PROJECT MANUAL

FOR

Monahans Sandhills State Park
Visitors Center & Section House Renovations

Park Road 41, Monahans, Texas 79756

Texas Parks and Wildlife Department

TPWD Project # 1110169

Negrete & Kolar Architects, LLP
11720 North IH-35, Austin, TX 78753
512.474.6526
PART ONE

TECHNICAL SPECIFICATIONS
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This table of contents identifies all documents in this project manual. Following this table of contents are sealed sheets listing the specifications for which each discipline is responsible.

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200301 TPWD MONAHANS SANDHILLS STATE PARK – FACILITY REPAIRS

THE FOLLOWING SPECIFICATION SECTIONS WERE PREPARED BY KINGS STRUARCHURAL, INC.

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KINGS # 200301

KINGS STRUARCHURAL ENGINEERING

KINGSSE # 200301

3/19/2021

STATE OF TEXAS
PATRICK ASIEDU
105858
PROFESSIONAL ENGINEER
3/19/2021

Kings Struarchural, Inc.
2851 Joe DiMaggio Blvd. |Suite 22
Round Rock, TX 78665

Firm # 13346
(512) 244 1966
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23 3713  DIFFUSERS, REGISTERS, AND GRILLES
23 7312  DX AIR HANDLING UNITS SINGLE ZONE VAV
**DIVISION 1**

**GENERAL REQUIREMENTS**

The Agreement, General Conditions Of The Contract For Construction, Supplementary Conditions Of The Contract For Construction, and all Addenda are a part of the Contract. The Contractor shall consult them in detail for instructions pertaining to the Work. The Contractor shall also consult all other divisions and sections of the Project Manual, and all Drawings in the execution of the work of the Contract.

The Contractor shall provide all labor, materials, systems, equipment, items, articles, operations, and/or methods listed, implied, mentioned, or scheduled in the Contract Documents and/or necessary and/or required for the satisfactory completion of the Work.

The listing of work, requirements, and products in this section is not intended to be conclusive. The Contractor shall check all other parts of the Contract Documents and shall provide all miscellaneous items of work and products necessary for the satisfactory completion of the Work described in the Contract Documents.
Summary of Code Requirements
TPWD Monahans Sandhills State Park
Visitors Center and Section House Renovations

There are two building sites within the project scope. Most of the work is at the Visitors Center with minor work at the Section House. They will be treated separately in this code Analysis.

VISITORS CENTER

1) General Description
   The Visitors Center is comprised of two building components; the Visitors Center proper and the Comfort Station. In accordance with IBC 503.1.2 option, this project will consider them as a single building.
   a) Project Name: Monahans Sandhills State Park Visitors Center and Section House Renovations
   b) Project Location: Park Road 41, Monahans, Texas 79756
   c) Applicable Codes: Since this is a project of the State of Texas, there is no local jurisdiction. The TPWD in accordance with state requirements prescribes the following Codes.
      i) International Building Code (IBC) - 2015
      ii) International Plumbing Code (IPC) - 2015
      iii) International Mechanical Code (IMC) - 2018
      iv) International Fuel Gas Code (IFGC) - 2018
      v) International Existing Buildings Code (IEBC) - 2015
      vi) National Electrical Code (NFPA-70) - 2020
      vii) Fire Code (NFPA-1) - 2015
      ix) Energy:
         (1) International Energy Conservation Code (IECC) - 2015
         (2) Energy Standards for Buildings ASHRAE 90.1 - 2017
      x) Accessibility
         (1) Dept. of Justice 2010 ADA Standards for Accessible Design
         (2) Architectural Barriers Act Accessibility Guidelines, Outdoor Developed Areas, November 25, 2013
         (3) Texas Accessibility Standards (TAS) - 2012US
   d) Occupancy Classifications:
      i) This is a mixed occupancy building with non-separated occupancies (IBC 508.3, NFPA 101 6.14.3.2)
      ii) Group A-3 – Assembly IBC 303.4
         (1) This area, to the west end of the Visitors Center building, is an exhibit hall.
      iii) Group B – Business IBC 304.1
         (1) This area on the east end of the Visitors Center building will include private and open area office, a small conference room, and break room. There is a transaction window to the exterior but we have not segregated this as mercantile.
      iv) Group M - Mercantile IBC 309
         (1) This area is located in the center of the Visitors Center building.
      v) The Restroom building is located adjacent to the Visitors Center building. The only functions therein are restrooms and thus do not have a specific occupancy classification. They serve the Visitors Center and the Park generally.

   e) Construction Type:
      i) Type V-B (V (000)) IBC 602.5 (NFPA 220 4.6)

Notes:
(1) This building will not have any automatic sprinkler (fire) system.
(2) Type V construction is that type of construction in which the structural elements, exterior and interior walls may be of any material permitted by the code.

