed and field wiring.
2. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model indicated, weights (shipping, installed, and operating), furnished specialties and accessories, and installation, start-up instructions, and warranty data.
3. Maintenance Data: Submit maintenance data and parts list for each boiler, control, and accessory; including "trouble-shooting" maintenance guide. Include this data and product data in maintenance manual.
2. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

Warranty: 1. Furnish manufacturer’s standard, but not less than ten (10) year warranty from date of substantial completion.

Training: 1. Provide training for maintenance and operations personnel.

Products:
1. Manufacturer (Cast Iron):
   a. Bryan Steam Corp.
   b. Hydrotherm, Inc.
   c. Peerless Heater Co., The, Div. of Peerless Industries, Inc.
   d. Weil-McLain, A Marley Co.
2. Cast Iron Boilers:
   a. Factory assembled packaged (forced draft) cast iron gas fired boilers.
   b. Cast iron sections set on insulated steel base, insulated jacket.
   c. Aluminized steel burners, stainless steel radiation plates, 100% shutoff.
   d. Spark or electric ignition.
   e. 40 psig water pressure rating.
   f. Design/Build Contractor will install proper percentage of glycol anti-freeze as required for specific site outdoor design conditions; applicable system use; and in accordance with glycol manufacturer's recommendations for application freeze or burst protection.
   g. Boiler Trim:
      1) ASME safety relief valve, combination water pressure and temperature gage, low water cutoff, factory assembled electric control, and electronic modulating operating temperature controller.
   h. Natural gas (forced draft) type gas burner, and safety controls.
   i. Boiler Management Control System:
      1) Computer-based controller with nonvolatile memory and solid-state sensors. Controller consists of chassis, program module, keyboard display, and flame signal amplifier.
   j. Control Panel:
      1) Motor controllers, relays, and control switches factory assembled in NEMA 250, Type 1A enclosure
3. Manufacturer (Condensing):
   a. Fulton Boiler Works, Inc.
   b. AERCO International.
   c. Lochinvar.
4. Condensing Boilers:
   a. Factory assembled packaged condensing boilers.
   b. Fire tube type on steel base, insulated jacket, nonferrous corrosion resistant heat exchangers.
   c. Forced draft or pulse combustion type burner and safety controls.
   d. Carbon steel pressure vessel with welded heads and tube connections.
   e. Spark or electric ignition with 100 percent main valve shut-off with electronic flame supervision.
   f. Separate combustion air intake, exhaust and condensate drain.
   g. Combination gas valve with manual shut-off and pressure regulator.
   h. Boiler Trim:
      1) ASME safety relief valve, combination water pressure and temperature gage, low water cutoff, factory assembled electronic control, and electronic modulating operating temperature controller.
   i. Boiler Management Control System:
      1) Computer-based controller with nonvolatile memory and solid-state sensors. Controller consists of chassis, program module, keyboard display, and flame signal amplifier.
   j. Control Panel:
      1) Motor controllers, relays, and control switches factory assembled in NEMA 250, Type IA enclosure.

--- End of Section ---

SECTION 23 54 16.00 48 DIRECT-FIRED MAKEUP AIR UNITS

Scope: 1. Provide packaged indoor direct gas fired makeup air units to meet project requirements.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z83.4 Non-Recirculating Direct Gas-Fired Heating and Forced Ventilation Appliances for Commercial and Industrial Applications

INTERNATIONAL APPROVAL SERVICES (IAS)

IAS Directory IAS Directory of AGA and CGA Certified Appliances and Accessories

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG1 Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 National Fuel Gas Code

UNDERWRITERS LABORATORIES (UL)

UL Gas & Oil Dir Gas and Oil Equipment Directory

Submittals: 1. Product Data: Submit manufacturer's technical product data for makeup air units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, gages and finishes of materials, and installation instructions. Provide burner, fan, and other component removal and replacement clearance requirements.
2. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to makeup air units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
3. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals.

Products: 1. Manufacturer:
a. Hartzell Fan, Inc.
b. Lennox Industries, Inc.
c. Modine Manufacturing Co.
d. Reznor/Thomas & Betts.
e. Sterling Gas-Fired Heating Equipment Div.
2. Direct-Fired Makeup Air Furnace:
a. Provide gas-fired packaged factory-assembled, pre-wired, self-contained unit. Minimum 0.052 inch thick, galvanized steel panels, formed to ensure rigidity. Factory-applied, neoprene-faced, glass-fiber insulated, 1 inch thick, applied on complete unit.
b. Burners: Capable of modulating turndown ratio of 25:1, including electric-modulating main gas valve, motorized shutdown valve, main and pilot gas regulators, pilot electric gas valve, manual shutoff valve, and pilot adjustment valve. Provide control and gas train to meet Code.
1) Pilot: Electrically ignited by spark rod through high-voltage ignition transformer.
2) Safety Controls: Factory installed sensors verify correct airflow before energizing pilot and sense pilot ignition before activating main gas valve.

3) Manual Reset, Low- and High-Limit Controls: Maintain supply air temperature between set points, and shut fan down if temperatures are exceeded.
4) Purge-Period Timer: Automatically delays burner ignition and bypasses low-limit control.

c. Description: Rated according to AMCA 210; statically and dynamically balanced, galvanized steel, centrifugal fan mounted on solid steel shaft with heavy-duty, self-aligning, prelubricated ball bearings and V-belt drive with matching motor sheaves and belts.
   1) Fan Type: Forward curved.
   2) Fan Type: Backward inclined.

d. Controls: Provide factory-wire connection for power supply and field-wire unit to remote control panel.

--- End of Section ---

SECTION 23 64 10.00 48 PACKAGED AIR-COOLED SCROLL CHILLERS

Scope: 1. Provide exterior air-cooled scroll chiller and hydronic system accessories for chilled water cooling systems.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AIR CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 550/590 Water Chilling Packages Using the Vapor Compression Cycle

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15 & 34 Safety Standard for Refrigeration Systems/ Designation and Classification of Refrigerants
ASHRAE 90.1 Energy Standard for Buildings Except Low Rise Residential Buildings

ASME INTERNATIONAL (ASME)

ASME BPVC Sec VIII Div 1 Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 – Basic Coverage

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 Motors and Generators
NEMA MG 2 Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators

Submittals: 1. Product Data: Submit manufacturer's technical product data for chiller showing dimensions, weights, capacities, ratings with operating point clearly indicated, motor electrical characteristics, gages and finishes of material, and installation instructions. Provide component removal and replacement clearance requirements.
2. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to chiller units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Submit manufacturer's chiller computer panel literature and wiring diagrams. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
3. Sound Data: Submit manufacturer's sound power level data in 8 octave bands beginning with the 60 Hertz mean frequency band and including the 8000 Hertz band. Where split systems are used, include sound data for all components furnished.
4. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in Maintenance Manuals.

Warranty: 1. Furnish manufacturer's standard, but not less than five (5) year warranty on the entire chiller from date of substantial completion.

Training: 1. Provide training for maintenance and operations personnel.

Products: 1. Manufacturer:
a. Carrier.
b. Daikin.
c. Trane.
d. York.

2. Chiller:
   a. Chiller shall be factory assembled, shall have single point electrical connection, and shall include all required piping and controls.
   b. Unit shall be ARI 590 rated and shall include a five (5) year warranty.
   c. Compressors shall be scroll type with hermetically sealed construction.
   d. Chiller barrel shall be a direct expansion shell and tube with refrigerant in the tubes and liquid in the shell. Working pressure shall be 235 psig for the refrigerant side.
   e. Chiller heat exchanger shall be brazed plate single-pass direct-expansion design utilizing stainless steel construction.
   f. Chiller barrel to be constructed to ASME code requirements.
   g. Air cooled condenser coil shall be an extended surface fin-and-tube type utilizing copper tubes with aluminum or copper fins.
   h. Heat Reclaim Condenser: Air cooled chiller with a dedicated heat reclaim condenser shall be factory fabricated and tested refrigerant to water heat exchanger for hot water heating from the high pressure refrigerant. When there is a simultaneous need for chilled water and hot water, the chiller has the capability to operate in heat reclaim mode.
   i. Chiller controls shall include integral or remote mounted microprocessor control panel with functional and alarm monitoring, and reset control capability. Panel shall include instrumentation allowing open communication to Owner's Building Automation System.
   j. Design/Build Contractor will install proper percentage of glycol anti-freeze as required for specific site outdoor design conditions; applicable system use; and in accordance with glycol manufacturer's recommendations for application freeze or burst protection.

Execution:
1. Installation shall be in accordance with manufacturer's recommendations and industry guidelines.
2. Provide concrete pad under entire chiller frame.

--- End of Section ---

SECTION 23 64 26.00 48 PACKAGED AIR-COOLED ROTARY-SCREW CHILLERS

Scope: 1. Provide exterior air-cooled rotary-screw chiller and hydronic system accessories for chilled water cooling systems.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AIR CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 550/590	Water Chilling Packages Using the Vapor Compression Cycle

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15 & 34	Safety Standard for Refrigeration Systems/ Designation and Classification of Refrigerants
ASHRAE 90.1	Energy Standard for Buildings Except Low Rise Residential Buildings

ASME INTERNATIONAL (ASME)

ASME BPVC Sec VIII Div 1	Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 – Basic Coverage
ASME BPVC Sec IX	Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	Motors and Generators
NEMA MG 2	Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators

Submittals: 1. Product Data: Submit manufacturer's technical product data for chiller showing dimensions, weights, capacities, ratings with operating point clearly indicated, motor electrical characteristics, gages and finishes of material, and installation instructions. Provide component removal and replacement clearance requirements.
2. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to chiller units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Submit manufacturer's chiller computer panel literature and wiring diagrams. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
3. Sound Data: Submit manufacturer's sound power level data in 8 octave bands beginning with the 60 Hertz mean frequency band and including the 8000 Hertz band. Where split systems are used, include sound data for all components furnished.
4. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in Maintenance Manuals.

Warranty: 1. Furnish manufacturer's standard, but not less than five (5) year warranty on the entire chiller from date of substantial completion.

Training: 1. Provide training for maintenance and operations personnel.

Products: 1. Manufacturer:
a. Carrier.
b. Daikin.
c. Trane.
d. York.

2. Chiller:
   a. Chiller shall be factory assembled, shall have single point electrical connection, and shall include all required piping and controls.
   b. Unit shall be ARI 590 rated and shall include a five (5) year warranty.
   c. Compressors shall be rotary-screw type with semi-hermetic construction.
   d. Chiller barrel shall be a direct expansion shell and tube with refrigerant in the tubes and liquid in the shell. Working pressure shall be 235 psig for the refrigerant side.
   e. Chiller heat exchanger shall be brazed plate single-pass direct-expansion design utilizing stainless steel construction.
   f. Chiller barrel to be constructed to ASME code requirements.
   g. Air cooled condenser coil shall be an extended surface fin-and-type type utilizing copper tubes with aluminum or copper fins.
   h. Heat Reclaim Condenser: Air cooled chiller with a dedicated heat reclaim condenser shall be factory fabricated and tested refrigerant to water heat exchanger for hot water heating from the high pressure refrigerant. When there is a simultaneous need for chilled water and hot water, the chiller has the capability to operate in heat reclaim mode.
   i. Chiller controls shall include integral or remote mounted microprocessor control panel with functional and alarm monitoring, and reset control capability. Panel shall include instrumentation allowing open communication to Owner's Building Automation System.
   j. Design/Build Contractor will install proper percentage of glycol anti-freeze as required for specific site outdoor design conditions; applicable system use; and in accordance with glycol manufacturer's recommendations for application freeze or burst protection.

Execution:
1. Installation shall be in accordance with manufacturer's recommendations and industry guidelines.
2. Provide concrete pad under entire chiller frame.

--- End of Section ---

SECTION 23 73 00.00 48 AIR HANDLING UNITS

Scope: 1. Provide modular indoor air handling units of size and configuration required for project.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AIR CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 410	Forced-Circulation Air-Cooling and Air-Heating Coils
AHRI 430	Central-Station Air-Handling Units
AHRI Guideline D	Application and Installation of Central Station Air-Handling Units

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 210	Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300	Reverberant Room Method for Sound Testing of Fans

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.2	Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 84	Method of Testing Air to Air Heat Exchangers

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 900	Standard for Air Filter Units
UL Elec Const Dir	Electrical Construction Equipment Directory
UL Fire Resist Dir	Fire Resistance Directory

Submittals: 1. Product Data: Submit manufacturer's technical product data for air handling units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, gages and finishes of materials, and installation instructions. Provide coil, fan, and other component removal and replacement clearance requirements.
2. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to air handling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
3. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals.

Training: 1. Provide training for maintenance and operations personnel.

Products:
1. Manufacturer:
   a. Carrier Air Conditioning.
   b. Daikin.
   c. Pace.
   d. Haakon.
   e. York.
   f. Trane.
   g. Aaon.
2. Casing: Provide 2-inch double wall insulated casings for all sections exposed to the air stream. Interior of casing to be galvanized steel, 20 gauge nominal. Provide double wall insulated drain pan.
3. Fans: Air foil blade design for units over 18,000 CFM and air foil or forward curved design for units below 18,000 CFM, dynamically balanced before and after installation in cabinet. V-belt drive to be cast-iron or steel sheaves with adjustable pitch. Service factor to be 1.3 times fan brake horsepower.
4. Coils: Provide preheat, hot water, chilled water, or DX cooling coils as unit requires. Copper tubes with aluminum fins, ARI certified, UL listed.
5. Provide access sections with double wall doors. Access doors shall be provided for all sections that require maintenance this includes before and after coils for cleaning, filter, fans, belts, etc. VFD shall be mounted external to unit. (Removal of unit wall panels shall not be required to access the VFD.) Door shall be operable without the use of tools.
6. Provide blender section for mixing of return and outside air streams.
7. Filter Section: Sealed filter section with MERV 8 pre-filters and MERV 13 final filters when measured in accordance with ASHRAE 52.2.
8. Energy Recovery Devices: Air handling units with energy recovery devices shall be factory fabricated and tested for sensible or total heat transfer from exhaust air to supply air stream.
   a. Rotary wheel units shall have published device performance according to ASHRAE 84 with tested energy transfer effectiveness and cross-contamination performance. Exchange media shall be chemically inert moisture-resistant, fire-retardant, laminated, nonmetallic material which complies with NFPA 90A. Isolate exhaust and supply streams by seals which are static, field adjustable, and replaceable. Fabricate enclosure from galvanized steel and include provisions for maintenance access. Include recovery control and rotation failure provisions.
   b. Flat plate cross-flow heat exchanger units shall include supply air fan and motor and exhaust air fan and motor. Provide 2-inch double wall insulated galvanized steel casing. Provide fibrous desiccant cross-flow type heat exchanger core with clog resistant design capable of easy removal from the unit. Stainless steel drain pans shall be provided beneath the exhaust and supply sided of the exchanger. Provide supply and exhaust air filters and low leakage dampers.

--- End of Section ---

SECTION 23 81 26.00 48 SPLIT SYSTEM AIR CONDITIONING UNITS

Scope:
1. Provide split system air conditioning units for dedicated cooling applications.
2. Air conditioning units shall be ceiling mounted.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AIR CONDITIONING. HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 210/240	Unitary Air-Conditioning and Air-Source Heat Pump Equipment
AHRI 410	Forced-Circulation Air-Cooling and Air-Heating Coils
AHRI 460	Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
AHRI 700	Specifications for Fluorocarbon and Other Refrigerants

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1071	Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15 & 34	Safety Standard for Refrigeration Systems/Designation and Classification of Refrigerants
ASHRAE 52.2	Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 90.1	Energy Standard for Buildings Except Low-Rise Residential Buildings

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	Industrial Control and Systems, Enclosures
NEMA MG 1	Motors and Generators
NEMA MG 2	Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1995	Heating and Cooling Equipment
UL 900	Standard for Air Filter Units

Submittals:
1. Product Data: Submit manufacturer's technical product data for air-conditioning units/condenser units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, gages and finishes of materials, and installation instructions. Provide coil, fan, and other component removal and replacement clearance requirements.
2. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to air-conditioning units/condenser units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
3. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals.

Products:
1. Manufacturer:
   a. Carrier Air Conditioning.
   b. Data-Aire.
   c. Liebert.
2. Provide self-contained air conditioning unit consisting of cabinet, fan, evaporator coil, and controls. Evaporator coil to be direct expansion type with required piping and expansion valves.
3. Condensing unit shall be remote grade mounted air cooled DX unit with hermetic compressor.
4. Filters to be pleated with a MERV of 6 when measured in accordance with ASHRAE 52.2.
5. Unit control system shall be factory mounted with remote programmable operation terminal.

--- End of Section ---

SECTION 23 81 43.00 48 AIR-TO-AIR HEAT PUMPS

Scope: 1. Provide split system air-to-air heat pumps for project.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AIR CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 210/240	Unitary Air-Conditioning and Air-Source Heat Pump Equipment
AHRI 410	Forced-Circulation Air-Cooling and Air-Heating Coils
AHRI 460	Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
AHRI 700	Specifications for Fluorocarbon and Other Refrigerants

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1071	Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15 & 34	Safety Standard for Refrigeration Systems/Designation and Classification of Refrigerants
ASHRAE 52.2	Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 90.1	Energy Standard for Buildings Except Low-Rise Residential Buildings

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	Motors and Generators
NEMA MG 2	Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1995	Heating and Cooling Equipment
UL 900	Standard for Air Filter Units

Submittals: 1. Product Data: Submit manufacturer's technical product data for air-to-air heat pumps showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, gages and finishes of materials, and installation instructions. Provide coil, fan, and other component removal and replacement clearance requirements.

2. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to air-to-air heat pumps. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

3. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals.

Products:
1. Manufacturer:
   a. Carrier Air Conditioning, Division of Carrier Corp.
   b. Lennox Industries.
   c. Rheem – Air Conditioning Division.
2. Heavy gauge galvanized steel cabinet with powdered enamel finish.
3. Extra large surface area for circuitry of coils to provide maximum efficiency.
4. Scroll type compressor.
5. Crank case heater, coils, belt driven fans, reversing valves, check/expansion valve, high capacity drier, high pressure switch, freezestat and low ambient controls.
6. Filter Section: Angle filter with 2” – MERV 8 filters when measured in accordance with ASHRAE 52.2.
7. Economizer control to be included.

--- End of Section ---

SECTION 23 82 00.00 48 TERMINAL HEATING UNITS

Scope: 1. Provide terminal heating units as required for project.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AIR CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 410	Forced-Circulation Air-Cooling and Air-Heating Coils
AHRI 880	Air Terminals

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 210	Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.47	Gas-Fired Central Furnaces

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	National Fuel Gas Code
NFPA 90A	Installation of Air Conditioning and Ventilating Systems
NFPA 90B	Installation of Warm Air Heating and Air Conditioning Systems
NFPA 211	Chimneys, Fireplaces, Vents, and Solid Fuel-Burs

UNDERWRITERS LABORATORIES (UL)

UL 441	Gas Vents
UL 900	Standard for Air Filter Units
UL 1738	Venting Systems for Gas-Burning Appliances, Categories II, III and IV
UL Bld Mat Dir	Building Materials Directory
UL Elec Const Dir	Electrical Construction Equipment Directory
UL Fire Resist Dir	Fire Resistance Directory

Submittals: 1. Product Data: Submit manufacturer's specifications for terminal heating units showing dimensions, capacities, ratings, performance characteristics, gages and finishes of materials, and installation instructions.
2. Operation and Maintenance Manuals.

Products: 1. Manufacturer – Air Coils, Cabinet Unit Heaters, and Unit Heaters:
a. Airtherm Mfg. Co.
b. Carrier A/C Group, Carrier Corp.
c. Trane.
2. Manufacturer – Infrared Heaters:
a. Perfection-Schwank, Inc.
b. Roberts-Gordon, Inc.
c. Solaronics, Inc.

3. Air Coils: Provide duct mounted coils of capacities, pressure drops in accordance with ARI 410. Copper tubing aluminum fins, mechanically bonded. Proof test coils at 300 psi, leak test at 200 psi under water.
4. Cabinet Unit Heaters: Cabinet to be 16 gauge removable front panel, 18 gauge top and sides. Insulate front panel over coil section with access door on coil connection side, and at unit controller. Inlets and outlets to be ducted or through front panel. Factory color or custom colors available. Motors to have thermal overload protection. Fans forward curved fan wheels. Coils to be seamless copper tubes mechanically bonded to aluminum fins.
5. Infrared Heaters: Heavy-duty cast iron burners and cast iron combustion chambers with prewired controls. Radiant pipe and fittings to be 4” black steel pipe ASA Schedule 40, ASTM A 120. Reflectors shall be a highly infrared reflective material. Provide hanging materials and programmable thermostat.
6. Unit Heaters: Provide vertical/horizontal units constructed of steel with baked enamel finish. Aluminum fan factory balanced with built-in overload protection. Coils to be plate type aluminum mechanically bonded to copper tubes.

--- End of Section ---

SECTION 23 82 19.00 48 FAN COIL UNITS

Scope: 1. Provide fan coil units as required for project.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AIR CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 440	Performance Rating of Room Fan-Coil Units

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 1995	Standard for Safety Heating and Cooling Equipment
UL Bld Mat Dir	Building Materials Directory

Submittals: 1. Product Data: Submit manufacturer's specifications for fan coil units showing dimensions, capacities, ratings, performance characteristics, gages and finishes of materials, and installation instructions.
2. Operation and Maintenance Manuals.

Products: 1. Manufacturer – Fan Coil Units:
a. Carrier A/C Group, Carrier Corp.
b. Environmental Technologies.
c. Daikin.
d. Trane.
e. York.
2. Fan Coil Units: Provide ducted fan coil units with insulated casing, stainless steel drain pan, and filters. Cabinet of steel with baked enamel finish. Direct driven aluminum or galvanized steel double width, forward curved, centrifugal fan factory balanced. Provide painted steel or galvanized steel fan scrolls. Permanently lubricated multispeed motor with built-in overload protection resiliently mounted in the fan inlet. Coils to be plate type aluminum mechanically bonded to copper tubes with valve and piping package.

--- End of Section ---

SECTION 23 83 00.00 48 RADIANT FLOOR HEATING SYSTEM

Scope:
1. Provide radiant floor heating system, including tubing, manifolds, and all accessories necessary for a complete system.

Submittals:
1. Submit shop drawings, descriptions of materials, and details of installation.
2. Components of the buried tubing system shall be provided by one manufacturer, including; tube, fittings, manifolds, and other ancillary items required for a complete installation.
3. Operation and Maintenance Manuals.

Warranty:
1. Tubing System Warranty Period: Twenty-five (25) years from date of substantial completion.
2. Manifold and Ancillary Components: Eighteen (18) months from date of substantial completion.