2) Height & Area Limits (IBC Section Tables 504.3, 504.4, and 506.2)

a) Height:
   i) A-3 Occupancy – 40 feet, 1 story (1 story and 300 occupants or less per NFPA 101 Table 12.1.6)
   ii) B Occupancy – 40 feet, 2 story
   iii) M Occupancy – 40 feet, 1 story
   iv) This building - 20’ 6”, 1 story.
      (1) This building is generally 11'-0” above grade except that it extends over an arroyo. The 20’ 6” height is taken at the greatest extent of depth of the arroyo.

b) Allowable Areas: (IBC Table 506.2)
   i) A-3 Occupancy – 6,000 nsf (300 occupants NFPA 101 Table 12.1.6)
      (1) This building - 1,155 nsf. (39 occupants)
   ii) B Occupancy – 9,000 sf.
      (1) This building – 840 gsf.
   iii) M Occupancy – 9,000 gsf. (Class C Mercantile NFPA 101 36.1.2.2.1(3) This is the main occupancy.
      (1) This building – 1,406 sf.
   iv) Restroom Building
      (1) This building – 588 gsf
   v) Total Building: 3,989 sf.

c) The occupancies are non-separated occupancies as outlined under IBC Section 508.3.
   i) IBC Section 508.3.2 requires the most restrictive occupancy to be used to determine allowable height and area. The most restrictive being A-3 with 1 story, 40 foot height, and 6,000 sf.
   ii) Height and Area Increases:
      (1) Frontage Increase (IBC 506.3 and Equation 5-4)
         (a) F & P : The entire perimeter is fronted by open space.
         (b) F/P = 1
         (c) W = 30
       (d) I=[(F/P)-(0.25)]W/30 (IBC Eq. 5-4)  I=[(1-0.25)*30]/30  I=0.75*1I=0.75
       (e) This allows an additional 4,500 sf of allowable area.
   iii) 6,000 sf + 4,500 sf = 10,500 sf total allowable. Building is 3,989 sf. OK

3) Fire Resistance Requirements for Building Elements (IBC Table 601, NFPA 220 Table 4.1.1)

a) Tabular requirements
   i) Primary Structural Frame 0 hours
   ii) Exterior Bearing Walls 0 hours
   iii) Interior Bearing Walls 0 hours
   iv) Nonbearing walls & Partitions (exterior) 0 hours (based upon min. 30’ fire separation distance, Table 602)
   v) Nonbearing walls & Partitions (interior) 0 hours
   vi) Floor Construction 0 hours
   vii) Roof Construction & secondary members 0 hours

b) Exterior Bearing Walls
   i) Openings in exterior walls:
      (1) For fire separation distance of 30 feet or greater, no protection for openings is required. (IBC Table 705.8)

c) Interior Wall and Ceiling Finish Requirements by Occupancy. sprinklered (IBC Table 803.9)
   Flame Spread/Smoke Developed: IBC 803.1.1
   i) Class A: 0-25 flame, 0-450 smoke;
ii) Class B: 26-75 flame, 0-450 smoke.
iii) Class C: 76-200 flame, 0-450 smoke.

<table>
<thead>
<tr>
<th>Group</th>
<th>Exit enclosures &amp; passageways</th>
<th>Corridors</th>
<th>Rooms/Enclosed Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-3</td>
<td>Class A</td>
<td>Class A</td>
<td>Class C</td>
</tr>
<tr>
<td>B</td>
<td>Class A</td>
<td>Class B</td>
<td>Class C</td>
</tr>
<tr>
<td>M</td>
<td>Class A</td>
<td>Class B</td>
<td>Class C</td>
</tr>
</tbody>
</table>

d) This project has no existing enclosures or passageways and no corridor. Class C minimum finishes are required.