Products:
1. Manufacturer:
   a. Wirsbo.
   b. Viega
2. Tubing Systems:
   a. Tubes shall be crossed-linked polyethylene, rated at 180ºF maximum working temperature and 100 psi working pressure, manufactured in accordance with ASTM Standard Specification F876.
3. Manifolds:
   a. Manifolds shall be cast brass construction, and shall have integral circuit balancing valves. Manifolds shall be capable to vent air from the system. Manifolds shall have support brackets, and shall be isolated from supply and return tubing with isolation and balancing valves.
4. Fittings:
   a. Fittings shall be dezinctified resistant brass. The fittings shall consist of a barbed insert, compression ring, and compression nut.
5. Supply and Return Piping to Manifolds:
   a. Piping shall be metal pipe or crossed-linked polyethylene tube with an integral oxygen diffusion barrier. Crossed-linked polyethylene tube should only be used when specifically approved by the local building inspector.
6. Mixing Valves:
   a. Provide 3-way motorized mixing valves as recommended by the manufacturer to provide individual water supply temperatures as required in each zone.

--- End of Section ---

SECTION 23 84 16.00 48 DEHUMIDIFIER UNITS

Scope: 1. Provide UL listed dehumidifier unit and drain piping for condensate.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

UNDERWRITERS LABORATORIES (UL)

Products: 1. Manufacturer:
   a. EBAC.
   b. Edison.
   c. Oasis Corporation.
2. Sealed refrigeration unit with quiet running fan.
3. Automatic humidistat control, plus or minus 1% accuracy in range down to 20% RH.
4. Threaded drain line connection.
5. Automatic frost-free control to prevent frost buildup on coils.
6. One (1) year warranty on parts and labor.

--- End of Section ---

SECTION 26 05 00.00 48 COMMON WORK RESULTS FOR ELECTRICAL

Scope:
1. The Contractor shall become familiar with all details of work and verify all dimensions in the field so that outlets and equipment are properly located and readily accessible.
2. Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products. Products shall have been for sale through advertisement, catalog, or brochures and in satisfactory commercial use for a minimum of two years before submittal. Materials shall be listed and labeled for the application with a nationally recognized testing laboratory in accordance with NFPA 70.
3. Materials and Equipment shall be installed in accordance with NFPA 70, and the recommendations of the manufacturer.
4. Lighting fixtures, outlets, and other equipment and materials shall be coordinated with structural features and all other trades prior to installation.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section and apply to the entire project.

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

NECA 1	Standard Practices for Good Workmanship in Electrical Construction

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code
NFPA 70E	Standard for Electrical Safety in the Workplace

--- End of Section ---

SECTION 26 05 19.00 48 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

Scope: 1. Provide wiring and cables and associated splices, connectors, and terminations for wiring systems rated 600 volts and less.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	Hard-Drawn Copper Wire
ASTM B 3	Soft or Annealed Copper Wire
ASTM B 8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA/ANSI WC 70	Non-Shielded Power Cable 2000V or Less for the Distribution of Electrical Energy

UNDERWRITERS LABORATORIES (UL)

UL 44	Thermoset-Insulated Cables
UL 83	Thermoplastic – Insulated Wires and Cables
UL 1569	Metal-Clad Cables

Products:
1. Service Entrance: Type XHHW in conduit.
2. Feeders: Type THHN/THWN in conduit.
3. Branch Circuits: Type THWN or THHN, in conduit. Conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long and of 277 volts more than 200 feet long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.
4. Control and Signal Circuits: Type TW, THW, or TF.
5. Equipment Grounding Conductor: Type TW.
6. Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller shall be solid, except that conductors for remote control, alarm, and signal circuits, Classes 1, 2, and 3 shall be stranded.
7. All conductors shall be copper.
8. Conductors shall be color coded with colored insulation or colored vinyl tape.
9. Metal-Clad Cable: Aluminum or galvanized steel interlocking armor outer sheath with full size equipment grounding conductor.
10. Bonding Conductors: ASTM B1 solid bare copper for sizes No. 8 AWG and smaller. ASTM B8 stranded bare copper for sizes No. 6 AWG and larger.

Execution: 1. Provide continuity and insulation resistance tests.

--- End of Section ---

SECTION 26 05 26.00 48 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

Scope:
1. Provide solidly grounded electrical systems with multiple, redundant grounding electrodes including metal water pipe, structural steel, concrete encased electrode, ground ring (counterpoise), and ground rod all bonded together at Main Grounding Bar (MGB).
2. Provide telecommunications grounding system in accordance with TIA 607 and the ARNEC ITC including Telecommunications Main Grounding Busbar (TMGB), Telecommunications Grounding Busbars (TGB), and Rack Grounding Busbars (RGB) bonded together and to the MGB with a Telecommunications Bonding Backbone (TBB). Bond all metallic components. See also Outline Technical Specification Section 27 10 00.00 48.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 3	Soft or Annealed Copper Wire
ASTM B 8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 780	Installation of Lightning Protection Systems

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA 607	Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

UNDERWRITERS LABORATORIES (UL)

UL 467	Grounding and Bonding Equipment

UNIFIED FACILITIES CRITERIA

UFC 3-580-01	Telecommunication Building Cabling System Planning and Design

U.S. ARMY RESERVE

U.S. Army Reserve Network Enterprise Center Infrastructure Technical Criteria (ARNEC ITC)

Submittals:
1. Test Reports.

Products:
1. Ground Rods: Shall be sectional type copper clad steel, 5/8” diameter, 120” long.
2. Ground Bus: Shall be flat copper in one piece, size and quantities based on application.
3. Equipment Grounding Conductors: Provide a green insulated copper equipment grounding conductor, sized in accordance with NFPA 70, regardless of the type of conduit.
4. Grounding Electrode Conductors: Provide bare copper grounding electrode conductor, sized in accordance with NFPA 70. Install in conduit where potentially subject to damage.

Execution:
1. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment. Connections to grounding electrodes shall be by exothermic weld or irreversible connector.
2. Ground resistance testing by fall of potential method per IEEE Standard 81.

--- End of Section ---

SECTION 26 05 29.00 48 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

Scope:
1. Provide hangers and supports of electrical equipment/components suitable for the project.
2. Provide preformed steel channel racks for mounting cabinets and panelboards. Provide preformed steel channel racks for mounting disconnect switches, control enclosures, pull and junction boxes, and other devices unless components are mounted directly to structural elements of adequate strength.
3. Provide seismic supports and bracing for electrical equipment and systems independent of other systems.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

METAL FRAMING MANUFACTURERS ASSOCIATION (MFMA)

MFMA 4 Metal Framing Standards

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

NECA 101 Standard for Installing Steel Conduits

Products:
1. Damp and Wet Locations: Provide hot-dip galvanized materials.
2. Dry Locations: Provide steel materials.
3. Preformed Steel Channels: Comply with MFMA-4.
4. Support Clamps for PVC Raceways: Provide click-type clamp system.
5. Selection of Supports: Comply with manufacturer’s written instructions.
6. Strength of Supports: Provide supports adequate to carry present loads and a minimum of 25 percent additional future loads, times a safety factor of at least four; minimum of 200 lb. (90 kg.) design load.
7. Mounting, Anchoring, and Attachment Components: Zinc coated steel mechanical expansion anchors, steel or malleable iron concrete inserts, steel or malleable iron clamps for attachment to structural steel elements, structural type hex head through bolts, steel spring head type toggle bolts, threaded steel hanger rods.

--- End of Section ---

SECTION 26 05 33.00 48 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

Scope:
1. Provide raceways and boxes suitable for the project.
2. Provide an efficiently laid out system that allows for future growth.
3. Coordinate raceways with the work of Divisions 26, 27, and 28 sections.
4. Coordinate layout and construction with other construction elements to ensure maximum headroom, working clearance, and access.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	Electrical Rigid Steel Conduit (ERSC)
ANSI C80.3	Electrical Metallic Tubing (EMT)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment
NEMA OS1	Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA TC2	Electrical Polyvinyl Chloride (PVC) Conduit

Products:
1. Outdoors (Exposed): Rigid steel conduit.
2. Outdoors (Concealed): Rigid steel conduit or Schedule 80 PVC.
3. Underground: Schedule 40 or 80 PVC.
4. Indoors (Not Subject to Physical Damage): EMT.
5. Indoors (Subject to Physical Damage): Rigid steel conduit.
6. Connection to Vibrating Equipment: Flexible metal conduit, liquid-tight in damp and wet locations.

--- End of Section ---

SECTION 26 05 53.00 48 IDENTIFICATION FOR ELECTRICAL SYSTEMS

Scope: 1. Provide nameplates on major items of electrical equipment and major components such as panelboards, starters, safety switches, motor control centers, transformers, equipment enclosures, switchgear, switchboards, motors, control power transformers, control devices, instrument transformers and similar equipment. Nameplate legend shall match equipment designations on construction documents and shall include the required minimum Ampere Interrupting Rating for the equipment where applicable.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 709 Laminated Thermosetting Materials

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR, Part 1910 Occupational Safety and Health Standards

UNDERWRITERS LABORATORIES (UL)

UL 510 Insulating Tape

Products: 1. Nameplates: Engraved, laminated plastic with black outer layers and a white core. Minimum dimensions of 2.5 inches wide, 1.0 inches high and 0.125 inches thick. Edges shall be chamfered. Minimum letter height 3/8 inch. Fasten nameplates with black-finished round-head drive screws.
2. Warning Labels and Signs: Comply with CFR 1910.
3. Marking Tape: UL 510 listed polyvinyl chloride type with pressure sensitive adhesive. Minimum 7mm thick, flame retardant, fade resistant.

--- End of Section ---

SECTION 26 06 00.00 48 ELECTRICAL UTILITY SERVICES

Scope: 1. Provide equipment as required by the local utility company (public or private electric service provider or military installation) for service entrance equipment.

References: 1. Publications and instructions of the local utility company establish minimum requirements for materials, systems and execution that may apply.

Products: 1. Verify exact mounting of pad mount transformer and pad. Verify transformer pad size and requirements with local utility company. Provide transformer pad per the utility company's requirements.
2. Coordinate primary cable and conduit routing and installation with local utility company.
3. Provide secondary service size according to required load on facility. Coordinate requirements with local utility company.
4. Coordinate CT/meter location and requirements with local utility company. Provide components per local utility company requirements.

--- End of Section ---

SECTION 26 08 00.00 48 EQUIPMENT INSPECTION AND TESTING

Scope: 1. Provide acceptance testing for electrical equipment.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	Acceptance Testing Specifications for Electrical Power Equipment and Systems

Submittals: 1. Test Reports.

Products:
1. Grounding: Measure ground resistance of completed grounding system by fall-of-potential method according to IEEE 81.
2. Low-Voltage Transformers: Provide visual and mechanical inspection and electrical testing in accordance with NETA ATS.
3. Switchgear, switchboards, motor control centers and panelboards: Provide visual and mechanical inspection and electrical testing in accordance with NETA ATS.
4. Switches and Circuit Breakers: Provide visual and mechanical inspection and electrical testing in accordance with NETA ATS.
5. Motor Controllers: Provide visual and mechanical inspection and electrical testing in accordance with NETA ATS, except optional tests.

--- End of Section ---

SECTION 26 22 00.00 48 LOW-VOLTAGE TRANSFORMERS

Scope: 1. Factory-assembled and -tested, dry-type, air-cooled units, designed for 60 HZ service and in compliance with DOE 2016 and NEMA TP-1 and TP-2.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

DEPARTMENT OF ENERGY (DOE)

DOE 2016	Efficiency Standards: Low Voltage Distribution Transformers

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ST 20	Dry-Type Transformers for General Applications
NEMA TP-1	Guide for Determining Energy Efficiency for Distribution Transformers
NEMA TP-2	Test Method for Measuring the Energy Consumption of Distribution Transformers

UNDERWRITERS LABORATORIES (UL)

UL 1561	Dry-Type General Purpose and Power Transformers

Submittals: 1. Shop Drawings.
2. Product Data.

Products: 1. Products provided under this Section shall be manufactured and assembled by the same manufacturer.
2. Cores: Grain-oriented, nonaging silicon steel.
3. Coils: Electrical grade aluminum. Continuous windings without splices, except for taps.
4. Internal Coil Connections: Brazed or pressure type.
5. Enclosure: Class complies with NEMA 250 for the environment in which installed.
6. Insulation: 220 degrees C with temperature rise not exceeding 150 degrees C under continuous full-rated load in maximum ambient temperature of 40 degrees C.
7. Taps: For transformers 7.5 kVA and larger, full-capacity taps in high-voltage windings shall be as follows:
   a. Taps, 7.5 through 24 kVA: One 5-percent tap below and one 5-percent tap above rated high voltage.
   b. Taps, 25 and above: Six 2.5-percent taps, 2 above and 4 below rated high voltage.
8. K-Factor Rating: Provide transformers K-factor rated and listed to comply with UL 1561 requirements for nonsinusoidal load current handling capability as required for non linear loads.
   a. Transformer design prevents overheating when carrying full load with harmonic content corresponding to the designated K-factor.
   b. Nameplate states the designated K-factor of the transformer.
9. Sound Level: Maximum sound level at least 3dBA less than NEMA ST-20.

10. Provide concrete housekeeping pad.
   a. Construct concrete bases that provide a 2-inch wide surface around the perimeter of the unit/equipment to be supported. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations. Use 3000 psi 28-day compressive-strength concrete and reinforcement.

--- End of Section ---

SECTION 26 24 00.00 48 SWITCHBOARDS, PANELBOARDS, AND CONTROL CENTERS

Scope:
1. Dead-front switchboards shall conform to NEMA PB 2. Switchboards shall be completely enclosed self-supporting metal structures with the required number of vertical panel sections, buses, molded-case circuit breakers, and other devices as required for the application. Switchboards shall be fully rated.
2. Panelboards shall conform to NEMA PB 1. Panelboards shall consist of assemblies of molded-case circuit breakers with buses and terminal lugs for the control and protection of branch circuits“Loadcenter” type panels are not acceptable. Panelboards shall be designed for installation in surface-mounted or flush-mounted cabinets accessible from the front only. Panelboards shall be fully rated.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 187	Copper Bar, Bus Bar, Rod and Shapes

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	Surge Voltages in Low-Voltage AC Power Circuits

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 61643	Low-Voltage Surge Protective Devices

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA PB 1	Panelboards
NEMA PB 2	Deadfront Distribution Switchboards

UNDERWRITERS LABORATORIES (UL)

UL 489	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Break Enclosures
UL1449	Surge Protective Devices

Submittals:
1. Shop Drawings.
2. Product Data.
3. Operation and Maintenance Manuals.

Products:
1. Products provided under this Section shall be manufactured and assembled by the same manufacturer.
2. Molded-Case Circuit Breakers: Molded-case circuit breakers shall conform to the applicable requirements of UL 489. The circuit breakers shall be manually-operated, shall be quick-make, quick-break, common trip type, and shall be automatic-trip type.
3. Controllers: Comply with the requirements of Outline Technical Specification Section 26 29 00.00 48 ENCLOSED CONTROLLERS.
4. Switchboards:
   a. Buses: Buses shall be of copper and all bolted splices and connections between buses and for extensions or taps for equipment shall be tin or silver-plated throughout. Cabinets shall be fabricated from sheet steel of not less than 14 gauge. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B 187.
   b. Switchboards shall be dead-front type designed for group-mounted devices.
   c. A copper ground bus, rated not less than 300 amps, extending the entire length of the assembled structure, shall be mounted near the bottom of enclosure.

   d. Each switchboard shall be equipped with molded-case circuit breakers conforming to paragraph MOLDED-CASE CIRCUIT BREAKERS.
   e. Provide digital multi-function watt hour meter with pulse output for tenant use.
   f. Provide concrete housekeeping pad.
5. Panelboards:
   a. Panelboards shall be dead-front type with buses and circuit breakers mounted on a plate or base for installation as a unit in a cabinet. Buses shall be copper and shall be tin or silver-plated throughout.
   b. Cabinets shall be fabricated from sheet steel of not less than 14 gauge.
6. Motor Control Centers:
   a. Comply with paragraph SWITCHBOARDS.
   b. Provide motor controllers and overcurrent protective devices as required for the project.
7. Surge Protection:
   a. Provide parallel type, transient voltage, surge suppression at the service entrance switchboard.
   b. Provide phase to neutral, phase to ground, and neutral to ground protection rated at 100,000 amps per mode minimum.
   c. Provide units with voltage protection rating of 1,200 volts maximum for 480Y/277 volt systems and 700 volts for all other voltage systems.
   d. Provide units with a minimum maximum continuous operating voltage rating of 600/320 volts for 480Y/277 volt systems and 300/150 volts for all other voltage systems.
   e. Provide units recognized under UL 1449 and designed, manufactured, and tested under IEC 61643.

--- End of Section ---

SECTION 26 27 13.00 48 ELECTRICITY METERING

Scope:
1. Provide meter equipment compatible with the Army metering program pursuant to Public Law 109-58, Section 103 of the Energy Policy Act of 2005. The intent is for all advanced meters to report their data to an installation-centric energy reporting and management system such as a utility monitoring and control system or data managmenet system. The advanced meters must provide data at least daily and measure at least hourly consumption of electricity.
2. Advanced meters are those that have the capability to measure and record interval data (at least hourly for electricity), and communicate the data to a remote location in a format that can be easily integrated into an advanced metering system.
3. Advanced metering systems: A system that collects time-differentiated energy usage data from advanced meters via a network system on either an on-request or defined schedule basis. The system is capable of providing usage information on at least a daily basis and can support desired features and functionality related to energy use management, procurement, and operations.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.90.1	Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C57.13	Requirements for Instrument Transformers

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 62053-22	Electricity Metering Equipment (A.C.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.18	Protocol Specification for ANSI Type 2 Optical Port
ANSI C12.20	Electricity Meters – 0.1, 0.2, and 0.5 Accuracy Classes
ANSI C62.61	Gas Tube Surge Arresters on Wire Line Telephone Circuits
ANSI/CEA 709.1	Control Network Protocol

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

Products:
1. Provide meters with the following minimum features:
   a. Quantities Measured: Power (kiloWatt), average demand over 15 minute intervals. Energy (kiloWatt-hours).
   b. Measurement Configuration: For single phase application, 120-240 Volt; for three phase application, 208-600 Volt, 3 wire delta or 4 wire wye.
   c. Operating Temperatures: -20 degrees C to +70 degrees C. For exterior mounting, consider the local ambient temperature extremes and moisture proof enclosures.
   d. Humidity Operating Range: 5% to 90% RH (non-condensing).
   e. Accuracy: ANSI C12.20 (0.5% Accuracy).
   f. Frequency: 60 Hz +/- 5%.
   g. For non-LonWorks meter applications; Digital Output Only: Modbus RTU/RS485.
   h. For LonWorks meter applications: Digital Output Only: ANSI/CEA-709.1B protocol (LonTalk) output for communications using Standard Network Variable Types (SNVTs) for measured values.
   i. Provide with one pulse output channel that can be configured as KYZ pulse output.

j. Provide parallel type surge protective devices that comply with UL 1449 at each building service entrance. Provide surge protectors in a NEMA 3R enclosure per NEMA ICS 6. Provide the following modes of protection:

FOR SINGLE PHASE AND THREE PHASE WYE CONNECTED SYSTEMS

1) Each phase to neutral (L-N)
2) Neutral to ground (N-G)
3) Phase to ground (L-G)

k. Surge protective devices at the service entrance shall have a minimum surge current rating of 80,000 amperes per mode minimum. The maximum line to neutral (L-N) Suppressed Voltage Rating (SVR) shall be:
   1) 500 Volt for 208Y/120V, three phase system

l. The minimum MCOV (Maximum Continuous Operating Voltage) rating shall be:
   1) 300/150V for 208Y/120V, three phase system

m. EMI/RFI filtering shall be provided for each mode with the capability to attenuate high frequency noise. Minimum attenuation shall be 20db.

--- End of Section ---

SECTION 26 27 26.00 48 WIRING DEVICES

Scope:
1. Provide receptacles, connectors, switches, and finish plates of types and quantities suitable for the project.
   a. Wiring devices shall meet NEMA WD 1 and dimensional requirements of wiring devices shall meet NEMA WD 6.
2. Provide multi-outlet assemblies, floor boxes, and fire rated poke-throughs of types and quantities suitable for the project.
3. Device and coverplate color shall be coordinated with the interior design.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WD 1	General Color Requirements for Wiring Devices
NEMA WD 6	Wiring Devices Dimensions Requirements

UNDERWRITERS LABORATORIES (UL)

UL 20	General-Use Snap Switches
UL 498	Attachment Plugs and Receptales

Products:
1. Device Plates:
   a. Device plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, or cast metal having rounded or beveled edges.
   b. Device plates on finished walls shall be impact-resistant nylon.
   c. Color to match device.
   d. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate.
2. Single and Duplex Receptacles:
   a. Shall be rated 20 amperes, 125 volts, 2-pole, 3-wire, grounding type with polarized parallel slots, back and side wired.
   b. Shall be suitable for the environment and application.
   c. UL 498 listed.
3. Toggle Switches:
   a. Shall be rated 120-277 volt AC grounding type, totally enclosed tumbler type, general use.
   b. UL 20 listed.
4. Floor Boxes: Shall be adjustable and each outlet shall consist of a cast-metal body with threaded openings for conduits.
5. Poke-Through Assemblies: Factory-fabricated assembly of below-floor junction box with multi-channel, through-floor raceway and fire stop unit and flush floor service outlet assembly.
6. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement.

--- End of Section ---

SECTION 26 28 16.00 48 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

Scope:
1. Provide individually mounted enclosed switches and circuit breakers for feeder and branch-circuit protection, motor and equipment disconnecting means and for service disconnects.
2. Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper conductors. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. Circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	Molded-Case Circuit Breakers and Molded-Case Switches

UNDERWRITERS LABORATORIES (UL)

UL 489	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures

Products:
1. Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489 for circuit breakers and circuit breaker enclosures. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers.
2. Thermal magnetic circuit breakers shall have automatic operation obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above 150 amperes.
3. HACR circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked “Listed HACR Type.”
4. Ground fault circuit interrupters: Breakers equipped with ground fault circuit interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings as required for the application.
5. Products provided under this Section shall be manufactured and assembled by the same manufacturer.