4) Means of Egress Requirements (IBC Chapter 10)
a) In determining means of egress requirements, the number of occupants for whom means of egress facilities are needed shall be determined in accordance with this (IBC Section 1004).
   i) Per IBC Section1004.1.2, areas without fixed seating, “the number of occupants computed at the rate of one occupant per unit of area as prescribed in Table 1004.1.2.” (occupancy numbers computed by this method, see below)
b) Occupancy Load Factors used (IBC Table 1004.1.2, NFPA 101 Table 7.3.1.2)
   i) Assembly - Exhibit Gallery and Museum 30 sf net (note: NFPA does not have a specific loading for exhibit galley/museum)
      (1) This is used for the Exhibit Hall.
   ii) Business areas 100 sf gross
   iii) Mercantile 30 sf gross (Note IBC Table 1004.1.2 indicates 60 sf but NFPA indicates 30 sf for floors w/ street level access)
   iv) Mercantile Storage 300 sf gross
      (1) This load factor has been used for the two storage areas along the north wall.
c) Loading and egress calculations:
   i) The building is generally divided into three areas. Their loading is as follows:
      (1) A-3 Exhibit:
         (a) 1,155 sf @ 30 sf/occ. = 38.5 occupants
      (2) Business
         (a) 840 sf @ 100sf/occ. = 8.4 occupants
      (3) Mercantile (sales area)
         (a) 1,248 sf @ 30sf/occ. = 41.6 occupants
      (4) Mercantile (storage)
         (a) 158 sf @ 300sf/occ. = 0.5 occupants
      (5) Total Occupants: 92.5 or 93 occupants
      (6) There are no individual spaces with an occupancy over 49 occupants. No individual spaces require 2 or more exits.
   ii) Minimum egress widths for egress components other than stairway in a non-sprinklered building shall be 0.2” per occupant (IBC 1005.3.2, NFPA 101 Table 7.3.3.1) but not less than 32” for doors
      (1) Egress components include doors and passage openings at the following locations:
         (a) Door 203 handles ½ the exhibit occupancy or 20 occupants. 0.2 x 17 = 4” but 32” minimum. 36” standard door complies.
         (b) Doors 105 and 101 in series handle ½ the exhibit occupants (20 occupants), ½ the M occupancy (22 occupants) and ½ the B occupancy (5 occupants) for a total load of 47 occupants x 0.2” requires 9.4” but 32” minimum. Doors are 40” doors and comply.
(c) Doors 103 and 102 in series handle 1/2 the M occupancy (22 occupants) and 1/2 the B occupancy (5 occupants) for a total load of 27 occupants x 0.2" requires 5.4" but 32" minimum. 36" standard doors comply.

d) Maximum Travel Distance
   i) IBC Table 1017.2 permits exit access travel distance in non-sprinklered spaces up to:
      (1) Group A: 200 feet
      (2) Group B: 200 feet (100 ft. when a single exit NFPA 101 38.2.4.3)
      (3) Group M: 200 feet (150 ft. NFPA 101 36.2.6)
   ii) Longest travel distance in the project is 63' 9" feet from the northeast corner of the Break Room 304 to the exit through door 102. This is less than the most restrictive of the travel distances.

e) Minimum Number of Exits per Story (IBC 1006.3, NFPA 101 7.4.1.1)
   i) IBC Table 1006.3.1 requires two exits per story for the first 500 occupants.
   ii) When two exits are required, arrangement shall be such that they are placed a distance apart equal to but not less than one-half of the length of the maximum overall diagonal. (IBC 107.1.1, NFPA 101 7.5.1.3.2)
      (1) The maximum diagonal is 146.5 feet. Half of this is 73.75 feet.
      (2) This diagonal distance from the west door 203 to the north door 102 is 108 feet, greater than the minimum 73.75 feet. **OK**

f) Common Path of Egress
   i) In a non-sprinklered condition (IBC Table 1006.2.1), B and M spaces with less than 49 occupants may have a single point of egress. For over 49 occupants, common path of travel is limited to 75'. (NFPA 101 – 12.2.5.1.2 A occ. 75; 37.2.5.3.2 M occ. 75')
      (1) A occupancy has two exits and common path of travel is 0. (NFPA 101 12.2.5.1.2 allows 75 feet)
      (2) M occupancy has two exits. Maximum common path of travel is from NE corner of Storage and is 11.5 feet.
      (3) B occupancy has a single exit which leads into the associated mercantile area. With only 9 occupants this complies (also NFPA 101 38.2.4.3).

g) Fire Alarm
   i) IBC 907.2 does not require the installation of fire alarm systems in existing buildings that are renovated. The loading of the building also does not meet the threshold requiring such systems in new buildings. NFPA 101 similarly has a threshold higher than this building.
      (1) Though not required, a fire alarm system is indicated to be installed.
5) Plumbing Facility Requirements

a) IPC Table 403.1 requirements applied in tables below.

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>Occupants</th>
<th>Toilet factor Male</th>
<th>Toilet Male Required</th>
<th>Toilet factor Female</th>
<th>Toilet Female Required</th>
<th>Toilet factor unisex &lt; 50</th>
<th>Toilets Unisex Required</th>
<th>Male Toilets Provided</th>
<th>Female Toilets Provided</th>
<th>Unisex Toilets Provided</th>
<th>Lavatories Required</th>
<th>Lavatories Provided</th>
<th>Drink fountain factor</th>
<th>Drink Fountains Required</th>
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</tr>
</tbody>
</table>

b) Fixtures provided:
   i) Visitors Center:
      (1) A single user toilet room (106) is provided with one toilet and one lavatory. This complies with the minimum requirement for the M and B occupancy. The A occupancy is served by the Comfort Station.
      (2) A hi-lo drinking fountain is provided in Room 103 which meets the requirement.
   ii) Comfort Station:
      (1) Women: There are three toilets and two lavatories which exceeds the 1 toilet and 1 lavatory requirement.
      (2) Men: There are two toilets, one urinal, and two lavatories which exceeds the 1 toilet and 1 lavatory requirement.
      (3) There is a hi-lo drinking fountain that serves the general population which exceeds the minimum requirement.

6) Energy Efficiency
a) This project is required to maintain certain existing elements to preserve the historical context. At the Visitors Center Building additional insulation assemblies are being added to exterior walls and the glazing systems are being replaced. In both cases these will meet or exceed the current energy code. The Comfort Station, new construction, will meet all energy code requirements.

SECTION HOUSE
1) General Description

The Section House is an existing building. No modifications are being made to the building. Work includes refinishing the exterior, restoring the historic windows, and replacing the roof. The replacement of the roof will be to the existing roof deck but to maintain the historic appearance insulation will not be added above deck but rather blown into the attic space.

END OF SECTION 01 4113.13
PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      2. Construction waste recycling.
      3. Construction waste adaptive reuse.
   B. Related Sections:
      1. Section 01 8113 - Sustainable Design Requirements.

1.2 PLAN REQUIREMENTS
   A. Develop and implement construction waste management plan as approved by Owner.
   B. Intent:
      1. Divert construction, demolition, and land-clearing debris from landfill disposal.
      2. Redirect recyclable material back to manufacturing process.
      3. Generate cost savings or increase minimal additional cost to Project for waste disposal.

1.3 SUBMITTALS
   A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special
      Conditions of the Contract.
   B. Construction Waste Management Plan: Submit construction waste management plan describing
      methods and procedures for implementation and monitoring compliance including the following:
      1. Transportation company hauling construction waste to waste processing facilities.
      2. Recycling and adaptive reuse processing facilities and waste type each facility will accept.
      3. Construction waste materials anticipated for recycling and adaptive reuse.
      4. On-Site sorting and Site storage methods.
   C. Submit documentation with each application for payment substantiating construction waste
      management plan was maintained and goals are being achieved.
      1. Trash: Quantity by weight deposited in landfills. Include associated fees, transportation costs,
         container rentals, and taxes for total cost of disposal.
      2. Waste to Energy: Quantity by weight diverted to a waste to energy plant. This waste is credited
         at 50% diverted.
      3. Salvaged Material: Quantity by weight with destination for each type of material salvaged for
         resale, recycling, or adaptive reuse. Include associated fees, transportation costs, container
         rentals, taxes for total cost of disposal, and reimbursements due to salvage resale.
      4. Total Cost: Indicate total cost or savings for implementation of construction waste management
         plan.