--- End of Section ---

SECTION 26 29 00.00 48 ENCLOSED CONTROLLERS

Scope:
1. Provide controllers for motors except those that include integral overload protection.
2. Provide combination controllers for motors except fractional horsepower motors. A combination controller consists of a disconnecting means, an overcurrent protective device, a controller overload device, and control circuits integral to the controller enclosure.
3. Provide automatic controllers with manual-off-auto control switch except for motors that require only manual control.
4. Coordinate control schemes, control voltages, and connections with motors and other trades installing motor-driven equipment.
5. Motor short-circuit protectors shall be used only as part of a combination motor controller that provides coordinated motor branch-circuit overload and short-circuit protection, and shall be rated in accordance with the requirements of NFPA 70.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	Industrial Control and Systems: General Requirements
NEMA ICS 2	Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts
NEMA ICS 7	Adjustable-Speed Drives

UNDERWRITERS LABORATORIES (UL)

UL 508	Industrial Control Equipment

Products:
1. Products provided under this Section shall be manufactured and assembled by the same manufacturer.
2. Controllers shall be UL 508 listed and comply with NEMA ICS-1 and NEMA ICS-2.
3. Controllers: Motor controller units shall contain motor circuit protectors, molded-case circuit breakers, auxiliary and pilot devices and a magnetic contactor with thermal overload relays and/or reduced voltage starter. Where control pushbuttons, indicating lamps, HAND OFF-AUTOMATIC switches, and similar control devices are associated with a unit, they shall be mounted on the unit compartment door. Door-mounted components shall not interfere with access within the compartments. Molded case circuit breakers for use in combination starters shall meet the requirements of paragraph MOLDED-CASE CIRCUIT BREAKERS. Motor circuit protectors shall be only part of the combination starters as required by NFPA 70 and shall conform to all requirements of paragraph MOLDED-CASE CIRCUIT BREAKERS, except that trip units shall have provision for locking the selected trip setting.
4. Manual Motor Controller: Fractional horsepower enclosed, manual motor starter switch with melting alloy thermal overload relay protection.
5. Combination Motor Controller: Full voltage, NEMA rated, enclosed, combination motor starter-circuit breaker with melting alloy overload relay protection.
6. Reduced Voltage Controller: Autotransformer, Wye-Delta, Part Winding, or Solid State, NEMA rated, enclosed motor starter with melting alloy overload relay protection.
7. Adjustable Speed Drives/Variable Frequency Controller: Comply with NEMA ICS 2 and NEMA ICS 7, pulse-width-modulated variable frequency drive controller designed and arranged to provide variable speed of NEMA MG 1 motors. 3-Phase, premium efficiency induction motor. Rated to match motor, load type and torque requirements. Internal adjustment capabilities for minimum speed, maximum speed, acceleration, deceleration, and current limit. Self-protection and reliability features include input transient protection, motor overload relay, notch filter, instantaneous overcurrent trip, loss-of-phase protection, reverse-phase protection, under- and overvoltage trips, overtemperature trip, short-circuit protection, and automatic reset/restart.

Indicators and controls include status lights, panel-mounted operator station, indicating devices, and integral disconnecting means.

8. Molded-Case Circuit Breakers: Molded-case circuit breakers shall conform to the applicable requirements of UL 489. The circuit breakers shall be manually-operated, shall be quick-make, quick-break, common trip type, and shall be automatic-trip type.

--- End of Section ---

SECTION 26 41 13.00 48 LIGHTNING PROTECTION

Scope:
1. Provide a complete lightning protection system that conforms to NFPA 780 and UL 96 carrying a UL master label for the building.
2. The lightning protection system shall consist of air terminals, roof conductors, down conductors, ground connections, and grounds, electrically interconnected to form the shortest distance to ground. Conductors on the structures shall be concealed as much as possible. Where they cannot be concealed, conductors shall be installed in protective sleeves which shall be coordinated to minimize aesthetic impacts. Secondary conductors shall interconnect with grounded metallic parts within the building. Interconnections made within side-flash distances shall be at or above the level of the grounded metallic parts. Items to be interconnected include metallic parts such as metal doors, windows, and gutters.
3. Items to be grounded or bonded:
   a. Steel frame buildings.
   b. Ramps.
   c. Tanks and towers.
   d. Metal stacks.
   e. Nonmetallic stacks.
   f. Post tensioning systems.
   g. Interconnection of metal bodies.
   h. Fences.
   i. Exterior overhead pipe lines.
   j. Separately mounted shielding systems “mast type”.
   k. Separately mounted shielding systems “overhead ground-wire type”.
   l. Metal roofs.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 780	Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 96	Lightning Protection Components

Submittals:
1. Shop Drawings.
2. Certificates of Compliance.

Products:
1. No combination of materials shall be used that forms an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals.
2. Copper conductors 375 pounds per thousand feet and minimum size wire not less than No. 15 AWG.
3. Copper conductor ribbon or web minimum size of No. 12 AWG.
4. Copper counterpoise minimum size of No. 1/0 AWG.
5. Aluminum strips for minimum size of No. 12 AWG in thickness and at least 1.5-inches wide.
6. Ground Rods: Minimum size of ¾ inch in diameter and 10 feet in length, copper clad steel.
7. Connectors: Clamp-type connectors for splicing conductors.

--- End of Section ---

SECTION 26 51 00.00 48 INTERIOR LIGHTING

Scope:
1. Provide interior luminaires of types suitable for the project.
2. Provide exit signs as required by applicable codes of types suitable for the project.
3. Provide emergency lighting systems as required by applicable codes.
4. Provide automatic lighting controls as required by applicable codes and standards.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

ILLUMINATING ENGINEERING SOCIETY (IES)

IES HB-10	IES Lighting Handbook
IES LM-79	Electrical and Photometric Measurements of Solid-State Lighting Products
IES LM-80	Measuring Lumen Maintenance of LED Light Sources
IES TM-21	Projecting Long Term Lumen Maintenance of LED Light Sources

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	Recommended Practice on Surge Voltage in Low-Voltage AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA SSL 1	Electronic Drivers for LED Devices, Arrays, or Systems
NEMA SSL 3	High-Power White LED Binning for General Illumination
NEMA SSL 7A	Phase-Cut Dimming for Solid State Lighting
NEMA ANSLG C78.377	Specifications for the Chomaticity of Solid-State Lighting Products

UNDERWRITERS LABORATORIES (UL)

UL 916	Energy Management Equipment
UL 924	Emergency Lighting and Power Equipment
UL 1472	Solid-State Dimming Controls
UL 1598	Luminaires
UL 8750	Light Emitting Diode (LED) Equipment for Use in Lighting Products

Submittals:
1. Products.

Products:
1. Light Sources:
   a. LED light sources utilizing white 5-light phosphor conversion that comply with NEMA ANSLG C78.377 and NEMA SSL 3.
   b. Corrected Color Temperature (CCT) of 3,500 or 4,000 degrees K per UFC 3-530-01.
   c. RoHS compliant.
   d. Minimum five year manufacturer’s warranty.
2. Drivers:
   a. Electronic, UL Class 1, constant-current type.
   b. Provide continuous range dimming drivers where daylight harvesting or other dimming systems are employed.
   c. Comply with NEMA SSL 1 and UL 8750.
   d. RoHS compliant.
   e. Minimum five year manufacturer’s warranty.
3. Luminaires:
   a. Minimum L70 lumen maintenance of 50,000-hours as calculated by IES TM-21 per IES LM-80 requirements.
   b. Listed with the Design Lights Consortium Qualified Products List.

   c. Minimum overall luminaire efficacy of 100 lumens per watt (LPW) for troffers, 90 LPW for linear and low/high bay, and 60 LPW for downlights.
4. Emergency Lighting:
   a. Fixtures and accessories shall be constructed and independently tested to meet the requirements of applicable codes and be UL 924 Listed.
5. Exit Signs:
   a. The manufacturer warranty for defective parts shall be at least five years.
6. Batteries:
   a. Batteries shall be Nicad or equal with no required maintenance and shall have a minimum life expectancy of five years and warranty period of a minimum of five years.
   b. Provide integral battery system in general lighting fixtures in finished spaces.
   c. Provide integral battery systems in unit equipment in unfinished and utilitarian spaces.
   d. Battery chargers shall be general purpose, continuous current output, with solid state rectifiers. Means shall be provided to regulate and to adjust the dc output voltage. Chargers shall have continuous current ratings of 10 to 15 percent higher than battery current outputs based upon an 8-hour discharge.
7. Lighting Controls:
   a. Provide line voltage toggle switches as specified in Technical Outline Specification Section 26 27 26.00 48.
   b. Provide dimming controllers that continuously vary the light output throughout the dimming range, are flicker-free and UL 1472 Listed and in compliance with NEMA SSL 7A. Controllers shall be compatible with the associated LED drivers.
   c. Provide occupancy/vacancy sensors that are UL 916 Listed. Provide passive infrared, ultrasonic, or dual technology sensors as applicable to the type and use of each space.
   d. Provide lighting control panel with electronic astronomic time switch and appropriate relays and contactors for basic area control.
   e. Provide networked lighting control system for advanced lighting controls.
   f. Provide UL 924 Listed relays where control of egress lighting is provided.

--- End of Section ---

SECTION 26 56 00.00 48 EXTERIOR LIGHTING

Scope:
1. Provide exterior luminaires complete with poles and accessories.
2. Provide luminaire control devices to control exterior luminaries including the following: time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS	Structural Supports for Highway Signs, Luminaires and Traffic Signals

ILLUMINATING ENGINEERING SOCIETY (IES)

IES HB-10	IES Lighting Handbook
IES LM-79	Electrical and Photometric Measurements of Solid-State Lighting Products
IES LM-80	Measuring Lumen Maintenance of LED Light Sources
IES RP-8	Roadway Lighting Equipment

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts
NEMA SSL 1	Electronic Drivers for LED Devices, Arrays, or Systems
NEMA SSL 3	High-Power White LED Binning for General Illumination
NEMA ANSLG C78.377	Specifications for the Chomaticity of Solid-State Lighting Products

Submittals:
1. Products.

Products:
1. Light Sources:
   a. LED light sources utilizing white 5-light phosphor conversion that comply with NEMA ANSLG C78.377 and NEMA SSL 3.
   b. Corrected Color Temperature (CCT) of 3,500 or 4,000 degrees K per UFC 3-530-01..
   c. Minimum Color Rendering Index (CRI) of 80.
   d. RoHS compliant.
   e. Minimum five year manufacturer's warranty.
2. Drivers:
   a. Electronic, UL Class 1, constant-current type.
   b. Comply with NEMA SSL 1 and UL 8750.
   c. RoHS compliant.
   d. Minimum of five year manufacturer's warranty.
3. Luminaires:
   a. Minimum L70 lumen maintenance of 100,000-hours as calculated by IES TM-21 per IES LM-80 requirements.
   b. Listed with the Design Lights Consortium Qualified Products List.
   c. Minimum overall luminaire efficacy of 65 lumens per watt (LPW).
4. Controls:
   a. Provide electronic time switches, arranged to turn "ON" at programmed time, astronomical sunset or by photocell input, and turn "OFF" at programmed time, astronomical sunrise or by photocell, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide battery or capacitor, to maintain accurate time for a minimum of 7 hours following power failure. Provide time switch with a manual on-off bypass switch.

b. Provide photocell switch with single-throw contacts designed to fail to the ON position. A time delay shall prevent accidental switching from transient light sources.
c. Provide lighting contactor to meet NEMA ICS 2, electrically or mechanically held contactor. Provide contactor with hand-off-automatic or on-off selector switch as required for each installation.

5. Poles:
   a. Provide poles designed for wind loading in accordance with AASHTO LTS while supporting luminaire effective projected areas. Poles shall be embedded or anchor-base type designed for use with underground supply conductors. Poles shall have handhole near bottom of pole. Poles shall have an internal grounding connection accessible from the handhole. Scratched, stained, chipped, or dented poles shall not be installed.
   b. Provide aluminum poles manufactured of corrosion resistant aluminum alloys conforming to AASHTO LTS. Poles shall be seamless extruded or spun seamless type with minimum 3/16 inch wall thickness.
   c. Provide steel poles to meet AASHTO LTS. Steel poles shall have minimum 11-gage steel with minimum yield/strength of 331 MPa and hot-dipped galvanized and factory finish.

--- End of Section ---

SECTION 26 60 13.00 48 LOW-VOLTAGE MOTORS

Scope:
1. Provide motors suitable for their locations and provide motors with minimum efficiencies at levels recommended by the Department of Energy's Federal Energy Management Program (FEMP).
2. Test motors for phase rotation, starter operation, high potential tests of windings, insulation resistance tests of each winding, vibration, and dielectric absorption.

References:
1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	Motors and Generators
NEMA MG10	Energy Mangement Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Motors
NEMA MG11	Energy Management Guide for Selection and Use of Single Phase Motors

U.S. DEPARTMENT OF ENERGY (DOE)

DOE CI-1	How to Buy a Premium Energy-Efficient Electric Motor

Products:
1. Motors: Motors shall conform to NEMA MG 1.
2. The horsepower rating of motors should be limited to no more than 125 percent of the maximum load being served unless a NEMA standard size does not fall within this range. In this case, the next larger NEMA standard motor size should be used.
3. Three-phase motors for use on 3-phase 208-volt systems shall have a nameplate rating of 200 volts. Three-phase motors for use on 3-phase 480 volt systems shall have a nameplate rating of 460 volts. Motors shall have continuous-duty classification based on a 40 degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics. The Contractor shall be responsible for selecting the actual horsepower ratings and other motor requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.
4. Single Phase Motors: Provide high efficiency types corresponding to the applications listed in NEMA MG 11.
5. Polyphase Motors:
   a. Select motors based on high efficiency characteristics as listed in NEMA MG10.
   b. Provide premium efficiency motors that meet the requirements of NEMA MG 1.

--- End of Section ---

SECTION 27 51 16.00 48 PUBLIC ADDRESS SYSTEM

Scope: 1. Provide a PA System with microphones, speakers, amplifiers, and music sources as required by UFC 4-171-05.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

TIA -568 Generic Telecommunications Cabling for Customer Premises

U.S. ARMY RESERVE

U.S. Army Reserve Network Enterprise Center Infrastructure Technical Criteria (ARNEC ITC)

Products: 1. Products shall as a minimum conform to the following specifications:

a. Amplifiers rated power output to be 250 watts RMS, or output power sized to exceed power requirement of connected load by minimum of 20 percent, based on the sum of all connected loudspeaker transformer taps.
b. Mixer – Preamplifier rated output to be 18dB, with frequency response + or - 1dB, 20 – 20,000 Hz. Tone controls will be + or – 10dB range at 50 and 15,000 Hz.
c. Provide USB Type C input for GFGI music source.
d. Microphones shall be a dynamic element, low impendence, with a minimum frequency response of 50 -12,000 Hz. Provide one wireless microphone and one wired microphone with floor stand assembly.
e. Loudspeakers – Flush Ceiling/Wall Mount (Plenum Application): To consist of a factory manufactured plenum-rated unit, including enclosure/backcan with grille, cone speaker/transformer, and accessory ceiling supports or mounting hardware.
Flush Ceiling/Wall Mount (Non-Plenum Application): To consist of an assembly including steel backcan, cone speaker/transformer, grille, and supports/mounting hardware.
Surface Wall/Ceiling Mount: To consist of an enclosure with grille, cone speaker with transformer, and mounting hardware, assembled or a factory manufactured unit.
All Loudspeakers: Diameter (Speaker Cone): 5-inch (minimum). Frequency range: 75 – 12,000 Hz (-10 dB) minimum. Power capacity: 10 watts continuous (minimum) or greater as required. Transformers: Dual 25/70 volt, multiple taps 0.5, 1, 2, and 4 watts (minimum) with up to 8 watt tap if required by location
f. Speaker enclosures that are not an integral part of a factory manufactured loudspeaker unit are to be as recommended by the manufacturer for use with the specific loudspeaker model used and internally padded with acoustic material
g. AM/FM tuner with minimum FM selectivity of 60dB, 1.5 microvolts FM sensitivity and roof-mounted outdoor AM/FM antenna assembly with mounts, coaxial cable, lightning arrestor and ground connections.
h. Compact disc player with minimum frequency response of 10-20,000 Hz (±1dB), signal to noise ratios of 100Db. Equipment racks shall be 19” racks in accordance with EIA ANSI/EIA/310-D. Ventilated rear panels, solid side panels, and solid top panels shall be provided.
i. Microphone and line-level audio circuits: to consist1 pair, 20 AWG, stranded conductors with overall foil shield, drain wire and plenum rated jacket Provide larger sizes as required to compensate for signal losses.
Loudspeaker circuits: Cabling shall be a minimum of 18 AWG, twisted pair with plenum rated jacket.
j. Control Circuits (low voltage): Cabling to consist of 20 AWG or larger, multiconductor (quantity as required) with plenum rated jacket.

--- End of Section ---

SECTION 28 20 01.00 48 ELECTRONIC SECURITY SYSTEM

Scope:

1. Provide a Physical Access Control System in accordance with UFGS 28 13 00.00 48. Refer to the Corps of Engineers, Louisville District, Army Reserve Customer website for 28 13 00.00 48.

2. Provide card readers and keypads as required by UFC 4-171-05 and at selected doors to facilitate the tenant's operational access requirements.

3. Provide door contact switches on exterior doors.

4, Provide Intrusion Detection System (IDS) infrastructure in accordance with UFC 4-171-05, AR NEC ITC, and the USAR IDS Responsibilities document. Refer to the Corps of Engineers, Louisville District, Army Reserve Customer website for USAR IDS responsibilities.

References: 1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

UNIFIED FACILITIES CRITERIA (UFC)

UFC 3-600-01	Fire Protection Engineering for Facilities
UFC 4-171-05	Army Reserve Facilities (Design Guide or DG)

U.S. ARMY RESERVE

U.S. Army Reserve Network Enterprise Center Infrastructure Technical Criteria (AR NEC ITC)

--- End of Section ---

SECTION 28 31 76.00 48 FIRE ALARM AND MASS NOTIFICATION SYSTEM

Scope:

1. Provide a complete analog/addressable, supervised, combined fire alarm and mass notification system designed in accordance with NFPA 72 and UFC 3-600-01.
2. Designer Qualifications:
   a. Registered Professional Fire Protection Engineer or a Registered Professional Engineer with at least four (4) years of current verifiable experience in the design of the fire protection and detection systems.
3. Provide the following: NICET Level 4 Fire Alarm Technicians to supervise the installation of the system in accordance with their certification.
4. Provide preliminary and acceptance testing in accordance with recommendations of NFPA 72.
5. The fire alarm system shall be activated into the alarm mode by actuation of any alarm initiating device.The Mass Notification System shall be activated by controls at the Autonomous Control Unit (ACU) or the Local Operating Console (LOC). Alarm notification appliances shall be connected to notification appliance circuits (NAC), Class B. Alarm initiating devices shall be connected to Signal Line Circuits (SLC), Class B. Addressable system shall be microcomputer based and provide the following features:
   a. Individual identity of each addressable device for the following conditions: alarm; trouble; supervisory.
   b. Capability of each addressable device being individually disabled or enabled from the panel.
6. Interface between Fire Alarm and Mass Notification System (MNS) notification appliances: The MNS shall temporarily deactivate the building fire alarm system's audible notification appliances when the MNS audible notification system is activated. The Government recognizes that this requirement deviates from the requirements of NFPA 72. The Government authorizes this deviation from the NFPA 72 requirements for alarm signal deactivation to permit an individual building MNS to deactivate the audible notification appliances of that building's fire alarm system for the minimum time period necessary to transmit intelligible voice messages. The system shall synchronize fire alarm strobe lights with the MNS strobe lights when they both are operating. The system shall temporarily deactivate (mute) the Assembly Hall PA system when either the fire alarm or MNS is operating.
7. The MNS shall be capable of accepting a voice signal from a dedicated telephone line and a separate line level source.

References:

1. The publications referenced below establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/ASA S3.2	Method for Measuring the Intelligibility of Speech Over Communication Systems
ANSI S3.41	Audible Emergency Evacuation Signal

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60268	The Objective Rating of Speech Intelligibility by Speech Transmission Index
IEC 60849	Sound Systems for Emergency Purposes

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 72	National Fire Alarm Code

UNIFIED FACILITIES CRITERIA (UFC)

UFC 3-600-01	Fire Protection Engineering for Facilities
UFC 4-021-01	Design and O&M: Mass Notification Systems

Submittals:
1. Shop Drawings.
2. Product Data.
3. Test Plan/Reports.
4. Certificates of Compliance.
5. Operation and Maintenance Manuals.

Products:
1. Control Panel: Control panel be modular fully enclosed in a lockable steel enclosure, with prominent identification for LED/LCDs, zones, SLC, controls, meters, fuses, and switches. The LED/LCD displays shall be located on the exterior of the cabinet door or be visible through the cabinet door. Loss of power, including batteries, shall not require the manual reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation.
   a. Provide a notification appliance silencing switch, that when activated, will silence the audible signal appliances, but will not affect the visual alarm indicator.
   b. Provide program capability via switches in a locked portion of the FACP to bypass the automatic notification appliance circuits, fire reporting system, air handler shutdown, elevator recall, door release, and door unlocking features.
   c. The MNS control panel shall have the capability to temporarily deactivate the fire alarm audible notification appliances while delivering voice messages.
2. Fire Alarm Remote Annunciation and Control Panel: Provide panel with an audible appliance that operates in conjunction with the panel integral display and is silenced by a system silence switch on the remote panel. Provide the remote panel with an LED/LCD visual display that provides identification, consisting of the word description and ID number for each device as displayed on the control panel. The remote visual appliance located with the audible appliance shall not be extinguished until the trouble or alarm has been cleared. Locate the panel in the main entrance lobby or as directed by the Authority Having Local Jurisdiction.
3. MNS Local Operating Console (LOC): Provide secure LOC's in accordance with UFC 4-021-01 for initiating programmed tones, recorded messages, live messages, and MNS strobes. Provide with secure microphone for delivering live voice messages. The LOC shall be contained in a secure flush wall-mounted enclosure with a locking feature for the housing that prevents unauthorized access to electronic components and wiring but allows immediate access to operational controls without the use of a locking device.
4. Battery Charger: Battery charger shall be completely automatic, 24 Vdc.
5. Storage Batteries: Provide 24 Vdc sealed, lead-calcium batteries sized and protected in accordance with NFPA 72 to operate the fire alarm system. Provide substantiating battery calculations for supervisory and alarm power requirements including ampere-hour requirements for each system component and each panel component and voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.
   a. Provide the batteries with sufficient capacity to operate the system under supervisory and trouble conditions, including audible trouble signal devices for 48 hours and audible and visual signal devices under alarm conditions for an additional 15 minutes.
6. Addressable Manual Fire Alarm Stations: Addressable manual fire alarm stations shall be dual action. Break glass type is prohibited.
7. Fire Detecting Devices:
   a. Detectors located in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD. All fire alarm initiating devices shall be individually addressable.
   b. Heat detectors shall be designed for detection of fire by fixed temperature, combination fixed temperature and rate-of-rise principle, or rate-compensating principle.
   c. Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be photoelectric, or projected beam type. Detectors that are to be installed in concealed (above false ceilings, etc.) locations shall be provided with a remote indicator LED/LCD suitable for mounting in a finished, visible location. Provide alarm verification capability for smoke sensors.
   d. Duct-mounted photoelectric smoke detectors shall be furnished and installed in accordance with NFPA 72. Units shall consist of a smoke detector, mounted in a special housing fitted with duct sampling tubes.