1.4 CONSTRUCTION WASTE MANAGEMENT PLAN
   A. Construction Waste Landfill Diversion: Minimum 25 percent by weight of construction waste
      materials for duration of Project through resale, recycling, or adaptive reuse.
   B. Implement construction waste management plan at start of construction.
   C. Review construction waste management plan at preconstruction meeting and progress
      meetings.
   D. Distribute approved construction waste management plan to Subcontractors and others affected
      by plan requirements.
   E. Oversee plan implementation, instruct construction personnel for plan compliance, and
      document plan results.
   F. Purchase products to prevent waste by:
      1. Ensuring correct quantity of each material is delivered to Site.
      2. Choosing products with minimal or no packaging.
      3. Requiring suppliers to use returnable pallets or containers.
      4. Requiring suppliers to take or buy back rejected or unused items.
1.5 CONSTRUCTION WASTE RECYCLING
A. Use source separation method or comingling method suitable to sorting and processing method of selected recycling center. Dispose nonrecyclable trash separately into landfill or to waste to fuel plant.
B. Source Separation Method: Recyclable materials separated from trash and sorted into separate bins or containers, identified by waste type, prior to transportation to recycling center.
C. Comingling Method: Recyclable materials separated from trash and placed in unsorted bins or container for sorting at recycling center.
D. Materials required to be recycled include:
   1. Packing materials including paper, cardboard, foam plastic, and sheeting.
   2. Recyclable plastics.
   4. Equipment oil.
E. Materials suggested for recycling include:
   1. Organic plant debris.
   2. Asphalt and concrete paving.
   3. Concrete masonry products.
   5. Glass, clear and colored types.

1.6 CONSTRUCTION WASTE ADAPTIVE REUSE
A. Arrange with processing facility for salvage of construction material and processing for reuse. Do not reuse construction materials on-Site except as allowed by Architect/Engineer or indicated in the Contract Documents.
B. Materials suggested for adaptive reuse include:
   1. Concrete and crushed concrete.
   2. Masonry units.
   3. Lumber suitable for re-sawing or refinishing.
   4. Casework and millwork.
   5. Doors and door frames.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE COLLECTION
A. Collect construction waste materials in marked bins or containers and arrange for transportation to recycling centers or adaptive salvage and reuse processing facilities.
B. Maintain recycling and adaptive reuse storage and collection area in orderly arrangement with materials separated to eliminate co-mingling of materials required to be delivered separately to waste processing facility.
C. Store construction waste materials to prevent environmental pollution, fire hazards, hazards to persons and property, and contamination of stored materials.
D. Cover construction waste materials subject to disintegration, evaporation, settling, or runoff to prevent polluting air, water, and soil.

3.2 CONSTRUCTION WASTE DISPOSAL
A. Deliver construction waste to waste processing facilities. Obtain receipt for deliveries.
B. Dispose of construction waste not capable of being recycled or adaptively reused by delivery to landfill, incinerator, or other legal disposal facility. Obtain receipt for deliveries.

END OF SECTION 01 7419
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Sustainable design Project goals.
   2. Sustainable design product requirements.
B. Related Sections:
   1. Section 01 7419 - Construction Waste Management and Disposal: Recycling and adaptively reusing construction waste.
   2. Individual Specification Sections for additional product requirements.

1.2 REFERENCE STANDARDS
A. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
   1. ASHRAE 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
B. ANSI:
C. ASTM International (ASTM):
D. California Code of Regulations (CCR):
   1. CCR Title 24 - California Building Code.
E. California Department of Health Services (CA/DHS):
F. Carpet and Rug Institute (CRI):
   1. CRI Green Label Plus Testing Program.
   2. CRI Green Label Testing Program.
G. Forest Stewardship Council (FSC):
   1. FSC Guidelines.
H. Green Seal (GS):
   1. GC-03 - Anti-Corrosive Paints.
   2. GS-11 - Product Specific Environmental Requirements.
   3. GS-36 - Aerosol Adhesives.
I. GREENGUARD Environmental Institute:
   1. GREENGUARD Children and Schools Certification Program.
J. International Standards Organization (ISO):
   1. ISO 14021 - Environmental Labels and Declarations - Self-Declared Environmental Claims (Type II Environmental Labeling).
K. Scientific Certification Systems (SCS):
   1. SCS EC 10.2 - Environmental Certification Program Indoor Air Quality Performance.
L. Sheet Metal and Air Conditioning Contractors (SMACNA):
   1. SMACNA IAQ - IAQ Guidelines for Occupied Buildings Under Construction.
M. South Coast Air Quality Management District (SCAQMD):
   1. SCAQMD Rule 1113 - Architectural Coatings.
   2. SCAQMD Rule 1168 - Adhesive and Sealant Applications.
N. U.S. Environmental Protection Agency (EPA):
   1. ENERGY STAR Voluntary Labeling Program.
   2. EPA IAQ Testing - Compendium of Methods for the Determination of Air Pollutants in Indoor Air.
   3. EPA Construction General Permit.

1.3 SUSTAINABLE PROJECT GOALS
A. Comply with the following general sustainable Project goals. Refer to specific Specification Sections for more detailed requirements.
   1. Notify Owner and Architect/Engineer when conflicts arise between Work performance and sustainable Project goals.
B. Use resources efficiently:
   1. Reuse existing buildings and materials.
   2. Furnish materials that use resources efficiently.
   3. Use construction practices that achieve efficient use of resources and materials.
   4. Recycle or reuse Project Site waste.
   5. Furnish recycled content materials.
   6. Furnish materials that can be recycled.
C. Avoid scarce, irreplaceable, or endangered resources:
   1. Furnish materials from abundant, well-managed resources.
   2. Furnish materials that are replaceable, renewable, or can be replenished.
   3. Furnish materials that minimize damage to natural habitats.
D. Use durable materials:
   1. Furnish materials with longest usable life.
   2. Furnish materials that can be reused.
   3. Furnish materials with least maintenance requirements.
E. Create spaces that are healthy for occupants:
   1. Furnish low-toxicity products and materials.
   2. Furnish materials without toxic maintenance requirements.
   3. Furnish mechanical equipment that provides fresh air and does not trap water or pollutants.
F. Use energy efficiently:
   1. Furnish materials with low embodied energy.
   2. Furnish materials that save energy during building operations.
G. Use water efficiently:
   1. Use construction practices that use water efficiently.
   2. Furnish water conserving appliances and equipment.
   3. Landscape Project Site for water conservation.
H. Furnish materials that generate least amount of pollution.
I. Protect and restore natural habitats on Site.

1.4 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data:
   1. Submit data for filter media and filter efficiency.
C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
   1. Certify paving material solar reflectance index:
      a. Indicate solar reflectance index and percent of total Site hardscape surfaces for each paving material.
   2. Certify roofing material solar reflectance index.
a. Indicate roof slope, solar reflectance index, and percent of total roof surface for each roofing material.
3. Certify plumbing fixture water consumption rates.
   a. Indicate manufacturer and model number of each fixture and fitting and water consumption rates.
4. Certify source and origin for reused products.
   a. Include description and location of each reused product in completed construction.
5. Certify recycled material content for recycled content products permanently installed as part of Project.
   a. Indicate post-consumer recycled content percent by weight.
   b. Indicate pre-consumer recycled content percent by weight.
   c. Indicate recycled content materials according to ISO 14021.
6. Certify volatile organic compound content for each interior adhesive and sealant and related primer.
   a. Include data sheet indicating volatile organic compound content, in g/L, for each product.
7. Certify volatile organic compound content for each interior paint and coating.
   a. Include data sheet indicating volatile organic compound, in g/L, and chemical component content for each product.
8. Certify each composite wood and agrifiber product contains no added urea-formaldehyde resins.
   a. Include data sheet indicating urea-formaldehyde resin content for each product.
D. Construction Photographs: Submit photographs of measures protecting materials from moisture for the following:
1. Absorptive materials, including but not limited to masonry units, lumber, finished architectural woodwork, flush wood doors, gypsum board, and insulation.
2. Ducts and other HVAC equipment.
E. Product Cost Data:
1. Submit cost of products, excluding cost of labor and equipment for installation, for all materials installed in the project. Costs for the following products installed as part of permanent construction shall also be broken out:
   a. Products with recycled material content.
F. Construction Plans:
2. Construction Indoor Air Quality (IAQ) Plan: Indicate absorptive material and HVAC system protection; source control; pathway interruption; housekeeping; and construction sequencing.
3. Recycled Materials Management Plan: Indicate list of proposed materials and products with recycled content to be incorporated into the Work. Include total and weighted recycled content cost data for each proposed material and product. Calculate value of recycled content as a percentage of total Project material and product cost.
   a. Submit monthly report of actual recycled materials and products purchased for the Work. Adjust remaining proposed materials and products to ensure compliance with specified results.