8. Voice Notification System: The Voice Notification System shall comply with the requirements of NFPA 72 for In-Building Mass Notification Systems , IEC 60849, IEC 60268, and ANSI S3.2. The system shall be a one-way multi-channel voice notification system incorporating user selectability of tone signaling, and the incorporation of a voice module for delivery of prerecorded and live voice messages. The system shall be capable of operating all speakers at the same time. The digitalized voice message shall consist of non-volatile (EPROM) microprocessor based input to the amplifiers.All outputs and operational modules shall be fully supervised with on-board diagnostics and trouble reporting circuits. Form “C” contacts shall be provided for system alarm and trouble conditions. During a Mass Notification event the panel shall not generate nor cause any trouble alarms to be generated with the Fire Alarm System. The Control Panel for the MNS shall be capable of autonomous operation in the event of Fire Alarm System failure.
    a. Provide eight audible emergency evacuation signals (tones). One tone shall be 1000 Hz (1 second on, ½ second off).
    b. Provide two pre-recorded fire alarm voice messages with verbiage as directed by the Authority Having Jurisdiction.
    c. Provide five pre-recorded MNS voice messages with verbiage as directed by the Government.
    d. Provide the capability for tone only, two cycles of tones followed by a pre-recorded voice message and voice message only. Program the system as directed by the Authority Having Jurisdiction and the Government.
    e. Amplifiers shall be supervisable and in modular format with a minimum of 40 watts per module. Provide amplifier capacity adequate to drive the entire load and with ample dynamic headroom to support voice and tone propagation without clipping of the waveform. Provide amplifiers that produce sound levels, characteristics and intelligibility in accordance with the applicable portions of NFPA 72, IEC 60849, IEC 60268 and ANSI S3.2.
9. Visual notification appliances shall conform to the applicable requirements of the Americans with Disabilities Act (ADA).
    a. Visual Alarm Notification Appliances shall output white light and be marked “Alert” in red letters.
    b. Textual appliances shall be in accordance with NFPA 72 and UFC 4-021-01.
10. Fire Detection and Alarm System Peripheral Equipment: Electromagnetic door hold-open devices shall be attached to the walls unless otherwise indicated.Devices shall operate on 24 volt dc power. Compatible magnetic component shall be attached to the door.
11. Radio alarm transmitters shall be compatible with proprietary supervising station receiving equipment. Each radio alarm transmitter shall be the manufacturer’s recognized commercial product, completely assembled, wired, factory tested, and delivered ready for installation and operation. Transmitters shall be provided in accordance with applicable portions of 47 CFR 15. Provide telephonic backup system for radio system. Fire alarm, supervisory, and/or trouble signals shall be automatically transmitted to the fire department and/or a central station as directed by the Authority Having Jurisdiction.
12. Telephonic reporting system transmitters shall be compatible with existing receiving equipment at the Supervising Station. Transmitter shall respond to the actuation of the fire alarm control panel and shall be of the electric motor-driven or prewound spring mechanism type; it shall transmit not less than four rounds of code.
13. Special Tools and Spare Parts: Provide software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment to the Contracting Officer. Two spare fuses of each type and size required shall be furnished. Two percent of the total number of each different type of detector, but not less than two each, shall be furnished.
14. Overvoltage and Surge Protection:
    a. Power Line Surge Protection: All equipment connected to alternating current circuits shall be protected from surges. Fuses shall not be used for surge protection.
    b. Low Voltage DC and Signal Line Circuits Surge Protection: All SLC, NAC, and communication cables/conductors shall have surge protection installed at each point where it exits or enters a building.

Execution:

1. Testing:
   a. Test Plan: Provide a test plan that incorporates preliminary and final testing procedures, equipment, personnel and schedule. Submit test plan to the Contracting Officer for approval a minimum of 30 days prior to start of preliminary testing. Notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.
   b. Preliminary Tests: Upon completion of the installation, subject the system to functional and operational performance tests including tests of each installed initiating and notification appliance. Provide testing as required to complete the Certificate of Completion IAW NFPA 72. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional. After completing the preliminary testing the Contractor shall complete and submit the NFPA 72, Certificate of Completion.
   c. Acceptance Test: Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion.The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The Contractor shall complete and submit the NFPA 72, Inspection and Testing Form.
2. Training: Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period for systems operation and maintenance shall consist of 1 8-hour training day and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system.

--- End of Section ---

SECTION 31 00 00.06 48 – EARTHWORK

Scope:

1. Perform excavation, filling, compacting and grading operations on the site as required for below grade improvements and to achieve contours and elevations indicated on the plans. Performing excavation, dewatering, filling, compacting and grading operations both inside and outside building footprint limits as required for below grade improvements and to achieve the contours and elevations indicated on the plans. Excavate, shore and brace sidewalls in excavations for utility systems.
2. Dewatering.
3. Provide suitable sub-base preparation and site soils improvement materials and common filled materials for site improvements. Provide sub-base materials, drainage fill and common fill materials for building, slabs, pavements and improvements and preparation for foundations. Provide select granular material for shaping of pipe bedding and pipe zone soil materials for utilities
4. Provide suitable fill from off-site sources if on-site quantities are insufficient and dispose of excess fill off-site or spoil on-site as directed.
5. Provide rock excavation without blasting unless blasting is specifically authorized.
6. Provide trenching and back fill for structural building components and utilities within the building envelope. Backfill utility trenches.

References:

1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

-AASHTO T 180 Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

-AASHTO T 224 Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

AMERICAN WATER WORKS ASSOCIATION (AWWA)

-AWWA C600 Installation of Ductile-Iron Mains and Their Appurtenances

AMERICAN WELDING SOCIETY (AWS)

-AWS D1.1/D1.1M Structural Welding Code – Steel

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

-AWPA P5 Standard for Waterborne Preservatives

ASTM INTERNATIONAL (ASTM)

ASTM INTERNATIONAL (ASTM)

-ASTM A139/A139M Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)

-ASTM A252 Standard Specification for Welded and Seamless Steel Pipe Piles

-ASTM C136/C136M Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

-ASTM C33/C33M Standard Specification for Concrete Aggregates

-ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing

-ASTM D1556/D1556M Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method

-ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)

-ASTM D1883 Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils

-ASTM D2167 Density and Unit Weight of Soil in Place by the Rubber Balloon Method

-ASTM D2434 Permeability of Granular Soils (Constant Head)

-ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

- ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method

-ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

-ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

-ASTM D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ARMY CORPS OF ENGINEERS (USACE)

-EM 385-1-1 Safety and Health Requirements Manual

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

-EPA 600/4-79/020 Methods for Chemical Analysis of Water and Wastes

-EPA SW-846.3-3 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

-CID A-A-203 Paper, Kraft, Untreated

Submittals: 1. Test reports, field density, gradation, Proctor, etc. Refer to section 01 02 00.00 48, paragraph 3.2.2 for detailed requirements. The Contractor's QC plan shall detail these testing requirements and outline the plan to report the testing results

2. Testing certifications.

Products: 1. Satisfactory materials Satisfactory materials are project specific and to be defined by the contractor's geotechnical engineer.
2. Top soil as specified in the specifications Section 32 05 33.00 48 LANDSCAPING for landscape work.
3. Select Granular material shall conform to State Department of Transportation specifications.
4. Marker Tape according State requirements. Tracer wire for nonmetallic pipes and conduits.
5. Capillary water barrier consisting of clean crushed non-porous rock, crushed gravel or un-crushed gravel with a maximum particle size of 1 ½ inches and with no more than 2% by weight passing the 1/8 inch size.
6. 8 mil polyethylene barrier over capillary water barrier.

Execution: 1. Strip topsoil to depth of as determined by the geotechnical engineer.

2. Excavation of every type of material encountered to lines, grades and elevations indicated on the plans and specified.

3. Furnish borrow material according to materials specified or as noted on the plans.

4. Compaction shall be achieved by equipment approved by the project professional geotechnical engineer. Materials shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the compaction specified with the equipment used. Each layer of fill placed shall be no greater than 8 inches thick. Compact each layer to not less than the percent of maximum density specified in section 01 02 00.00 48 Part 3 and in accordance with ASTM D-1557. The requirements shall be verified and modifications recommended by the consulting project professional geotechnical engineer whenever engineering, soils or climatic factors indicate the necessity. Any modifications to the stated compaction requirements shall require approval from the COR.

5. Compact capillary water barrier under concrete floor slabs minimal 2 passes of a hand operated plate type vibratory compactor.

6. Construction to lines and grades for utilities as noted on the plans

7. Vapor barrier shall be lapped a minimum of 6" and taped at seams. Provide minimum 6" compacted sand layer for slab/vapor barrier separation.

8. Fill placement and compaction operations shall be observed and tested on a full-time basis by a qualified independent testing agency as directed by the project professional geotechnical engineer.

9. During construction, all foundation excavations shall be inspected and approved by the Contractor's professional geotechnical engineer prior to placing concrete.

10. During construction, all subgrade proof rolling shall be observed by the Contractor's professional geotechnical engineer. Notify Contracting Officers Representative (COR) in advance of proof rolling to provide COR opportunity to witness the tests. Undercut rutting or pumping of material as recommended by the contractor's geotechnical engineer and approved by the Contracting Officer.

--- End of Section --

SECTION 31 11 00.00 48 – CLEARING AND GRUBBING

Scope:
1. Filling, trimming and cutting of trees into sections.
2. Satisfactory disposal of the trees and other vegetation designated for removal including downed timber snags, brush and rubbish occurring in the areas to be cleared.
3. Removal and disposal of stumps, roots and matted roots from grubbing areas.

Submittals:
1. Permission to dispose of products on private property.

Products:
1. Not applicable.

Execution:
1. Organic and metallic debris removal in a depth not less than 18 inches below finished grade.

--- End of Section ---

SECTION 31 31 16.13 48 – CHEMICAL TERMITE CONTROL

Scope: 1.Provide soil treatment for termite control at buildings at the end of earthwork operations.

Submittals:
1. Application plan.
2. Products
3. Verification of other site work will not disturb treatment
4. Location of vents, crawl, and air spaces
5. Verification of volume used
6. Equipment calibration and testing
7. Applicator qualifications and license

Warranty: The Contractor shall provide a 5-year written warranty against infestations or re-infestations by subterranean termites of the buildings or building additions constructed under this contract. Warranty shall include annual inspections of the buildings or building additions.

Products:
1. Termiticides furnished shall be currently registered by the EPA and selected for maximum effectiveness and duration after application. Selected termiticide shall be suitable for the soil and climactic conditions at the project site. The termiticide shall not be injurious to plants and landscaping.

Execution:
1. Apply termiticide using calibrated application equipment and qualified personnel

--- End of Section ---

SECTION 32 01 19.00 48 – FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS

Scope:

1. Provide requirements for field molded sealants in sealing or resealing joints in rigid pavements on airfields, roads, streets, and other areas

References

1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

ASTM INTERNATIONAL (ASTM)

ASTM C1016	Standard Test Method for Determination of Water Absorption of Sealant Backing (Joint Filler) Material
ASTM D5893/D5893M	Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM D789	Determination of Relative Viscosity and Moisture Content of Polyamide (PA)

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 525	Corps of Engineers Test Method for Evaluation of Hot-Applied Joint Sealants for Bubbling Due to Heating

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS SS-S-200	Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

Submittals

1. Manufacturer ‘s Recommendations, Equipment

Products:

1. Sealants – Comply with Referenced Standard

Execution:

1. Executing Equipment – Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and maintained in satisfactory condition at all times.

--- End of Section ---

SECTION 32 05 33.00 48 – LANDSCAPING

Scope:
1. Provide certified soil testing, including percolation, pH, micro and macro nutrient analysis, chemical analysis, and mechanical analysis.
2. Provide topsoil and planting soil.
3. Provide trees, shrubs, ground covers, perennials and vines.
4. Provide sod and seeded areas.
5. Provide related materials such as, but not limited to, soil amendments and fertilizers.
6. Provide related landscape accessories such as, but not limited to, metal edgings, mineral mulch, wood mulch and non woven weed barrier fabric.
7. Provide pruning and relocation of existing plant materials as directed.
8. Provide weather and climatic planting limitations.
9. Define plant warranty (one-year typical). Require landscape maintenance instructions to be submitted which recommend procedures to be established by the Owner for maintenance of exterior plants during a calendar year.

Products:
1. Trees and plants: Balled and burlapped and container–grown plants in accordance with American Standard for Nursery Stock, ANSI Z60.1. Bare root plants shall not be used.
2. Topsoil: From site stockpile with additional fertile, friable topsoil from local source.
3. Lawns:
   a. Seed: New crop seed mixture.
   b. Sod: Vigorous, strongly rooted sod, 2 years old.
4. Native Grass Seed Areas
   a. Seed source shall not exceed a 250 mile radius from the project site.
5. Soil Amendments and Fertilizer: Nursery recommended corrections and planting soil additions based upon certified soil and percolation test.
6. Mulch:
   a. Building Maintenance Strip: Washed, 3/4-2.5” locally available mineral mulch.
   b. Periphery landscape: Shredded hardwood mulch.
7. Accessories:
   a. Edgings: 3/16” x 4” metal edger.
   b. Non-woven weed barrier fabric.
   c. Guying and Staking materials.
   d. Tree wrapping material: paper].

Execution:
1. Protection of Planting Areas: Before excavations are made, precautionary measures shall be taken to protect existing vegetation during planting operations. Locations for plants and outlines of areas to be planted shall be marked on the ground and approved before excavation is made.
2. Plant Pit Excavation:
   a. Excavation for planting shall include stripping and stacking all acceptable topsoil encountered within the areas to be excavated for trenches, plant pits, and planting beds.
   b. Excavation shall extend to the required subgrades indicated, but in no case less than specified.
   c. Minimum depths of plant pits shall be measured from finished grade.
   d. Planting beds in which ground cover or similar plantings are required shall be excavated to the depth shown to eliminate objectionable weeds or grasses.
   e. Diameter or minimum width of pits shall be at least twice the diameter of the ball.
   f. Acceptable excess excavated topsoil shall be used to form saucers around plants, wasted uniformly over nearby low or rough lawn areas, or disposed as approved.
   g. Excess soils not required or not suitable for the above usage shall be disposed as directed.
3. Plant Installation:
   a. Remaining nursery staking on plant materials shall be removed and disposed of off site prior to planting.

b. Plants shall be planted in pits and at such levels that, after settlement, plants will bear the same relation to the finished grade of the surrounding ground as to the grade of the ground from which plants were dug.
c. Plants shall be set plumb and rigidly braced in position until the soil has been tamped solidly around the ball.
d. Plants shall be planted in approved topsoil blend which shall be settled by watering and tamping.
e. Prior to watering, fix the finished grade of the topsoil blend to an elevation that is 10 percent of the fill depth higher than the desired finished grade.
f. To facilitate watering, a shallow saucer deep shall be formed around each plant by placing a ridge of topsoil blend around the edge of each filled-in pit.
g. Balled and burlapped (BB) plants:
    1. Place on a minimum of 6” of compacted topsoil blend that has been hand-tamped prior to placing plants.
    2. Plants shall then be placed in the plant pit and the topsoil blend tamped to fill all voids under the base and around the ball to a height of one-half the depth of the ball.
    3. Cloth, ropes, wires, and other wrapping material shall be cut away from the top half of the ball, and backfilling shall be completed. In no case shall cloth be pulled out from under the ball[~~,~~.]
    4. Containers shall be opened and the plants carefully removed so that the earth around the roots of the plants remains unbroken.
    5. Plants shall be placed on a minimum of 6” of compacted topsoil blend that has been hand-tamped prior to placing plants.
    6. Plants shall be placed in the plant pit and the topsoil blend tamped to fill all voids under the base and around the ball to the full depth of the ball.
h. Palms:
    1. Utilize padded fabric straps or slings for lifting root balls.
    2. Protect the terminal bud from damage during planting.
    3. Support the trunk of larger palms with props or guys after planting; do not insert nails, screws, or mechanical devices into the trunk.
i. Wrap deciduous tree trunks with paper trunk protection.

---End of Section---

SECTION 32 11 20.00 48 – BASE COURSE FOR RIGID AND SUBBASES FOR FLEXIBLE PAVING

Scope: 1. Provide aggregate base course for site paving and surfacing systems.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

- AASHTO T 180 Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- AASHTO T 224 Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test
- AASHTO T 88 Standard Method of Test for Particle Size Analysis of Soils

ASTM INTERNATIONAL (ASTM)

- ASTM C117 Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
- ASTM C131/C131M Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- ASTM C136/C136M Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- ASTM C29/C29M Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
- ASTM D1556/D1556M Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
- ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
- ASTM D2167 Density and Unit Weight of Soil in Place by the Rubber Balloon Method
- ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- ASTM D75/D75M Standard Practice for Sampling Aggregates
- ASTM E11 Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves

Submittals: 1. Plants, tools and equipment used.

2. Delivery tickets.

3. Test reports – Field density and thickness, samplings.

Products: 1. Clean sound durable particles of crushed stone, gravel, recycled concrete, or angular sand. Test recycled concrete for expansive aggregate. Do not use recycle concrete containing expansive aggregates.

Execution: 1. Construct aggregate base according to the lines and grades shown on the plan.

--- End of Section ---

SECTION 32 12 16.00 48 – HOT-MIX ASPHALT (HMA) FOR ROADS

Scope: 1 Provide asphaltic concrete paving for roadways, parking areas, driveways, walkways.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution which that may be specified in this Section.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

-AASHTO M 156 Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

-AASHTO M 320 Standard Specification for Performance-Graded Asphalt Binder

-AASHTO T 304 Standard Method of Test for Uncompacted Void Content of Fine Aggregate

ASPHALT INSTITUTE (AI)

-AI MS-2 Asphalt Mix Design Methods

-AI MS-22 Construction of Hot-Mix Asphalt Pavements

-AI SP-2 Superpave Mix Design

ASTM INTERNATIONAL (ASTM)

-ASTM C117 Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing

-ASTM C127 Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

-ASTM C128 Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate

-ASTM C131/C131M Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

-ASTM C136/C136M Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

-ASTM C142/C142M Standard Test Method for Clay Lumps and Friable Particles in Aggregates

-ASTM C29/C29M Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate

-ASTM C566 Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying

-ASTM C88 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

-ASTM D140/D140M (2016) Standard Practice for Sampling Asphalt Materials

-ASTM D1461 Standard Test Method for Moisture or Volatile Distillates in Asphalt Mixtures

-ASTM D2041/D2041M Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures

-ASTM D2172/D2172M Standard Test Methods for Quantitative Extraction of Asphalt Binder from Asphalt Mixtures

-ASTM D2419 Sand Equivalent Value of Soils and Fine Aggregate

-ASTM D242/D242M Mineral Filler for Bituminous Paving Mixtures

-ASTM D2489/D2489M Standard Test Method for Estimating Degree of Particle Coating of Asphalt Mixtures

-ASTM D2726/D2726M Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures

-ASTM D2950/D2950M Density of Bituminous Concrete in Place by Nuclear Methods

-ASTM D3381/D3381M Viscosity-Graded Asphalt Cement for Use in Pavement Construction

-ASTM D3665 Standard Practice for Random Sampling of Construction Materials

-ASTM D3666 Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

-ASTM D4125/D4125M Asphalt Content of Bituminous Mixtures by the Nuclear Method

-ASTM D4791 Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

-ASTM D4867/D4867M Effect of Moisture on Asphalt Concrete Paving Mixtures

-ASTM D5444 Mechanical Size Analysis of Extracted Aggregate

-ASTM D6307 Standard Test Method for Asphalt Content of Hot Mix Asphalt by Ignition Method

-ASTM D6925 Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor

-ASTM D6926 Standard Practice for Preparation of Asphalt Mixture Specimens Using Marshall Apparatus

-ASTM D6927 Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures

-ASTM D946/D946M Penetration-Graded Asphalt Cement for Use in Pavement Construction

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

-CTM 526 Method of Test for Operation of California Profilograph and Evaluation of Profiles

U.S. ARMY CORPS OF ENGINEERS (USACE)

-COE CRD-C 171 Standard Test Method for Determining Percentage of Crushed Particles in Aggregate

Submittals:

1. Mix design (JMF). For SUPERPAVE designs, insure that the “selected binder grade” determination is correct according to SUPERPAVE design requirements. This includes review of State DOT applications of the SUPERPAVE design procedure.
2. Quality control plan.
3. Aggregate tests.
4. Asphalt cement binder certification.
5. Equipment compliance, plant scale certification.

Products:

1. Provide JMF according to the State Department of Transportation requirements and tolerances. Asphaltic cement materials shall be as designed and specified according to JMF.
2. Clean, sound durable aggregates meeting the Job Mix Formula (JMF) requirements.
3. Bituminous tack and prime coat according to State Department of Transportation specifications. Materials shall comply with State and Local emissions and air quality regulations.

Execution:

1. Prepare, mix and place job mix formula according the State Department of Transportation practices and specifications to provide quality control monitoring and test results.

--- End of Section ---

SECTION 32 13 13.06 48 – PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES

Scope: 1. Provide Portland cement concrete for small site projects such as sidewalks, driveway aprons, and vehicle door aprons.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution which that may be specified in this Section.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

- ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
-ACI 301	Specifications for Structural Concrete
-ACI 305.1	Specification for Hot Weather Concreting
-ACI 306.1	Standard Specification for Cold Weather Concreting
-ACI 325.12R	Guide for Design of Jointed Concrete Pavements for Streets and Local Roads
-ACI 330R	Guide for the Design and Construction of Concrete Parking Lots

AMERICAN WATER WORKS ASSOCIATION (AWWA)

-AWWA C215	Extruded Polyolefin Coatings for Steel Water Pipe

ASTM INTERNATIONAL (ASTM)

-ASTM A184/A184M	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
-ASTM A615/A615M	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
-ASTM A775/A775M	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
-ASTM A966/A966M	Standard Test Method for Magnetic Particle Examination of Steel Forgings Using Alternating Current
-ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
-ASTM C1157/C1157M	Standard Performance Specification for Hydraulic Cement
-ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
-ASTM C143/C143M	Standard Test Method for Slump of Hydraulic-Cement Concrete

-ASTM C150/C150M	Standard Specification for Portland Cement
-ASTM C1549	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
-ASTM C1567	Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method
-ASTM C1602/C1602M	Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
-ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
-ASTM C172/C172M	Standard Practice for Sampling Freshly Mixed Concrete
-ASTM C231/C231M	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
-ASTM C260/C260M	Standard Specification for Air-Entraining Admixtures for Concrete
-ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
-ASTM C31/C31M	Standard Practice for Making and Curing Concrete Test Specimens in the Field
-ASTM C33/C33M	Standard Specification for Concrete Aggregates
-ASTM C494/C494M	Standard Specification for Chemical Admixtures for Concrete
-ASTM C595/C595M	Standard Specification for Blended Hydraulic Cements
-ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
-ASTM C78/C78M	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
-ASTM C94/C94M	Standard Specification for Ready-Mixed Concrete
-ASTM C989/C989M	Standard Specification for Slag Cement for Use in Concrete and Mortars
-ASTM D6155	Nontraditional Coarse Aggregate for Bituminous Paving Mixtures

U.S. DEPARTMENT OF DEFENSE (DOD)

-UFC 3-250-01	Pavement Design for Roads and Parking Areas

Submittals: 1. Product Data

2. Mix Proportions

Products:

1. Concrete mix design: Specific mix as required for sidewalks and aprons.
2. Reinforcing: Welded wire mesh and deformed bars.
3. Joints: Pre-formed joint fillers with applied sealers
4. Finish: Light broom.
5. Curing compound

--- End of Section ---

SECTION 32 17 23.00 48 – PAVEMENT MARKINGS

Scope: 1. Provide pavement markings for striping, traffic control and pedestrian control, and information.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution which may be specified in this Section.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

-AASHTO M 247	Standard Specification for Glass Beads Used in Pavement Markings
-AASHTO M 248	Standard Specification for Ready-Mixed White and Yellow Traffic Paints
-AASHTO M 249	Standard Specification for White and Yellow Reflective Thermoplastic Striping Material (Solid Form)

ASTM INTERNATIONAL (ASTM)

-ASTM D1652	Standard Test Method for Epoxy Content of Epoxy Resins
-ASTM D2074	Standard Test Methods for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
-ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
-ASTM D2621	Standard Test Method for Infrared Identification of Vehicle Solids from Solvent-Reducible Paints
-ASTM D2697	Volume Nonvolatile Matter in Clear or Pigmented Coatings
-ASTM D3335	Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
-ASTM D3718	Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy
-ASTM D3924	Standard Specification for Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials
-ASTM D3960	Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
-ASTM D4060	Abrasion Resistance of Organic Coatings by the Taber Abraser
-ASTM D4061	Standard Test Method for Retroreflectance of Horizontal Coatings
-ASTM D4280	Extended Life Type, Non-plowable, Raised, Retroreflective Pavement Markers

-ASTM D4383	Standard Specification for Plowable, Raised Retroreflective Pavement Markers
-ASTM D4505	Standard Specification for Preformed Retroreflective Pavement Marking Tape for Extended Service Life
-ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
-ASTM D471	Standard Test Method for Rubber Property - Effect of Liquids
-ASTM D476	Dry Pigmentary Titanium Dioxide Pigments
-ASTM D522/D522M	Mandrel Bend Test of Attached Organic Coatings
-ASTM D638	Standard Test Method for Tensile Properties of Plastics
-ASTM D6628	Standard Specification for Color of Pavement Marking Materials
-ASTM D695	Standard Test Method for Compressive Properties of Rigid Plastics
-ASTM D711	No-Pick-Up Time of Traffic Paint
-ASTM D7234	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
-ASTM D823	Standard Practices for Producing Films of Uniform Thickness of Paint, Coatings, and Related Products on Test Panels
-ASTM E1347	Color and Color Difference Measurement by Tristimulus (Filter) Colorimetry
-ASTM E1710	Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
-ASTM E2177	Standard Test Method for Measuring the Coefficient of Retroreflected Luminance (RL) of Pavement Markings in a Standard Condition of Wetness
-ASTM E2302	Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer
-ASTM G154	Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

-ICRI 03732	Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

MASTER PAINTERS INSTITUTE (MPI)

-MPI 32 Traffic Marking Paint, S.B

-MPI 97 Traffic Marking Paint, Latex

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

-SAE AMS-STD-595A Colors used in Government Procurement

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

-FAA AC 150/5370-10 Standards for Specifying Construction of Airports

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD Manual on Uniform Traffic Control Devices

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

-FS TT-B-1325 Beads (Glass Spheres) Retro-Reflective (Metric)

-FS TT-P-1952 Paint, Traffic and Airfield Markings, Waterborne

Submittals:
1. Product data – Equipment, paint composition, personnel qualifications.
2. Test reports – Paint materials.
3. VOC certification meeting EPA and local requirements.

Products:
1. Paint and thermoplastic compounds with cleaners and primers meeting applicable state and local laws and conforming to FS TT-P-752.
2. Comply with applicable State and local laws enacted to ensure compliance with Federal Clean Air Standards.

--- End of Section ---

SECTION 32 32 23.00 48 - SEGMENTAL CONCRETE BLOCK RETAINING WALL

Scope:

1. Segmental concrete block retaining wall

References:

1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution which that may be specified in this Section.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

-AASHTO M 252	Standard Specification for Corrugated Polyethylene Drainage Pipe
-AASHTO M 288	Standard Specification for Geosynthetic Specification for Highway Applications

-ASTM INTERNATIONAL (ASTM)

-ASTM C1262	Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units
-ASTM C136/C136M	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
-ASTM C1372	Standard Specification for Dry-Cast Segmental Retaining Wall Units
-ASTM C140/C140M	Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
-ASTM C920	Standard Specification for Elastomeric Joint Sealants
-ASTM C94/C94M	Standard Specification for Ready-Mixed Concrete
-ASTM D1241	Materials for Soil-Aggregate Subbase, Base, and Surface Courses
-ASTM D1556/D1556M	Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
-ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
-ASTM D2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
-ASTM D4355/D4355M	Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus

-ASTM D448	Standard Classification for Sizes of Aggregate for Road and Bridge Construction
-ASTM D4491/D4491M	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
-ASTM D4595	Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
-ASTM D4632/D4632M	Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D4873/D4873M	Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
-ASTM D5321/D5321M	Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear
-ASTM D6638	Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks)
-ASTM D6706	Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil
-ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
-ASTM D698	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

GEOSYNTHETIC INSTITUTE (GSI)

-GSI GRI GG6	Grip Types for Use in Wide Width Testing of Geotextiles and Geogrids

NATIONAL CONCRETE MASONRY ASSOCIATION (NCMA)

-NCMA TR127B	Design Manual for Segmental Retaining Walls

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

- FHWA NHI-00-043	Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines (ISDDC)

Submittals:

1. Product Data
    - Components and Equipment
    - Supplier Qualifications
    - Manufacturer's Representative

Products:

1. Design Requirements
    - Complete all stability analyses in accordance with either the NCMA TR127B or the Federal Highway Administration/AASHTO method detailed in. Only one method shall be followed for the complete design, including reinforcement design strength, layout, stability calculations, and seismic effects. The segmental retaining wall system shall be designed under the direction of, and be signed by, a professional engineer.

Execution:

1. General:
    - Conform to wall design system requirements

--- End of Section ---

SECTION 32 84 24.00 48 – LANDSCAPE IRRIGATION

Scope:
1. Provide underground irrigation system, complete with piping, encasement for piping, valves, outlets, valve boxes, fittings, sprinklers, drip irrigation specialties, bubblers, quick couplers, rain sensors, and evapotranspiration based controllers for landscaped areas.
2. Provide connection to utilities.
3. Define manufacturer warranty (2-year manufacturer warranty). At the completion of the irrigation system installation, the Contractor shall instruct the Owner's personnel in the proper programming, operation and maintenance of the system. The Contractor shall provide a reproducible drawing showing[ ]sprinkler heads, valves, and piping to scale with dimensions.

Products:
1. Pipe:
   a. 1 1/2" and smaller pipe shall be non-toxic polyethylene pipe conforming to ASTM D2239 and D1248
   b. 2" and larger pipe shall be PVC, ASTM D 1785, Schedule 40.
2. PVC Pipe Fittings:
   a. PVC pipe fittings for 2" and larger pipe shall be PVC, ASTM D 1785, Schedule 40.
3. Electronic Control Valves:
   a. Valves used in the electrically controlled automatic system shall be brass with pressure regulation, globe / angle configuration with female pipe thread inlet and outlet. Valve shall have a manual flow control, and external and internal bleed.
4. Valve Boxes:
   a. Valve boxes shall be plastic 12" x 17" rectangular box with cover. Electric valves, manual valves, major wire splices, or future expansion wires shall be installed in a valve box.
5. Sprinkler Heads: Rotor or sprays as required for area covered. Sprinkler head drive assembly shall utilize brass and stainless steel drive gears.
6. Communication Circuitry: Electrical control wires shall be #14 gauge single strand power wire and #12 gauge single strand, common. Extra wires shall be stubbed in from the controller to each expansion area noted on the plan. Electrical control wire shall be direct bury wire. Multiple valves operating on one zone shall have individual signal wires from the controller. Future wires stubbed from initial installation must run from controller to approximate location (shown on plan) and shall be installed in a valve box. Future wires shall be a different color from initial installation. Six to ten feet of extra wire shall be left at controller and valve box location
7. Evapotranspiration-based automatic controllers shall be pedestal cabinet, electric actuation w/ terminal block, timer, switches, and additional surge protection.
8. Manual gate valves 3" and larger shall be cast iron (push on) types. Manual valves 2½" and smaller shall be bronze gate type. Manual valves shall be sized according to the line size on which they are being installed
9. Rain Sensor: Provide rain sensor with bypass switch.
10. Sleeving: Sleeving under major roadways and parking areas shall be schedule 40 PVC, sized as shown on plan.

Execution:
1. Underground Structure: The Contractor shall be responsible for necessary information regarding the exact location of existing underground structures and utilities and shall mark their location at the site.
   a. The Contractor shall be liable for the damages to and the cost of repairing or replacing any buried conduit, cables or piping encountered during the installation of the work, unless they were not marked or the Contractor was not previously informed of such underground utilities. If the Contractor is aware of such utilities, he shall immediately have the incurred damages repaired at their own expense. Conversely, the Owner shall be liable for the cost of repairing to any of those existing utilities of which the Contractor had not been previously informed.
2. Excavating and Backfilling: Contractor shall do all necessary excavation required for the proper installation of his work. When backfilling, backfill material shall be free from rock, large stone or other unsuitable substances to prevent damage to the pipe. Backfilling of trenches containing plastic piping shall be done when pipe is cool to avoid excessive contraction. Backfill material will be compacted in 6" layers to grade to insure that no settling results.

3. Pipe: Main line pipe (pipe constantly under pressure) shall be installed with a minimum depth of 24” cover. Lateral pipe (pipe located after electric valve) shall be installed with a minimum of 12" cover. Piping shall be capped and secured at the end of each work day to prevent entrance of foreign material and damage or rising of pipe. Piping shall be flushed of construction material.
4. Wire: Irrigation wire shall be installed in the same trench as the main line piping. At each electric valve connection a minimum 2” of slack wire shall be provided to facilitate future service. Underground splices shall be waterproofed with the wire connectors and Direct Burial Splice Kit (DBY)
5. Sleeving: Pipe and wire crossing under roads, walkways, permanent fixtures, etc. shall be enclosed in PVC sleeving. Sleeving depth shall be a minimum of 24" under items crossed.
6. Rock Excavation: Rock excavation in the alignment and depth shown on the plan shall be adjusted to avoid its excavation. If alignment and depth adjustment cannot be made and it becomes necessary to remove the same, the Contractor shall be paid for additional cost incurred in the handling of it. The Contractor must show to the Owner or consultant the problem encountered and receive verbal and written approval before add-on monies will be allowed.
7. Backflow Prevention Device: Potable sources shall be protected by the appropriated backflow preventer. Water used for irrigation is considered hazardous; therefore nothing that is intended for human use or consumption may be tapped into the irrigation system after the backflow preventer.
8. Electrical: The owner shall provide 120 volt 15 amp circuit into the controller location. The irrigation contractor shall be responsible for the controller hook-up as specified.
11. Electric Valve: The electric valves shall be installed in the Globe position. Wire splices must use an approved water tight splice, such as DBY epoxy pack.

---End of Section---

SECTION 33 11 00.00 48 – WATER UTILITY DISTRIBUTION PIPING

Scope:

1. Provide water system piping and appurtenances for potable water supply and fire protection on site and outside the building footprint.

2. Provide testing for leakage pressure, fire flow capacity, and water quality parameters.

3. Provide cathodic protection at buried metal pipe and fittings.

References:

1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution which that may be specified in this Section.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

-AASHTO HB-17	Standard Specifications for Highway Bridges

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

-AREMA Eng Man	Manual for Railway Engineering

AMERICAN WATER WORKS ASSOCIATION (AWWA)

-AWWA B300	Hypochlorites
-AWWA B301	Liquid Chlorine
-AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
-AWWA C105/A21.5	Polyethylene Encasement for Ductile-Iron Pipe Systems
-AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings for Water
-AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
-AWWA C115/A21.15	Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
-AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast
-AWWA C153/A21.53	Ductile-Iron Compact Fittings for Water Service
-AWWA C200	Steel Water Pipe - 6 In. (150 mm) and Larger
-AWWA C203	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
-AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger - Shop Applied
-AWWA C206	Field Welding of Steel Water Pipe

-AWWA C207	Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 in. through 144 in. (100 mm through 3600 mm)
-AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
-AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fitting for Steel Water Pipelines
-AWWA C210	Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
-AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
-AWWA C300	Reinforced Concrete Pressure Pipe, Steel-Cylinder Type
-AWWA C301	Prestressed Concrete Pressure Pipe, Steel-Cylinder Type
-AWWA C303	Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type
-AWWA C500	Metal-Seated Gate Valves for Water Supply Service
-AWWA C502	Dry-Barrel Fire Hydrants
-AWWA C503	Wet-Barrel Fire Hydrants
-AWWA C504	Standard for Rubber-Seated Butterfly Valves
-AWWA C508	Swing-Check Valves for Waterworks Service, 2 In. Through 48-In. (50--mm Through 1,200-mm) NPS
-AWWA C509	Resilient-Seated Gate Valves for Water Supply Service
-AWWA C511	Reduced-Pressure Principle Backflow Prevention Assembly
-AWWA C512	Air-Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service
-AWWA C515	Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
-AWWA C550	Protective Interior Coatings for Valves and Hydrants
-AWWA C600	Installation of Ductile-Iron Mains and Their Appurtenances
-AWWA C602	Cement–Mortar Lining of Water Pipelines in Place—4 In. (100 mm) and Larger
-AWWA C604	Installation of Buried Steel Water Pipe—4 In. (100 mm) and Larger
-AWWA C605	Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
-AWWA C606	Grooved and Shouldered Joints
-AWWA C651	Standard for Disinfecting Water Mains

-AWWA C655	Field Dechlorination
-AWWA C700	Cold-Water Meters - Displacement Type, Metal Alloy Main Case
-AWWA C701	Cold-Water Meters - Turbine Type for Customer Service
-AWWA C702	Cold-Water Meters - Compound Type
-AWWA C703	Cold-Water Meters - Fire Service Type
-AWWA C704	Propeller-Type Meters for Waterworks Applications
-AWWA C706	Direct-Reading, Remote-Registration Systems for Cold-Water Meters
-AWWA C707	Encoder-Type Remote-Registration Systems for Cold-Water Meters
-AWWA C800	Underground Service Line Valves and Fittings
-AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
-AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) through 65 In., (1,575 mm) for Water Distribution and Transmission
-AWWA C909	Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. (100 mm) and Larger
-AWWA C950	Fiberglass Pressure Pipe
-AWWA M11	Steel Pipe: A Guide for Design and Installation
-AWWA M23	Manual: PVC Pipe - Design and Installation
-AWWA M41	Ductile-Iron Pipe and Fittings
-AWWA M45	Fiberglass Pipe Design
-AWWA M55	PE Pipe - Design and Installation
-AWWA M6	Water Meters - Selection, Installation, Testing, and Maintenance
-AWWA M9	Manual: Concrete Pressure Pipe

ASME INTERNATIONAL (ASME)

-ASME B1.20.1	Pipe Threads, General Purpose (Inch
-ASME B1.20.3	Dryseal Pipe Threads (Inch
-ASME B16.1	Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
-ASME B16.18	Cast Copper Alloy Solder Joint Pressure Fittings

-ASME B16.26	Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
-ASME B16.3	Malleable Iron Threaded Fittings, Classes 150 and 300
-ASME B16.4	Standard for Gray Iron Threaded Fittings; Classes 125 and 250
-ASME B18.2.2	Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
-ASME B18.5.2.1M	Metric Round Head Short Square Neck Bolts
-ASME B18.5.2.2M	Metric Round Head Square Neck Bolts

ASTM INTERNATIONAL (ASTM)

-ASTM A276/A276M	Standard Specification for Stainless Steel Bars and Shapes
-ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
-ASTM A47/A47M	Standard Specification for Ferritic Malleable Iron Castings
-ASTM A48/A48M	Standard Specification for Gray Iron Castings
-ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
-ASTM A536	Standard Specification for Ductile Iron Castings
-ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
-ASTM A563M	Standard Specification for Carbon and Alloy Steel Nuts (Metric)
-ASTM A746	Standard Specification for Ductile Iron Gravity Sewer Pipe
-ASTM B32	Standard Specification for Solder Metal
-ASTM B584	Standard Specification for Copper Alloy Sand Castings for General Applications
-ASTM B61	Standard Specification for Steam or Valve Bronze Castings
-ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
-ASTM B88	Standard Specification for Seamless Copper Water Tube
-ASTM B88M	Standard Specification for Seamless Copper Water Tube (Metric)
-ASTM C1433	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
-ASTM C150/C150M	Standard Specification for Portland Cement
-ASTM C94/C94M	Standard Specification for Ready-Mixed Concrete

-ASTM D1599	Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
-ASTM D1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
-ASTM D1785	Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
-ASTM D2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
-ASTM D2466	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
-ASTM D2467	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
-ASTM D2774	Underground Installation of Thermoplastic Pressure Piping
-ASTM D2855	Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
-ASTM D3035	Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
-ASTM D3139	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
-ASTM D3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
-ASTM D3839	Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
-ASTM D4161	"Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
-ASTM F1483	Standard Specification for Oriented Poly(Vinyl Chloride), PVCO, Pressure Pipe
-ASTM F1674	Standard Test Method for Joint Restraint Products for Use with PVC Pipe
-ASTM F1962	Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings
-ASTM F2164	Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure
-ASTM F2620	Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
-ASTM F402	Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

-ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

-ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

-FCCCHR List (continuously updated) List of Approved Backflow Prevention Assemblies

-FCCCHR (Manual 10th Edition) Manual of Cross-Connection Control

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

-MSS SP-80 Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

-NFPA 1961 Standard on Fire Hose

-NFPA 24 Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NSF INTERNATIONAL (NSF)

-NSF 372 Drinking Water System Components - Lead Content

-NSF/ANSI 14 Plastics Piping System Components and Related Materials

-NSF/ANSI 61 Drinking Water System Components - Health Effects

U.S. DEPARTMENT OF DEFENSE (DOD)

-UFC 3-600-01 Fire Protection Engineering for Facilities

UNDERWRITERS LABORATORIES (UL)

-UL 246 Hydrants for Fire-Protection Service

-UL 262 Gate Valves for Fire-Protection Service

-UL 312 UL Standard for Safety Check Valves for Fire-Protection Service

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

-UBPPA UNI-PUB-08 Tapping Guide for PVC Pressure Pipe

Submittals:
1. Manufacturer products information and recommendations for each material and procedure used.
2. Waste water disposal method.
3. Test reports – Pressure test
4. Bacteriological test

Products:
1. Pipe: PVC or cement-lined ductile iron pipe.
2. Water control valves of the gate valve, check valve or butterfly valve type, 50 psi minimum working pressure unless system requirements are greater. Gate valve box shall have “water” cast into the lid.
3. Hydrant type compatible with municipal or public work fire protection systems
4. Water meter as furnished by local utility or compatible with local utility or public works standards.
5. Service pipe: Copper or PVC.
6. Post indicator valve according to requirements of NFPA 24.

Execution:
1. Install dielectric separation between copper and ferrous pipes.
2. Install or provide corrosive protection for ductile iron pipe according to the results of analyses of site soil conditions and properties.
3. Conduct pressure and leakage tests.
4 Provide bacteriological disinfection with water sample analyses.
5 Install according to Section 31 00 00.00 48 EARTHWORK.

--- End of Section ---

SECTION 33 11 01.00 48 – ADVANCED WATER METER SPECIFICATION
(This specification was created from Army Reserve criteria dated 12MAR2008)

General specifications for all meters

Quantities Measured:	Gallons of Water
Measurement Configuration:	Water Supply to a building. For buildings that already have a water meter with a pulse output, ensure that the pulse output is connected to a data gathering device (i.e. electric meter). For buildings where a water meter already exists but does not have a pulse output, add a pulse kit to the existing meter and tie the output into a data gathering device. If the existing meter will not accept a pulse kit or if no meter exists, a new water meter will be installed, also requiring a pulse output to a data gathering device.
Operating Temperatures:	32 degrees F to 120 degrees F. When exterior mounting is required, consider the local ambient temperature extremes and protect from freezing with insulated, moisture proof enclosures and heat tracing as required.
Humidity Operating Range:	5% to 90% RH (non-condensing)
Accuracy:	1.5% of scale.
Frequency:	Not less than one pulse per revolution. Meter pulser shall be coupled to the meter dial to provide a pulse rate of not less than one pulse per gallon of water.

For non-LonWorks meter applications

Digital Output Only:	Pulse Output

For LonWorks meter applications

Digital Output Only:	Pulse Output

Water Meters shall be the turbine, propeller, or displacement type with pulse output chosen to meet the specific application (pipe size, flow, pressure, etc.).

Turbine Type Meters
Turbine type meters shall conform to AWWA C701 Class I or Class II depending on the application. The main casing shall be bronze or cast iron protected by corrosion resistant
coating with stainless steel external fasteners. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 or an encoder type remote register designed in accordance with AWWA C707 but must be compatible with the local Utility Monitoring and Control System. Meters shall comply with the accuracy and capacity requirements of AWWA C701.

Propeller Type Meters
Propeller type meters shall conform to AWWA C704. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct-reading remote register designed in accordance with AWWA C706 or an encoder-type remote register designed in accordance with AWWA C707 but must be compatible with the local Utility Monitoring and Control System. Meters shall comply with the accuracy and capacity requirements of AWWA C703.

Displacement Type Meters
Displacement type meters shall conform to AWWA C700. Registers shall be straight-reading and shall read in U.S. gallons. Meters in sizes 1/2 through 1 shall be frost-protection design as required by the local environmental conditions. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 or an encoder type remote register designed in accordance with AWWA C707 but must be compatible with the local Utility Monitoring and Control System. Meters shall comply with the accuracy and capacity requirements of AWWA C700.

Compound Type Meters
Compound type meters shall conform to AWWA C702 and shall be furnished with strainers. The main casing shall be bronze or cast iron protected by corrosion resistant coating with stainless steel external fasteners. The main casing shall be tapped for field testing purposes. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons. The
meter shall be equipped with a coordinating register. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register
designed in accordance with AWWA C706 or an encoder type remote register designed in accordance with AWWA C707 but must be compatible with the local Utility Monitoring and Control System. Meters shall comply with the accuracy and capacity requirements of AWWA C702.

Fire Service Type Meters
Provide Fire Service Type Meters as required by the Installation. Fire service type meters shall be proportional type or turbine type conforming to AWWA C703 and shall be furnished with strainers. The main casing shall be bronze or cast iron protected by corrosion resistant coating with stainless steel external fasteners. Any isolation valves installed as part of the meter assembly shall either have tamper switches or be position indicating valves in accordance with NFPA. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons. The meter shall be equipped with a coordinating register. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 or an encoder type remote register designed in accordance with AWWA C707 but must be compatible with the local Utility Monitoring and Control System. Meters shall comply with the accuracy and capacity requirements of AWWA C703. When turbine type main line meters are used, the meter shall be supplied with a separate check valve, as a unit.

Meter Boxes
Meter boxes shall be of cast iron, concrete, or plastic. The boxes shall be of sufficient size to completely enclose the meter and shutoff valve or service stop. Meter boxes set in paved areas subject to vehicular traffic shall be cast iron, or concrete with cast iron lid and cast iron meter reader lid suitable for vehicle wheel loads. Boxes set in sidewalks, not subject to vehicular traffic, shall be concrete with cast iron lid and cast iron meter reader lid. Plastic

boxes and lids can be used in unpaved areas or grass areas not subject to vehicular traffic. Box height shall extend from invert of the meter to final grade at the meter location. The lid shall have the word "WATER" cast in it.

Dielectric Fittings
Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

Gate Valves Smaller than 3 Inch in Size
Gate valves smaller than 3 inch size shall meet MSS SP-80, Class 150, solid wedge, nonrising stem. Valves shall have flanged or threaded end connections, with a union on one side of the valve. Provide handwheel operators. Valves shall open by counterclockwise rotation of the valve stem.

Gate Valves 3 Inch Size and Larger
Gate valves 3 inch size and larger shall meet AWWA C500 or UL 262 and be of one manufacturer. Valves shall be AWWA C500, nonrising stem type with double-disc gates or UL 262, inside-screw type with operating nut, split wedge or double disc type gate, and designed for a hydraulic working pressure of 175 psi. Valves shall open by counterclockwise rotation of the valve stem.

End of General Section

EXECUTION:

Connections to Publicly or Privately Operated Water Utility Lines
Contractor shall provide materials for the connections to the existing water lines. Final connections and the turning on of water shall be made by the utility. The Contractor shall notify the Contracting Officer, in writing, 10 days before final connections and turning on of water lines. The Contractor shall make necessary arrangements with the Utility for tie in and activation of new water lines. Only the Operating Agency/Utility Company may reactivate the system after tie in. The Contractor shall furnish a certification by the Operating Agency/Utility Company that all Utility work has been satisfactorily completed.

Connection to Government Owned/Operated Water Lines
Provide the name and location of the utility or operating agency of the existing water lines. Show on the drawings, the location of valves to be operated for existing system deactivation. The Contractor shall provide connections to the existing water lines in accordance with approved procedures. The Contractor's Connection Plan shall be submitted and approved prior to making any connections to existing water lines. This plan shall include the Operating Agency's required procedures which may be obtained from the Contracting Officer. The Contractor shall notify the Contracting Officer, in writing, 10 days before connections to existing lines are to be made. Reactivation of any existing water lines will only be done by the Government.

Location of Meters
The location of meters and meter boxes shall be shown on the drawings. The meters shall be centered in the boxes to allow for reading and ease of removal or maintenance.

Disinfection
Prior to disinfection, obtain Contracting Officer approval of the proposed method for disposal of waste water from disinfection procedures. Disinfect existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 and 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplying nonpotable water is not required.
Chlorinating materials shall conform to the following:
Chlorine, Liquid: AWWA B301.
Hypochlorite, Calcium and Sodium: AWWA B300.

Field Tests and Inspections
Prior to hydrostatic testing, obtain Contracting Officer approval of the proposed method for disposal of waste water from hydrostatic testing. The Contracting Officer will conduct field inspections and witness field tests. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the approved Statement of Work.

Testing Procedure
Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at copper pipe joints, copper tubing joints (soldered, compression type, brazed), plastic pipe joints, flanged joints and screwed joints.

Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system. Hold this pressure for not less than 2 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

CLEANUP
Upon completion of the installation of water meters, all debris and surplus materials resulting from the work shall be removed.

--- End of Section ---

SECTION 33 30 00.00 48 – SANITARY SEWERAGE

Scope:

1. Provide an operating underground sanitary sewer collection system outside the building footprint. system components shall include sewer pipe, manholes, frames, covers and appurtenances.

2. Provide cathodic protection for buried metal pipe and appurtenances.

References:

1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution which that may be specified in this Section.

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

-ACPA 01-102	Concrete Pipe Handbook
-ACPA 01-103	Concrete Pipe Installation Manual

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA

-AREMA Eng Man	Manual for Railway Engineering

AMERICAN WATER WORKS ASSOCIATION (AWWA\

-AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
-AWWA C105/A21.5	Polyethylene Encasement for Ductile-Iron Pipe Systems
-AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings for Water
-AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
-AWWA C115/A21.15	Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
-AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast
-AWWA C153/A21.53	Ductile-Iron Compact Fittings for Water Service
-AWWA C302	Reinforced Concrete Pressure Pipe, Noncylinder Type
-AWWA C600	Installation of Ductile-Iron Mains and Their Appurtenances
-AWWA C605	Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
-AWWA C606	Grooved and Shouldered Joints
-AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm
-AWWA M9	Manual: Concrete Pressure Pipe

ASME INTERNATIONAL (ASME)

-ASME B1.20.1	Pipe Threads, General Purpose (Inch
-ASME B1.20.2M	Pipe Threads, 60 Deg. General Purpose (Metric)
-ASME B16.1	Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
-ASME B18.2.2	Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series
-ASME B18.5.2.1M	Metric Round Head Short Square Neck Bolts
-ASME B18.5.2.2M	Metric Round Head Square Neck Bolts

ASTM INTERNATIONAL (ASTM)

-ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
-ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
-ASTM A47/A47M	Standard Specification for Ferritic Malleable Iron Castings
-ASTM A48/A48M	Standard Specification for Gray Iron Castings
-ASTM A536	Standard Specification for Ductile Iron Castings
-ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
-ASTM A563M	Standard Specification for Carbon and Alloy Steel Nuts (Metric)
-ASTM A746	Standard Specification for Ductile Iron Gravity Sewer Pipe
-ASTM C12	Standard Practice for Installing Vitrified Clay Pipe Lines
-ASTM C1214	Standard Test Method for Concrete Pipe Sewer lines by Negative Air Pressure (Vacuum) Test Method
-ASTM C1214M	Standard Test Method for Concrete Pipe Sewer lines by Negative Air Pressure (Vacuum) Test Method (Metric
-ASTM C1227	Standard Specification for Precast Concrete Septic Tanks
-ASTM C1244	Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
-ASTM C1244M	Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill (Metric
-ASTM C14	Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe

-ASTM C14M	Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe (Metric
-ASTM C150/C150M	Standard Specification for Portland Cement
-ASTM C1644	Standard Specification for Resilient Connectors Between Reinforced Concrete On-Site Wastewater Tanks and Pipes
-ASTM C260/C260M	Standard Specification for Air-Entraining Admixtures for Concrete
-ASTM C270	Standard Specification for Mortar for Unit Masonry
-ASTM C33/C33M	Standard Specification for Concrete Aggregates
-ASTM C361	Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
-ASTM C361M	Standard Specification for Reinforced Concrete Low-Head Pressure Pipe (Metric
-ASTM C425	Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
-ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
-ASTM C443M	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)
-ASTM C478	Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
-ASTM C478M	Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
-ASTM C700	Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
-ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
-ASTM C76M	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
-ASTM C828	Low-Pressure Air Test of Vitrified Clay Pipe Lines
-ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
-ASTM C923M	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric)
-ASTM C94/C94M	Standard Specification for Ready-Mixed Concrete
-ASTM C969	Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

-ASTM C969M	Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
-ASTM C972	Compression-Recovery of Tape Sealant
-ASTM C990	Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
-ASTM C990M	Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants (Metric)
-ASTM D1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
-ASTM D1785	Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
-ASTM D2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series
-ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
-ASTM D2412	Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
-ASTM D2464	Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
-ASTM D2466	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
-ASTM D2467	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
-ASTM D2996	Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
-ASTM D2997	Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
-ASTM D3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
-ASTM D3139	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
-ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
-ASTM D3262	"Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
-ASTM D3350	Polyethylene Plastics Pipe and Fittings Materials
-ASTM D3753	Glass-Fiber-Reinforced Polyester Manholes and Wet wells

-ASTM D3840	"Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Non-pressure Applications
-ASTM D4101	Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
-ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension
-ASTM D4161	"Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
-ASTM D624	Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
-ASTM F1417	Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
-ASTM F2736	Standard Specification for 6 to 30 in. (152 To 762 mm) Polypropylene (PP) Corrugated Single Wall Pipe And Double Wall Pipe
-ASTM F2764/F2764M	Standard Specification for 6 to 60 in. [150 to 1500 mm] Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications
-ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
-ASTM F667/F667M	Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings
-ASTM F714	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
-ASTM F758	Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
-ASTM F794	Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
-ASTM F894	Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
-ASTM F949	Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

-IAPMO Z1000	Prefabricated Septic Tanks

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA

-29 CFR 1910.27 Scaffolds and Roope Descent Systems

UNI-BELL PVC PIPE ASSOCIATION (UBPPA

-UBPPA UNI-B-6 Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

Submittals:
1. Cement type for manholes and pipe.
2. Pipe manufacturer information

Products:
1. Pipe: PVC, cement line ductile iron.
2. Manholes: Pre-cast reinforced concrete according to ASTM C478.
3. Manhole frames, covers, grates: gray cast iron with “sanitary sewer” cast in the cover.
4. Manhole steps – Polypropylene encased steel designed for personnel access and safety.

Execution:
1. Provide deflection and leakage testing.
2. Install according to Section 31 00 00.00 48 EARTHWORK

--- End of Section ---

SECTION 33 40 00.00 48 – STORM DRAINAGE UTILITIES

Scope:

1. Provide an operating underground storm sewer collection system outside of the building footprint. The storm sewer system shall include pipe, manholes, catch basins with frames, covers and grates.

2. Special water level control manholes and associated gates and/or valves and weirs.

References:

1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution which that may be specified in this Section.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

-AASHTO HB-17	Standard Specifications for Highway Bridges
-AASHTO M 167M/M 167	Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
-AASHTO M 190	Standard Specification for Asphalt-Coated Corrugated Metal Culvert Pipe and Pipe Arches
-AASHTO M 219	Standard Specification for Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches
-AASHTO M 243	Standard Specification for Field-Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches
-AASHTO M 294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
-AASHTO MP 20	Standard Specification for Steel-Reinforced Polyethylene (PE) Ribbed Pipe, 300- to 1500-mm (12- to 60-in) Diameter

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

-ACI 346	Specification for Cast-in-Place Concrete Pipe

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

-AREMA Eng Man	Manual for Railway Engineering

ASTM INTERNATIONAL (ASTM)

-ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
-ASTM A48/A48M	Standard Specification for Gray Iron Castings
-ASTM A536	Standard Specification for Ductile Iron Castings

-ASTM A716	Standard Specification for Ductile Iron Culvert Pipe
-ASTM A742/A742M	Standard Specification for Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
-ASTM A760/A760M	Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
-ASTM A762/A762M	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
-ASTM A798/A798M	Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
-ASTM A807/A807M	Standard Practice for Installing Corrugated Steel Structural Plate Pipe for Sewers and Other Applications
-ASTM A849	Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
-ASTM A929/A929M	Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
-ASTM B26/B26M	Standard Specification for Aluminum-Alloy Sand Castings
-ASTM B745/B745M	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
-ASTM C1103	Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
-ASTM C1103M	Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
-ASTM C12	Standard Practice for Installing Vitrified Clay Pipe Lines
-ASTM C139	Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
-ASTM C14	Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
-ASTM C1433	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
-ASTM C1433M	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers (Metric)
-ASTM C14M	Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
-ASTM C231/C231M	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
-ASTM C270	Standard Specification for Mortar for Unit Masonry

-ASTM C32	Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
-ASTM C425	Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
-ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
-ASTM C443M	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)
-ASTM C444	Standard Specification for Perforated Concrete Pipe
-ASTM C444M	Standard Specification for Perforated Concrete Pipe (Metric)
-ASTM C478	Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
-ASTM C478M	Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
-ASTM C506	Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
-ASTM C506M	Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe (Metric)
-ASTM C507	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
-ASTM C507M	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe (Metric)
-ASTM C55	Standard Specification for Concrete Building Brick
-ASTM C62	Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
-ASTM C655	Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
-ASTM C700	Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
-ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
-ASTM C76M	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
-ASTM C828	Low-Pressure Air Test of Vitrified Clay Pipe Lines
-ASTM C877	External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
-ASTM C877M	External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections (Metric)

-ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
-ASTM C923M	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric)
-ASTM C969	Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
-ASTM C969M	Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
-ASTM C990	Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
-ASTM D1056	Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
-ASTM D1171	Standard Test Method for Rubber Deterioration - Surface Ozone Cracking Outdoors (Triangular Specimens)
-ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3
-ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
-ASTM D1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
-ASTM D1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
-ASTM D2167	Density and Unit Weight of Soil in Place by the Rubber Balloon Method
-ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
-ASTM D2729	Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
-ASTM D3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
-ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
-ASTM D3350	Polyethylene Plastics Pipe and Fittings Materials

-ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
-ASTM F1417	Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
-ASTM F2562/F2562M	Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage
-ASTM F2736	Standard Specification for 6 to 30 in. (152 To 762 mm) Polypropylene (PP) Corrugated Single Wall Pipe And Double Wall Pipe
-ASTM F2764/F2764M	Standard Specification for 6 to 60 in. [150 to 1500 mm] Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications
-ASTM F2881	Standard Specification for 12 to 60 in. (300 to 1500 mm) Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications
-ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
-ASTM F679	Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F714	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
-ASTM F794	Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
-ASTM F894	Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
-ASTM F949	Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

Submittals:
1. Product data.
2. Certificates, pipe line testing, soil density, water tight joints.
3. Frame and grating load capacity.

Products:
1. Pipe: Reinforced concrete pipe according to ASTM C 76. PVC pipe according to ASTM F794. PE pipe according to ASTM F714
2. Manholes and catch basins: Pre-cast reinforced concrete according to ASTM C 478.
3. Manhole castings, catch basins, frames, covers and grates: Grey cast iron with utility type cast in covers. The words “storm sewer” shall be cast into the cover.

4. Manhole steps: Polypropylene encased steel design and for personnel access and safety.

5. Select granular material

Execution: 1. . Provide deflection and leakage testing.

2. Backfill trenches according to Section 31 00 00.00 48 EARTHWORK as is required to meet the foundation requirements of any surface features

--- End of Section ---

SECTION 33 46 13.00 48 – FOUNDATION DRAINAGE SYSTEM

Scope:

1. Provide a foundation drainage system for building foundations.
2. Design of drainage system shall comply with foundation investigation recommendations.
3. Coordinate construction with structural and backfill specifications.
4. System will be complete, including drain pipe, pervious backfill, and outlet piping necessary to install system.

References: 1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution which that may be specified in this Section.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO

-AASHTO M 252	Standard Specification for Corrugated Polyethylene Drainage Pipe
-AASHTO M 294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter

ASTM INTERNATIONAL (ASTM)

-ASTM A74	Standard Specification for Cast Iron Soil Pipe and Fittings
-ASTM A760/A760M	Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
-ASTM B745/B745M	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
-ASTM C14	Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
-ASTM C14M	Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe (Metric
-ASTM C33/C33M	Standard Specification for Concrete Aggregates
-ASTM C4	Standard Specification for Clay Drain Tile and Perforated Clay Drain Tile
-ASTM C412	Concrete Drain Tile
-ASTM C412M	Concrete Drain Tile (Metric
-ASTM C425	Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
-ASTM C444	Standard Specification for Perforated Concrete Pipe
-ASTM C444M	Standard Specification for Perforated Concrete Pipe (Metric)
-ASTM C508/C508M	Asbestos-Cement Underdrain Pipe
-ASTM C654	Porous Concrete Pipe

-ASTM C654M	Porous Concrete Pipe (Metric)
-ASTM C700	Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
-ASTM D2751	Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
-ASTM D3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
-ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
-ASTM F667/F667M	Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings
-ASTM F758	Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
-ASTM F949	Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

Submittals: 1. Foundation Drain System design basis and system layout.

Products:
1. Concrete pipe, cast iron soil pipe, perforated concrete pipe, corrugated polyethylene drainage pipe, PVC with slots or openings sized to prevent migration of soil particles into the drain pipe.
2. Pervious backfill according to State Department of Transportation specifications.
3. Protective covering to preserve pervious backfill.

Execution: 1. Foundation drainage shall be furnished and installed as a complete system in accordance with all specifications.

--- End of Section ---

SECTION 33 46 16 – SUBDRAINAGE PIPING

Scope:

1. Subdrainage piping

References:

1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution which that may be specified in this Section.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

- AASHTO M 190	Standard Specification for Asphalt-Coated Corrugated Metal Culvert Pipe and Pipe Arches
-AASHTO M 252	Standard Specification for Corrugated Polyethylene Drainage Pipe
-AASHTO M 288	Standard Specification for Geosynthetic Specification for Highway Applications

ASTM INTERNATIONAL (ASTM)

-ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
-ASTM A27/A27M	Standard Specification for Steel Castings, Carbon, for General Application
-ASTM A47/A47M	Standard Specification for Ferritic Malleable Iron Castings
-ASTM A48/A48M	Standard Specification for Gray Iron Castings
-ASTM A760/A760M	Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
-ASTM A762/A762M	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
-ASTM A798/A798M	Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
-ASTM B745/B745M	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
-ASTM C136/C136M	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
-ASTM C33/C33M	Standard Specification for Concrete Aggregates
-ASTM C478	Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
-ASTM C478M	Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)

-ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
-ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
-ASTM D3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
-ASTM D3753	Glass-Fiber-Reinforced Polyester Manholes and Wetwells
-ASTM D4632/D4632M	Grab Breaking Load and Elongation of Geotextiles
-ASTM F758	Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
-ASTM F949	Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

Submittals:

1. Certificates
   - Geotextile
   - Pipe and Pipe Fittings

Products:

1. Pipe for subdrains
   - Submit samples of pipe and pipe fittings, before starting the work. Provide type and sizes of subdrain pipe indicated. Submit certifications from the manufacturers attesting that materials meet specification requirements. Certificates are required for drain pipe and fittings.

Execution:

1. Installation of geotextile and pipe for subdrains
   - Installation of Geotextile

   - Trench Lining and Overlaps
     Grade trenches to be lined with geotextile to obtain smooth side and bottom surfaces so that the geotextile will not bridge cavities in the soil or be damaged by projecting rock. Lay the geotextile flat but not stretched on the soil and secure it with anchor pins in accordance with manufacturer's instructions. Overlap at least 6 to 12 inches, and secure with anchor pins along the overlaps.

   - Pipelaying
     Install pipe in accordance with the manufacturer's recommendations

--- End of Section ---

SECTION 33 51 15.00 48 – NATURAL GAS / LIQUID PETROLIUM GAS DISTRIBUTION

Scope:

1. Provide piping and controls for a gas distribution system on site and outside of the building footprint to the gas main.
2. Provide and install gas service pipe from the main to the building, provide meter manifold and work from meter into the building.
3. Coordinate site work with gas utility.

References:

1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution which that may be specified in this Section.

AMERICAN GAS ASSOCIATION (AGA)

-AGA ANSI B109.1	Diaphragm Type Gas Displacement Meters (Under 500 cubic ft./hour Capacity)
-AGA ANSI B109.2	Diaphragm Type Gas Displacement Meters (500 cubic ft./hour Capacity and Over)
-AGA ANSI B109.3	Rotary-Type Gas Displacement Meters
-AGA ANSI B109.4	Self-Operated Diaphragm-Type Natural Gas Service Regulators for Nominal Pipe Size 1¼ inches (32 mm) and Smaller with Outlet Pressures of 2 psig (13.8 kPa) and Less
-AGA XR0603	AGA Plastic Pipe Manual for Gas Service

AMERICAN PETROLEUM INSTITUTE (API)

-API Spec 5L	Line Pipe
-API Spec 6D	Specification for Pipeline and Piping Valves
-API Std 1104	Welding of Pipeline and Related Facilities

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

-ASCE 25-16	Earthquake-Activated Automatic Gas Shutoff Devices

AMERICAN WATER WORKS ASSOCIATION (AWWA)

-AWWA C203	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
-AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

ASME INTERNATIONAL (ASME)

-ASME B1.20.1	Pipe Threads, General Purpose (Inch)
-ASME B1.20.2M	Pipe Threads, 60 Deg. General Purpose (Metric)
-ASME B16.11	Forged Fittings, Socket-Welding and Threaded
-ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
-ASME B16.34	Valves - Flanged, Threaded and Welding End
-ASME B16.39	Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
-ASME B16.40	Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems
-ASME B16.5	Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
-ASME B16.9	Standard for Factory-Made Wrought Steel Buttwelding Fittings
-ASME B31.8	Gas Transmission and Distribution Piping Systems
-ASME BPVC SEC VIII D1	BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1
-ASME PTC 25	Pressure Relief Devices

ASTM INTERNATIONAL (ASTM)

-ASTM A181/A181M	Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
-ASTM A333/A333M	Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service and Other Applications with Required Notch Toughness
-ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
-ASTM D2513	Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
-ASTM D2683	Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
-ASTM D2774	Underground Installation of Thermoplastic Pressure Piping
-ASTM D3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
-ASTM D3308	Standard Specification for TFE Resin Skived Tape
-ASTM F1802	Standard Test Method for Performance Testing of Excess Flow Valves
-ASTM F2138	Standard Specification for Excess Flow Valves for Natural Gas Service

-ASTM F2786	Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Gaseous Media Under Pressure (Pneumatic Leak Testing)

CSA GROUP (CSA)

-ANSI LC 1/CSA 6.26	Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing (CSST)
-CSA/AM ANSI Z21.93/CSA 6.30	Excess Flow Valves for Natural and LP Gas with Pressures up To 5 psig

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

-MSS SP-110	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
-MSS SP-25	Standard Marking System for Valves, Fittings, Flanges and Unions
-MSS SP-72	Ball Valves with Flanged or Butt-Welding Ends for General Service
-MSS SP-78	Cast Iron Plug Valves, Flanged and Threaded Ends

MASTER PAINTERS INSTITUTE (MPI)

-MPI 10	Latex, Exterior Flat (MPI Gloss Level 1)
-MPI 11	Latex, Exterior Semi-Gloss, MPI Gloss Level 5
-MPI 119	Latex, Exterior, Gloss (MPI Gloss Level 6)
-MPI 9	Alkyd, Exterior Gloss (MPI Gloss Level 6)

NACE INTERNATIONAL (NACE)

-NACE SP0185	Extruded Polyolefin Resin Coating Systems with Soft Adhesives for Underground or Submerged Pipe
-NACE SP0274	High Voltage Electrical Inspection of Pipeline Coatings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

-NFPA 54	National Fuel Gas Code
-NFPA 58	Liquefied Petroleum Gas Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

-SSPC 7/NACE No.4	Brush-Off Blast Cleaning
-SSPC Paint 25	Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
-SSPC SP 1	Solvent Cleaning
SSPC SP 3	Power Tool Cleaning
-SSPC SP 6/NACE No.3	Commercial Blast Cleaning

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

-49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

UNDERWRITERS LABORATORIES (UL)

-UL FLAMMABLE & COMBUSTIBLE	Flammable and Combustible Liquids and Gases Equipment Directory

Submittals:
1. Equipment list.
2. Spare parts list.
3. Schedule for connection to the in-place lines.
4. Qualification welder, jointers, inspectors, training.
5. Gas tie-in procedures.
6. O&M data.

Products:
1. Conduit: polyethylene pipe or steel pipe with protective coating and cathodic protection.
2. Valves: according to and compatible with piping system type.
3. Meters: Gas utility will provide and install the meter at the building.
4. Marker Tape and Tracking Wire: according to State pipeline safety requirements

Execution:
1. Comply with gas utility requirements

--- End of Section ---

SECTION 33 51 16.00 48 – ADVANCED NATURAL GAS METER SPECIFICATION
(This specification was created from Army Reserve criteria dated 12MAR2008)

General specifications for all meters

Quantity Measured:	Cubic Feet of Natural Gas
Measurement Configuration:	Natural Gas service to a building. For buildings that already have a gas meter with a pulse output, ensure that the pulse output is connected to a data gathering device (i.e. electric meter). For buildings where a natural gas meter already exists but does not have a pulse output, add a pulse kit to the existing meter and tie the output to a data gathering device. If the existing gas meter will not accept a pulse kit or if no meter exists a new natural gas meter will be installed, also requiring a pulse output to a data gathering device. Ensure the pulse frequency and electronic characteristics are compatible with the existing data gathering device, if any.
Operating Temperatures:	-40 degrees F to +150 degrees F.
Humidity Operating Range:	5% to 90% RH (non-condensing)
Accuracy:	± 1% of scale.
Pulse Frequency:	Not less than two pulses per revolution. Meter pulser shall be coupled to the meter dial to provide a pulse rate of not less than one pulse for every 100 cubic feet of gas.

For non-LonWorks meter applications

Digital Output Only:	Pulse Output

For LonWorks meter applications

Digital Output Only:	Pulse Output

NOTE: Gases are more difficult to measure than liquids, as measured volumes are highly affected by temperature and pressure. Gas meters measure a defined volume, regardless of the pressurized quantity or quality of the gas flowing through the meter. Temperature, pressure and heating value compensation must be made to measure actual amount and value of gas moving through a meter.

Natural Gas Meters shall be the Diaphragm, Rotary, or for high volume applications Turbine type with pulse output chosen to meet the specific application.

DIAPHRAGM

ROTARY

TURBINE

METERS
Provide gas meters for the natural gas service line to the building.
Diaphragm Gas Meters with flow rates less than 500 cubic feet per hour shall conform to AGA B109.1. Diaphragm Gas Meters with flow rates of 500 cubic feet per hour and higher shall conform to AGA B109.2. Rotary Type Gas Meters shall conform to AGA B109.3. Turbine Type Gas Meters shall conform to ASME MFC-4M. Meters shall be pipe or pedestal mounted and be provided with a strainer immediately upstream. Meters shall be provided with over-pressure protection as specified in ASME B31.8. Include tamper-proof protection, frost protection and fungus-proof protection as applicable. Meters shall be suitable for accurately measuring and handling gas at pressures, temperatures, and flow rates present. Meters shall have a pulse switch initiator capable of operating up to speeds of 500 pulses per minute with no false pulses and shall require no field adjustments or calibration. Initiators shall provide the maximum number of pulses up to 500 per minute that is obtainable from the manufacturer. The minimum pulse rate shall not be less than one pulse per 100 cubic feet of gas.

Valves and pressure regulators are necessary at all points where pressure reduction or regulation is required by the user. Install a shut-off valve upstream of the regulator and both upstream and downstream of the meter. Provide a gas meter bypass line with a lockable valve for buildings with critical service.

VALVES
Valves shall be suitable for shutoff or isolation service and shall conform to the following:
Steel valves 1-1/2 inches and smaller installed aboveground shall conform to ASME B16.34, carbon steel, socket weld or threaded ends with handwheel or wrench operator. Steel valves 2 inches and larger installed aboveground shall conform to API Spec 6D, carbon steel, buttweld or flanged ends, with handwheel or wrench operator.

SERVICE LINE REGULATORS
Pressure regulators for individual service lines shall have ferrous bodies. Regulator shall be capable of reducing distribution line pressure to pressures required for users. Regulators shall be provided where gas will be distributed at pressures in excess of 10 inches of water column. Pressure relief shall be set at a lower pressure than would cause unsafe operation of any connected user. Regulator shall have single port with orifice diameter no greater than that recommended by the manufacturer for the maximum gas pressure at the regulator inlet. Regulator valve vent shall be of resilient materials designed to withstand flow conditions when pressed against the valve port. Regulator shall be capable of regulating downstream pressure within limits of accuracy and shall be capable of limiting the buildup of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Regulator shall have a self contained service regulator. Regulator pipe connections shall not exceed 2 inch size.

EARTHQUAKE ACTUATED AUTOMATIC GAS SHUTOFF SYSTEM
Include earthquake actuated automatic gas shutoff system if the facility is either essential or hazardous. The designer will determine the classification of the facility and provide a detail on the drawings showing this system. ASCE 25-97 EARTHQUAKE ACTUATED AUTOMATIC GAS SHUTOFF DEVICES, includes a test procedure to verify that the valve will activate during strong ground shaking but will not activate for minor ground shaking or accidental bumping by a
pedestrian or vehicle. The State of California, Division of the State Architect/Real Estate Services Division maintains a list of devices that have been tested and conform to the ASCE Standard; inquiries can be directed to telephone no. 916-445-2600. Show the earthquake actuated automatic gas shutoff on the drawings when required in the project. Earthquake Actuated Automatic Gas Shutoff devices shall conform to requirements furnished by the Contracting Officer, and shall be listed by the State of California, Division of the State Architect as being
tested and in conformance with specified requirements. The system shall safely interrupt the flow of gas to the building due to strong ground shaking of an earthquake.

End of General Section

EXECUTION:

A shutoff valve, meter set assembly, and service regulator shall be installed on the service line outside the building, 18 inches above the ground on the riser. An insulating joint (dielectric connection) shall be installed on the inlet side of the meter set assembly and service regulator and shall be constructed to prevent flow of electrical current. A 3/8 inch tapped fitting equipped with a plug shall be provided on both sides of the service regulator for installation of pressure gauges for adjusting the regulator. All service regulator vents and relief vents shall terminate in the outside air in rain and insect resistant fittings. The open end of the vent shall be located where gas can escape freely into the atmosphere, away from any openings into the building and above areas subject to flooding.

Meters shall be installed in accordance with ASME B31.8. Permanent gas meters shall be installed with provisions for isolation and removal for calibration and maintenance, and shall be suitable for operation in conjunction with an energy monitoring and control system.

Contractor shall provide materials for the connections to the existing gas lines. Final connections and the turning on of gas shall be made by the utility. The Contractor shall notify the Contracting Officer, in writing, 10 days before final connections and turning on of gas lines. The Contractor shall make necessary arrangements with the Utility for tie in and activation of new gas lines. Only the Operating Agency/Utility Company may reactivate the system after tie in. The Contractor shall furnish a certification by the Operating Agency/Utility Company that all Utility work has been satisfactorily completed.

Connection to Government Owned/Operated Gas Lines
Provide the name and location of the utility or operating agency of the existing gas lines. Show on the drawings, the location of valves to be operated for existing system deactivation. The Contractor shall provide connections to the existing gas lines in accordance with approved procedures. Reactivation of any existing gas lines will only be done by the Government. The Contractor's Connection Plan shall be submitted and approved prior to making any connections to existing gas lines. This plan shall include the Operating Agency's required procedures which may be obtained from the Contracting Officer. The Contractor shall notify the Contracting Officer, in writing, 10 days before connections to existing lines are to be made.

Pressure and Leak Tests
Prior to returning the gas line back to service it shall be tested in accordance with ASME B31.8. Test pressures should recognize the weakest component of each system tested for the actual pressure, the maximum allowable operating pressure, and the gas supplier's maximum operating pressure. The test pressure will be 150 percent of the maximum operating pressure or 50 psig, whichever is greater. However, the maximum test pressure must not be more than three times the design pressure of the pipe.
The service lines shall be tested after modifications and before being placed in service using air as the test medium. Prior to testing the system, the interior shall be blown out, cleaned and cleared of all foreign materials. All meters, regulators, and controls shall be removed before blowing out and cleaning and reinstalled after clearing of all foreign materials. Testing of gas
service lines shall be done with due regard for the safety of employees and the public during the test. Persons not working on the test operations shall be kept out of the testing area while testing is proceeding. The test shall be made on the system as a whole or on sections that can be isolated. The test shall continue for at least 24 hours from the time of the initial readings to the final readings of pressure and temperature. The initial test readings of the instrument shall not be made for at least 1 hour after the pipe has been subjected to the full test pressure, and neither the initial nor final readings shall be made at times of rapid changes in atmospheric conditions. The temperatures shall be representative of the actual trench conditions. There shall be no indication of reduction of pressure during the test after corrections have been made for changes in atmospheric conditions in conformity with the relationship T(1)P(2)=T(2)P(1), in which T and P denote absolute temperature and pressure, respectively, and the numbers denote initial and final readings. During the test, the entire system shall be completely isolated from all compressors and other sources of air pressure. Each joint shall be tested by means of soap and water or an equivalent nonflammable solution prior to backfilling or concealing any work. The testing instruments shall be approved by the Contracting Officer. All labor, materials and equipment for conducting the tests shall be furnished by the Contractor and shall be subject to inspection at all times during the tests. The Contractor shall maintain safety precautions for air pressure testing at all times during the tests.

Gas distribution equipment shall be installed in accordance with all applicable federal, state and local codes and regulations. Gas distribution equipment shall be installed in conformance with the manufacturer's recommendations and applicable sections of ASME B31.8, AGA XR0104 and 49 CFR 192. Gas distribution equipment installed in areas where they will be subject to damage will be protected by appropriate physical barriers (i.e. bollards). The Contractor shall provide installation details including catalog cuts and installation drawings for each gas service to be modified for approval by the Contracting Officer or the Contracting Officer’s Representative.

--- End of Section ---

SECTION 33 70 02.00 48 ELECTRICAL DISTRIBUTION SYSTEM

Scope:
1. Provide underground, high-voltage distribution systems including primary overcurrent protection and disconnecting means, switchgear, transformers, conduit, conductors, surge protection, manholes, equipment, and accessories required for complete systems.
2. Equipment shall be rated for the applicable voltage class, and application shall be in accordance with manufacturer's recommendations.
3. System design and equipment specifications shall be in accordance with the requirements of the military installation or the electric service provider as applicable.

References:
1. The publications referenced below establish minimum requirements for materials, systems, and execution that may be specified in this Section.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS8	Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

ASTM INTERNATIONAL (ASTM)

ASTM B 231/B 231M	Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B 3	Soft or Annealed Copper Wire
ASTM B 609/B 609M	Standard Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical purposes
ASTM B 8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 800	8000 Series Aluminum Alloy Wire for Electrical Purposes-Annealed and Intermediate Tempers

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	National Electrical Safety Code
IEEE C37.20.3	Metal-Enclosed Interrupter Switchgear
IEEE C57.12.34	Requirements for Pad-Mounted, Compartmental-Type, Self-Coated, Three-Phase Distribution Transformers
IEEE C62.11	Metal-Oxide Surge Arresters for Alternating Current Power Circuits
IEEE Std 386	Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV
IEEE Std 48	Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1072	Medium-Voltage Power Cables

Submittals:
1. Shop drawings.
2. Test reports.

Products:
1. Underground cables shall be type MV conforming to NFPA 70 and UL 1072 with conductors of copper complying with ASTM B3, B8 and insulation conforming to CS8. Shielding shall be in accordance with IEEE C2. Provide PVC or polyethylene jacket.
2. Manholes shall be designed and sized for the application to provide adequate space for installed cables and equipment and to allow for growth, as well as providing adequate working space.
3. Pad-mounted transformers shall comply with IEEE C57.12.34 and shall be of the loop feed type. The high-voltage compartment shall be dead-front construction with primary switching and protective devices as required.
4. Pad-mounted, metal-enclosed switchgear shall comply with IEEE C37.20.3 and shall be equipped and configured to suit the application.
5. Surge arresters shall comply with IEEE C62.11 and shall be of the class and rating appropriate for the application.

Execution:
1. Cable shall be installed in conduit and concrete-encased where required by the military installation or electric service provider.
2. Manholes shall be located based on careful consideration of other utilities, access, grading, and paving.
3. Pad-mounted equipment shall be installed on reinforced concrete pads sized to properly support the equipment and with grounding in accordance with NFPA 70 and IEEE C2.

--- End of Section ---

SECTION 41 22 00.00 48 HOISTS AND CRANES

Scope: 1. Top running or underhung single or double girder: bridge electric overhead traveling crane utilizing under-running trolley hoists, monorail hoists, and jib cranes, suitable for interior and exterior use in hazardous or nonhazardous environments.

References:1. The publications referenced above (or below) establish minimum requirements for materials, systems and execution that may be specified in this Section.

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA Std 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA Std 11	Load Ratings and Fatigue Life for Roller Bearings

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC Pub No. S329	Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	Rigid Steel Conduit - Zinc Coated
ANSI MH27.1	Cranes and Monorail Systems, Underhung

ASTM INTERNATIONAL (ASTM)

ASTM B633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM E10	Standard Test Method for Brinell Hardness of Metallic Materials
ASTM F3125/F3125M	Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120ksi and 150 ksi Minimum Tensile Strength and Metric Dimensions 830 MPa and 1040 MPa Minimum tensile

ASME INTERNATIONAL (ASME)

ASME B30.16	Overhead Hoists (Underhung)
ASME HST-1M	Electric Chain Hoists
ASME HST-4M	Overhead Electric Wire Rope Hoists

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	Structural Welding Code - Steel
AWS D14.1	Welding Industrial and Mill Cranes and Other Material Handling Equipment

MATERIAL HANDLING INDUSTRY OF AMERICA (MHI)

MHI CMAA 74	Top Running and Under Running, Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	Industrial Control and Systems: Enclosures
NEMA KS 1	Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

NEMA WC 3	Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 50	Enclosures for Electrical Equipment
UL 355	Cord Reels
UL 674	Electric Motors and Generators for Use in Division I Hazardous (Classified) Locations

General Requirements:

1. Materials and equipment shall be standard products of manufacturers regularly engaged in the fabrication of cranes and hoists and shall essentially duplicate items which have been in satisfactory use for at least 2 years prior to bid opening. Any company licensed by a crane and hoist manufacturer to manufacture cranes and hoists bearing their name shall have the design and components approved by the licensor prior to submission to the Government for approval.
2. Nameplates: Each major component of equipment shall have the manufacturer's name, address, type or style, model or catalog number, and serial number on a metal plate secured to the equipment.
3. Welding: Bridge Cranes: Welding shall be in accordance with qualified procedures using AWS D14.1 as modified herein. Written welding procedures shall specify the Contractor's standard dimensional tolerances for deviation from camber and sweep and such tolerances shall not exceed those specified in AWS D14.1. All welding shall be performed indoors. Welders and welding operators shall be qualified in accordance with AWS D1.1 or AWS D14.1. Allowable stress values shall be in accordance with MHI CMAA 74.
4. Design Criteria: The crane(s) shall be designed to operate in the spaces and match the runway dimensions and rails indicated. The hook coverage and hook vertical travel shall not be less than that indicated.
5. Classification: The crane shall be designed and constructed to MHI CMAA 74 [Class H4, moderate duty] [ ] service requirements for operation in indoor nonhazardous environment. The hoist shall be designed and constructed to ASME HST-1M and ASME HST-4M, [Class Moderate Duty] [ ], service requirements for operation in nonhazardous environment.
6. Hoist Characteristics: Hoist shall be an electric-wire-rope hoist of type, class, control, suspension, lift, and operating characteristics specified. Each hoist shall have the capacity, lift-height, suspension, power source, and operating characteristics indicated and as follows:
   a. Hoist capacity shall be [ ] tons.
   b. Hoist shall be a standard lift with a minimum lift of [ ] ft..
   c. The hoist for the bridge cranes shall be tractor mounted with a motor-driven tractor-trolley unit.
   d. The hoist and suspension shall be the standard headroom type.
   e. Components of the hoist shall be designed and constructed for safety of operation and durability of components. Replacement parts shall be interchangeable and readily accessible.
7. Bridge Crane Characteristics: The bridge crane shall be top running single-girder overhead traveling crane utilizing an underrunning trolley hoist. Bridge crane travel speed shall be 1.7 [ ] ft/s.
8. Capacity Plates: Two capacity plates shall be provided, one for each side of the bridge. Each plate shall be lettered to indicate the total rated hoisting capacity of the crane. All lettering shall be of sufficient size to be easily read from the floor. Each lower load block shall be marked with the hoist rated capacity. Rated load of the hoist on the monorail shall be marked in accordance with ASME B30.16.

Definitions:
1. Capacity: Capacity shall mean the rated load in pounds, or tons of 2,000 pounds each, specified by the manufacturer for the hoist and marked plainly on the hoist and loadblock so as to be clearly legible. In determining the applied load, the weight of the handling devices shall be included.
2. Hoisting Speed: Hoisting speed shall mean the velocity in mm/s at which the hoist will lift the rated load. Actual lifting speed shall be within plus or minus 10 percent of the manufacturer's rating.
3. Bridge Crane Travel Speed: Bridge crane travel speed shall mean the velocity in mm/s at which the bridge crane will travel carrying with the rated load. Actual travel speed shall be within plus or minus 10 percent of the manufacturer's rating.
4. Rated Lift: Rated lift shall mean the distance between the upper and lower elevations of travel of the load block.
5. Headroom: Headroom shall be measured with the load hook in the highest position with full load which is the distance between the saddle of the load hook and the following points:
   a. The bottom of the beam when S-shape runways are used.
   b. The top of the bottom flange for all flat, wheel-bearing flange surfaces.
6. Trolley Speed: Trolley speed shall mean the velocity in mm/s at which a motor-driven trolley with hoist will travel carrying the rated load on level track; actual speed shall be within plus or minus 10 percent of the manufacturer's rating.

Submittals:
1. General Requirements: Materials and equipment shall be standard products of manufacturers regularly engaged in the fabrication of cranes and hoists and shall essentially duplicate items which have been in satisfactory use for at least 2 years prior to bid opening. Any company licensed by a crane and hoist manufacturer to manufacture cranes and hoists bearing their name shall have the design and components approved by the licensor prior to submission to the Government for approval.
2. Shop Drawings:
   a. Wiring and Schematic diagrams; Detailed drawings shall be submitted containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout, anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.
3. Product Data:
   a. Record of hook material and any heat treatment performed shall be submitted and shall be stamped on the hook shank or documented in certification papers furnished with the hooks.
   b. Bridge Crane System; A complete list of equipment and materials, including manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions shall be submitted.
   c. Hoist; Manufacturer's catalog data shall be submitted showing the equipment and accessories to be provided. Diagrams, instructions, and other sheets proposed for posting shall be submitted.
   d. Spare Parts; Spare parts data shall be submitted and shall include a complete list of parts and supplies, with current unit prices and source of supply.
   e. Bridge Crane System; Diagrams, instructions, and other sheets proposed for posting shall be submitted.
4. Test Reports:
   a. Electrification System Tests; Results of electrification system tests shall be submitted.
   b. Acceptance Testing; Test reports in booklet form shall be submitted showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. The report shall include the information as required by paragraph ACCEPTANCE TESTING.
5. Certificates:

a. Certification shall be submitted attesting that each hoist, hoist trolley and track, and hoist control has been factory tested for rated load capacity and operation, and that each hoist complies with the requirements specified.
b. Motor Controller; Certified results of thermal monitoring of motor components during tests shall be submitted.
c. Certification shall be submitted attesting that electric hoists, trolleys, wiring, contact conductors, controls, overcurrent protection, and grounding conform to NFPA 70 and to UL standards. The label or listing with reexamination by the UL will be accepted as evidence that the materials conform to this requirement and to NFPA 70. Certification shall be submitted attesting that each hoist, hoist trolley and track, jib framework, and hoist control has been factory tested for rated load capacity and operation, and that each hoist complies with the requirements specified.

6. Operation and Maintenance Data:
   a. Operations and Maintenance Manuals will be submitted in accordance with the requirements of EQUIPMENT OPERATING, MAINTENANCE, AND REPAIR MANUALS. Operation Manuals; Six copies of operation manuals shall be furnished for the equipment furnished. Operation manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operation manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their operating features. Operation manuals shall include a copy of the acceptance test report for information and future reference. Operation manuals shall include an overall description of the system describing any unique features that may need special attention.
   b. Maintenance Manuals; Six copies of maintenance manuals shall be furnished for the equipment furnished. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping, layout diagrams, equipment layout diagrams, and wiring and control diagrams of the system as installed. Maintenance manuals shall include a spare parts list of manufacturers recommended spare parts that should be maintained onsite and any long lead time items should be clearly identified. Maintenance manuals shall contain replacement part numbers for the entire assembly.

Products:

1. Electric Hoist:
   a. Electric hoist shall be of capacity, lift, type, suspension, headroom, and materials specified. Each unit shall be factory wired and ready for operation. Load-carrying parts of the hoist shall be designed so that the calculated static stress of the material, based on the rated capacity, will not exceed 20 percent of the average theoretical strength of the material. Each hoist shall be factory lubricated and shall be complete and ready for operation with the specified hoist controls and accessories.
   b. Electric Wire-Rope Hoists: Electric wire-rope hoists shall be equipped with the specified standard wire-rope and hook assembly with no corroding or sparking requirements.
   c. Hoist Speed: Each electric wire-rope hoist speed shall be approximately 4 inches/sec.
   d. Load and Motor Brakes: Load brake shall be a totally enclosed, automatic, mechanical-type brake with a hardened-steel, Weston-type ratchet and pawl mechanism that will hold the capacity load of the hoist at any point when the motor is stopped. Motor brakes are specified in paragraph MOTOR BRAKE.
2. Hoist Mechanical Equipment:
   a. Wire-Rope Hoist: Wire rope for standard applications shall be extra flexible, preformed, extra improved or improved plow steel, 6 by 37 fiber core sealed construction wire conforming to FS RR-W-410, Type I, Class 3.
   b. Wire rope shall be anchored to drum or dead end. Anchoring shall be of captive type, easily detached for changing and repair. Wire rope shall have a factor of safety of not less than 5, based on the minimum ultimate tensile strength of the material.
3. Hoist-Rope Drum: Wire-rope drum shall be hardened steel or special grade alloy ductile iron. Minimum diameter of the drum shall be 20 times the diameter of the hoisting rope for hoists with a capacity of 2000 lb. or less and 24 times the diameter of the hoisting rope for hoists over

2,000-pound capacity. Drum shall have accurate, machine-cut grooves, cut to full depth of wire-rope diameter, with rounded corners of dimension as required for the specified lift. In addition, the drum shall have not less than two complete turns of rope around it when the hook is in its lowest position. Groove diameter and pitch centers shall be 0.03 inches greater than diameter of rope. Drum shall be flanged at each end and shall have enclosed tops and sides to preclude cable binding and jamming. Cable reeving shall be arranged for double reeving. Hook shall remain centered under the drum at all times.

4. Hoist Load Block and Sheaves: The cable load block shall be an enclosed, safety type that will shroud the sheave and protect the operator. The sheave assembly shall be mounted on a steel axle and carried on sealed, prelubricated antifriction bearings. Wire-rope sheaves shall be machine-grooved, hardened steel, or cast iron with chilled groove surfaces. The pitch diameter for running sheaves shall be not less than 18 times the diameter of the wire rope, and the diameter of the idler and equalizer sheaves shall be not less than 16 times the diameter of the rope used.
5. Hoist Hook Assembly:
   a. Hooks and hook swivels shall be heat-treated alloy steel forgings. Yokes, crossheads, and bars shall be of suitable strength steel or cast iron.
   b. Hook assembly for electric- or air-operated hoists shall be carried on antifriction bearings to permit free swivel under rated capacity load without twisting load chain or wire. Each hook shall have a spring-loaded safety latch. Each hook assembly shall include a machined and threaded shaft and swivel locknut with an effective locking device to prevent nut from backing off
   c. Hoist Gear Assembly:
      1) Gears: Gears shall be spur, helical, spiral, or bevel-type, accurately machined, and conforming to AGMA standards for this type of service.
      2) Gear Shafts: Gear shafts shall be manufactured from high-carbon steel or alloy steel, machined and ground for accurate fit, and splined for fitting to the mating gear.
      3) Gear Train Assembly: Gear train assembly shall be totally enclosed in the hoist frame casting and shall operate in a sealed oil bath. Frame casting shall be provided with lubrication fittings and inspection ports.
   d. Hoist Bearings:
      1) Antifriction Bearings: Bearings in the hoist mechanism of electric- or air-powered hoists shall be antifriction bearings.
      2) Factory Sealed Bearings: Sprocket bearings, motor bearings, and load-block bearings shall be prelubricated factory sealed bearings.
   e. Hoist Lubrication: Adequate lubrication shall be provided for moving parts of the hoist and trolley and for filling, draining, and checking the level of the lubricant. Lubricant shall be designed for use in an ambient temperature of 54 to 109 degrees F. Hoist reduction gearing, load brake, and trolley wheel gears with electric motor drive shall operate in an oil bath. Lubrication and mechanism housing shall prevent leaking and shall prevent lubricant from coming into contact with electric motors and equipment. Lubricant shall conform to AGMA 9005-D.
   f. Hoist Frame and Housing: Operating parts of the hoist shall be mounted and enclosed in a sealed, factory-painted metal frame of malleable iron, cast steel, welded steel, or aluminum. Welded or bolted frames shall carry loads on the fabricated pieces. Welds or bolts shall be used only to hold the fabricated parts in position.
   g. Hoist Paint Finish: Each hoist and accessory shall receive a factory-applied paint finish. Hooks shall not be painted.
6. Trolleys:
   a. Paint: Each trolley assembly shall be factory-painted, designed specifically for use with the specified hoist, and shall be furnished by the hoist manufacturer. Paint finish shall be the same type and quality specified for the hoist.

7. Wheels:

a. Load Distribution: Each trolley assembly shall have not less than four wheels. Sufficient wheels shall be provided to properly distribute the load. The load on a wheel shall not exceed where D equals the diameter of the wheel in and W equals the width of the rail head or the nominal length of bearing on the tread.
b. Design and Type: Wheels shall be single-flange type manufactured from forged alloy steel with machined, hardened treads and flanges, or high-strength cast or nodular iron with machined flanges and treads, chill-hardened not less than 1/16 inch deep. Flanged wheels for motor-driven trolleys shall have treads and flanges hardened to not less than No. 320 Brinell hardness. Manually driven, trolley-wheel treads shall be hardened to not less than Brinell hardness No. 245 as defined in ASTM E 10. Wheels shall be designed to operate on sloped or flat flange I-beams.
c. Bearings: Trolley wheels shall be carried on sealed, permanently lubricated, antifriction bearings designed for axial and thrust loading. Bearings shall conform to the applicable requirements of ABMA Std 9 and ABMA Std 11. Bearings shall have an L-10 life of 3,000 hours or more, as defined by ABMA Std 9 or ABMA Std 11 as applicable.

8. Side Plates, Pins, and Axles
   a. Side Plates: Side plates shall be fabricated from structural-quality rolled-steel plate milled to the required profile with integral bosses where necessary to support equalizing pins; side plates shall be fitted with steel end bumpers.
   b. Pins and Axles: Equalizing pins and axles shall be heat-treated alloy steel, machined and finish ground to the required size.
9. Gearing:
   a. Gears: Gears shall be cut from heat-treated alloy steel accurately machined into spur, helical, and pinion gears, conforming to AGMA requirements.
   b. Drive Pinions: Drive pinions shall be carburized alloy steel, malleable iron, or bronze, with cut or cast teeth, conforming to AGMA requirements.
   c. Clamps: Plain trolleys and geared, manual-drive trolleys shall have suitable, quick-acting, steel track clamps. Clamps shall be adjustable for wear and shall not injure track flanges. They shall function satisfactorily on curved and straight track and shall be capable of withstanding a pull equivalent to one-third the rated capacity of the hoist when executed parallel to the track.
10. Safety Hangers or Lugs: Safety hangers or lugs shall be steel and shall be integral with, or fastened to, each hoist frame or to trolley frame. They shall ride free above the bottom flange of the beam. Hanger shall be of sufficient capacity to hold the hoist, fully loaded, in the I-beam in case of wheel or axle failure. Safety factor of each part of trolley assembly shall be not less than 5, based on the ultimate strength of the material used.
11. Electric-Motor-Driven Trolleys:
    a. Trolley shall be an electric-motor-driven geared type conforming to NFPA 70, the specified general trolley requirements, and the requirements specified.
    b. Trolley drive shall be an electric-motor-driven, tractor type conforming to the specified general trolley requirements. Motor shall drive through a totally enclosed gear train to an adjustable-tension, spring-loaded, rubber-tired, drive wheel. Trolley wheels shall be the flangeless type, carried on the specified type of antifriction bearings. Tractor frame shall include two guide rollers on each side of the frame, carried on sealed, permanently lubricated antifriction bearings.
    c. Trolley speed shall be not more than 10 inches/s.

12. Bridge Structural Items:
    a. Bolts, Nuts, and Washers: Bolts, nuts, and washers shall conform to ASTM F3125 GradeA 325 bolts. High-strength bolted connections shall conform to the requirements of AISC Pub No. S329, except that ASTM F3125 A Grade 490 bolts shall not be used. No galvanized bolts shall be used.
    b. Bridge Girders: Bridge girders shall be welded structural steel box sections, wide-flange beams, standard I-Beams, reinforced beams or sections fabricated from rolled plates and shapes.
    c. End Ties and Bridge Girder End Connections: Horizontal gusset plates shall be provided at the elevation of the top and bottom end tie flanges for connection to girder ends. End connections shall be made using high-strength bolts. Body-bound bolts fitted in drilled and reamed holes shall be used to maintain the crane square.
    d. Bridge End Trucks: End trucks shall be fabricated from structural steel providing a rigid structure and shall be of the rotating or fixed-axle type. Jacking pads shall be provided for removal of wheel assemblies. A means shall be provided to prevent the crane from dropping more than 1 inch in case of axle failure.
    e. Runway Rails and Beams: The runway rails and beams for the bridge travel shall be of the size recommended by the crane manufacturer and shall be in accordance with MHI CMAA 74.
13 Bridge Mechanical Equipment:
    a. Bridge Drives: Bridge drives shall consist of motor or motors driving through a suitable reduction unit or units to the wheels located at each end of the bridge.
14. Bridge Crane Gear Assembly:
    a. Gears: Gears shall be spur, helical, spiral, or bevel type, accurately machined, and conforming to AGMA standards for this type of service.
    b. Gear Shafts: Gear shafts shall be manufactured from high-carbon steel or alloy steel, machined and ground for accurate fit, and splined for fitting to the mating gear.
    c. Gear Train Assembly: Gear train assembly shall be totally enclosed in the drive housing and shall operate in a sealed oil bath. The drive housing shall be provided with lubrication fittings and inspection ports.
    d. Bridge Brakes: Bridge brakes are specified in paragraph BRAKES.
    e. Bridge Wheels:
        1) Wheels: The wheels shall be made of rolled or forged steel. The wheel treads and flanges shall be rim toughened to between 320 and 370 Brinell hardness number. Bridge wheels shall be double-flanged. Bridge wheels shall have tapered treads.
        2) Bearings: Wheels shall be carried on sealed, permanently lubricated, antifriction bearings designed for axial and thrust loading. Bearings shall conform to the applicable requirements of the ABMA Std 9 or ABMA Std 11. Bearings shall have an L-10 life of 3,000 hours or more, as defined by ABMA Std 9or ABMA Std 11 as applicable.
15. Electrical: Materials and installation, including electrical wiring, contact conductors, controls, overcurrent protection, and grounding shall meet the requirements of NFPA 70 and applicable UL and NEMA standards and specified requirements.
    a. Power Supply: Electrical power for operation of the crane and hoist will be supplied from the nominal 480 volt, 3 phase, 60-Hz alternating-current (a-c) power distribution system.
    b. Bridge Incoming Power Supply
        1) Festoon Conductors - Power shall be brought to the crane by means of a "Festoon" system consisting of flexible power cable supported by cable trolleys running on a steel messenger cable, an I-beam rail, or a channel. The power cable shall be Type G, 167 degree F, 600-volt insulation and heavy-duty neoprene or chlorosulfonated polyethylene jacket. The cable shall be sized as required by NFPA 70. The cable shall conform to the applicable requirements of NEMA WC 3, Part 7, and shall have class H or class K stranding. Cable conductors shall be terminated at both ends with terminal lugs on terminal blocks in terminal boxes. Cable ends shall have strain relief devices to protect the cable terminations.

c. Trolley Power Supply: Power may be brought to the trolley by a cable reel or a festoon system.
   1) Cable reel shall be an automatic rewind assembly with four-conductor type G cables sized for the current-carrying capacity of the hoist and trolley. Reel shall have a replaceable spring or electric motor with adjustable tension and sufficient takeup for the entire cable length. Main shaft shall be carried on permanently lubricated antifriction bearings. Unit shall include a bronze brush and collector ring assembly, wired into a safety terminal block. Unit shall be listed in the UL 355. Each reel shall include a guide roller cable outlet and cable length as required. Cable reel assembly shall include a swivel-mount base that will permit the indicated turn in either direction.
   2) Festoon system shall consist of flexible power cable supported by cable trolleys running on a steel messenger cable, an I-beam rail, or a channel. The power cable shall be type G, 167-degree F, 600-volt insulation and heavy-duty neoprene or chlorosulfonated polyethylene jacket. The cable shall be sized as required by NFPA 70. The cable shall conform to the applicable requirements of NEMA WC 3, Part 7, and shall have class H or class K stranding. Cable conductors shall be terminated at both ends with terminal lugs on terminal blocks in terminal boxes. Cable ends shall have strain relief devices to protect the cable terminations.
d. Motor Controller: Motor controller shall be a reversing-type magnetic starter with thermal-overload protection, molded case circuit breaker, and control transformer operated by a pushbutton control station. Controller and control station shall be mechanically or electrically interlocked to preclude possibility of operating opposing control circuits simultaneously.
   1) Contactor Fingers: Contactor fingers shall be adjustable and shall have renewable tips.
   2) Transformer: Transformer shall reduce the control-circuit voltage to 120 volts AC, to 48 volts AC, or to 24 volts AC.
   3) Enclosure for Mounting: Motor controller shall be mounted in either a gasketed cast metal or sheet metal enclosure, as required or noted, with hinged door conforming to the requirements of UL 50. Motor controller enclosures, complying with NEMA ICS 6, shall be NEMA, Type 1.
e. Pendant Control Station: Each hoist shall have a pendant-mounted conductor cable and pushbutton station with a strain-reliever chain or cable permanently attached to the hoist frame and integral with the pendant conductor cable. The control station shall be a full-guarded, momentary-contact, pushbutton type with each button clearly marked to indicate its function. A separate button or a single button providing steps for each speed of multispeed hoists or trolleys and bridge shall be provided. The pushbuttons shall return to the off (normally open contacts) position when pressure is released by operator. The pushbutton station shall be grounded to the hoist. The strain reliever chain or cable shall not be used as a grounding circuit.
f. Mainline Disconnect Switch: A mainline disconnect switch shall be provided and shall be a surface- mounted, heavy-duty, single-throw, air-break, enclosed type conforming to NEMA KS 1 as indicated. Disconnect switch shall be fused. Enclosure shall be NEMA Type 1.
g. Hoist Limit Switches: Adjustable upper-limit switch shall be provided to prevent overtravel of the hook or load block in the hoisting direction. Limit switch shall be arranged to stop the hoist motor and apply the motor brake before reaching the uppermost safe limit of travel. In case of hook overtravel, the motor shall automatically and momentarily be reversed. Adjustable lower-limit switch shall be provided to stop the hoist motor and apply the motor brake when the load hook reaches a predetermined lower limit.
h. Bridge and Trolley Travel Limit Switches: Limit switches shall be mounted to the bridge and trolley, respectively, to interrupt current to the bridge and trolley controls. Adjustable limit switch actuators shall be installed on both ends to actuate the limit switches and stop the crane bridge or trolley prior to contacting the bumpers.
i. Hoist Motors: Hoist motor shall be a high-starting torque, high-slip, 30-minute time rated, reversible electric motor specifically designed for hoist duty and capable of operating at the specified duty class, capacity, and speed. The motor shall be [_____]-volts, 3-phase, 60-

hertz and horsepower as recommended by manufacturer for capacity and lift speed of hoist. The hoist motors shall be provided with Class B insulation, and motor enclosures shall be totally enclosed, nonventilated (TENV). Enclosure shall be fitted with a UL-approved drain and breather and shall be certified and labeled in accordance with UL 674, Class 1, Groups C and D.

j. Bridge and Trolley Motors: Bridge and Trolley motors shall be single-speed, single-winding conforming to the requirements for hoist motors except they may be NEMA design B (high torque and slip not required).

k. Motor Brake:
   1) Motor brake shall be an externally adjustable, electrically operated single- or multiple-friction disk brake that shall apply automatically when the power is off. The brake shall be capable of holding 125 percent of the rated load from any operating speed. The brake shall hold a static load equal to 150 percent of the rated capacity of the hoist.
   2) Bridge Trolley unit shall have an automatic, adjustable, solenoid-operated, electric brake designed for trolley application. Brake shall apply and release smoothly during starts and stops to minimize pendulum action of the load. Braking torque shall be not less than 100 percent of motor torque and shall match motor torque characteristics.

f. Conduit and Wire:
   1) Conduit: Conduit between feeder enclosure and disconnect switches and fixed control stations shall be zinc-coated rigid-steel conduit, couplings, elbows, bends, and nipples conforming to ANSI C80.1. Zinc coating shall be an electrodeposited coating conforming to ASTM B 633.
   2) Wire: Building wire for use in conduits, raceways, and wireways in wet or dry locations shall be single-conductor, 600-volt, heat- and moisture-resistant Type RHW or THW with a maximum temperature rating of 167 degrees F, or cross-linked thermosetting, polyethylene insulation with a temperature rating of 194 degrees F.

Execution: 1. Monorail tracks shall be installed in accordance with the applicable requirements of ANSI MH27.1.

Testing: 1. Onsite Electrification System Tests

a. Electrification system shall be given continuity and insulation tests after the installation has been completed but before equipment is energized. Contractor shall provide necessary test equipment, labor, and personnel to perform the tests as specified. Electrification system equipment shall be completely isolated from all extraneous electrical connections. Substation and switchboard feeder breakers, circuit breakers in panelboards, and other disconnecting devices shall be used to isolate the equipment under test. Insulation tests on equipment and wiring shall be conducted using a 1,000-volt, insulation-testing instrument. Readings shall be recorded every minute and until three equal and consecutive readings are obtained. The resistance between phase conductors and between phase conductors and ground shall be not less than 1 megohm. Test data shall be recorded and shall include megohm readings versus time. Final acceptance shall depend upon satisfactory performance under test. Electrification system shall not be energized until recorded test data of the electrification system tests are approved.

2. Acceptance Testing: Acceptance testing shall comply with the following paragraphs.

a. Acceptance Test: The Contractor shall provide all personnel necessary to conduct the tests including but not limited to operators, riggers, rigging gear, and test weights. Testing shall be performed in the presence of Government. The Contractor shall notify the Government 14 days prior to testing operations.

b. Test Sequence: The equipment shall be tested according to the applicable paragraphs of this procedure in the sequence provided.

c. Test Data: Operating and startup current measurements shall be recorded for electrical equipment (motors and coils) using appropriate instrumentation. Speed measurements shall be recorded as required by the facility evaluation tests (normally at 100-percent load). Recorded values shall be compared with design specifications or manufacturer's

recommended values; abnormal differences shall be explained in the remarks and submitted for approval or appropriate adjustments performed. In addition, high temperatures or abnormal operation of any equipment or machinery shall be noted, investigated, and corrected. Hoist and trolley speeds should be recorded during each test cycle.

d. Equipment Monitoring: During the load test, improper operation or poor condition of safety devices, electrical components, mechanical equipment, and structural assemblies shall be monitored. Observed defects critical to continued testing shall be reported immediately to the Government and testing shall be suspended until the deficiency is corrected. During and immediately following each load test, the following inspections shall be made:
   1) Inspect for evidence of bending, warping, permanent deformation, cracking, or malfunction of structural components.
   2) Inspect for evidence of slippage in wire-rope sockets and fittings.
   3) Check for overheating in brake operation; check for proper stopping. All safety devices, including emergency stop switches and POWER OFF pushbuttons, shall be tested and inspected separately to verify proper operation of the brakes.
   4) Check for abnormal noise or vibration and overheating in machinery drive components.
   5) Check wire rope sheaves and drum spooling for proper operation, freedom of movement, abnormal noise, or vibration.
   6) Check electrical drive components for proper operation, freedom from chatter, noise, or overheating.
   7) Inspect external gears for abnormal wear patterns, damage, or inadequate lubrication.
   8) Hooks: Hooks shall be measured for hook-throat spread before and after load test. A throat dimension base measurement shall be established by installing two tram points and measuring the distance between these tram points (to within 1/64 inch). This base dimension shall be recorded. The distance between tram points shall be measured before and after load test. An increase in the throat opening by more than 1 percent from the base measurement shall be cause for rejection.

e. No-Load Testing:
   1) Hoist Operating and Limit Switch Test: The load hook shall be raised and lowered through the full range of normal travel at rated speed and other speeds of the crane. The load hook shall be stopped below the geared limit switch upper setting. In slow speed only, proper operation of upper and lower limit switches shall be verified. The test shall be repeated a sufficient number of times (minimum of three) to demonstrate proper operation. Brake action shall be tested in each direction.
   2) Trolley Travel: The trolley shall be operated the full distance of the rails exercising all drive speed controls in each direction. Brake operation shall be verified in each direction. In slow speed, the trolley bumpers shall contact the trolley stops located on the rails.
   3) Hoist Loss of Power No-Load Test: The hooks shall be raised to a height of approximately 6 1/2 ft. or less. While slowly lowering the hook, the main power source shall be disconnected verifying that the hook will not lower and that the brake will set.
   4) Travel Loss of Power No-Load Test: With the hook raised to clear obstructions and the trolley traveling in slow speed, the main power source shall be disconnected, verifying that the trolley will stop and that the brake will set.

f. Load Test:
   1) Hoist: Unless otherwise indicated, the following tests shall be performed using a test load of 125 percent of rated load.
      a) Dynamic Load Test: The test load shall be raised and lowered through the full-range while operating in each speed. The machinery shall be completely stopped at least once in each direction to ensure proper brake operation.
      b) Hoist Loss of Power Test: After raising the test load to approximately 6 1/2 ft above ground level and while slowly lowering the test load, the main power source and the control pushbutton shall be released verifying that the brake will set and that the test load will stop lowering.

c) Trolley Dynamic Load Test: While operating the trolley the full distance of the rails in each direction with test load on the hook (one cycle), the proper functioning of drive speed control points and proper brake action shall be tested.

Manufacturer's Services:

1. Services of a manufacturer's representative who is experienced in the installation, adjustment, erection, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

Field Training:

1. A field training course shall be provided for designated operating staff members. Training shall be provided for a total period of 16 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the operating and maintenance instructions. The Government shall be given at least 2 weeks advance notice of such training.

---End of Section---