1.5 QUALITY ASSURANCE
A. Owner and Architect/Engineer identified Project sustainable Project goals that are required.
B. Furnish products with materials and properties for entire Project to meet or exceed specified sustainable Project goals.
C. Perform Work using means and methods for entire Project to meet or exceed specified sustainable Project goals.

PART 2 - PRODUCTS
2.1 PROHIBITED MATERIALS
A. Do not use materials containing asbestos, polychlorinated biphenyls (PCB), or other hazardous materials.
B. Do not use HCFC-based refrigerants or halon extinguishing agents.
C. Do not use materials containing butyl for interior locations.

2.2 HVAC FILTERS
A. Temporary Return Air Filters: ASHRAE 52.2 minimum efficiency reporting value (MERV) of 8.

2.3 PAVING MATERIALS
A. Paving Surfaces: Minimum solar reflectance index (SRI) of 29, calculated according to ASTM E1980.
   1. Reflectance: Measured according to ASTM E903, ASTM E1918, or ASTM C1549.
   2. Emittance: Measured according to ASTM E408 or ASTM C1371.

2.4 ROOFING MATERIALS
A. Roof Surface: Minimum SRI of 78 for 75 percent of roof area, calculated according to ASTM E1980.
   1. Reflectance: Measured according to ASTM E903, ASTM E1918, or ASTM C1549.
   2. Emittance: Measured according to ASTM E408 or ASTM C1371.

2.5 RECYCLED CONTENT MATERIALS
A. Furnish the following materials with maximum available recycled content to achieve minimum 20 percent overall recycled content for Project's building products as defined by product cost.
   1. Concrete with pozzolan admixtures. Refer to Section 03 3000.
   2. Structural steel framing. Refer to Section 05 1200.
   3. Steel Fabrications. Refer to Section 05 5000.
   4. Steel Railings: Refer to Section 05 5200.
   5. Quartz Surfacing. Refer to Section 06 6119.
   6. Insulation. Refer to sections 07 2116 and 07 2126.
   7. Metal roofing trim, gutters, and downspouts. Refer to Sections 07 6200 and 07 7123.
   8. Hollow Metal Frames and Doors. Refer to Section 08 1213.13 and 08 1313.13.
   9. Aluminum framed storefronts and entrance. Refer to Section 08 4113.
   10. Aluminum pass thru windows. Refer to Section 08 5619.
   11. Gypsum board. Refer to Section 09 2116.
   12. Toilet Compartments. Refer to Section 10 2113.13.
   13. Toilet Accessories. Refer to Section 10 2800.

2.6 LOW-EMITTING MATERIALS - ADHESIVES AND SEALANTS
A. Adhesives and Sealants: Maximum volatile organic compound content according to product and testing requirements of CA/DHS/EHLB/R-174.
B. Adhesives, Sealants, and Sealant Primers: Maximum volatile organic compound content according to SCAQMD Rule 1168.
C. Aerosol Adhesives: Maximum volatile organic compound content according to GS-36.

2.7 LOW-EMITTING MATERIALS - PAINTS AND COATINGS
A. Architectural Paints and Coatings: Maximum volatile organic compound content according to GS-11.
B. Anti-Corrosive and Anti-Rust Paints: Maximum volatile organic compound content according to GC-03.
C. Clear Wood Finishes, Floor Coatings, Stains, Primers, and Shellacs: Maximum volatile organic compound content according to SCAQMD Rule 1113.

2.8 LOW-EMITTING MATERIALS - COMPOSITE WOOD AND AGRIFIBER
A. Composite Wood and Agrifiber Products: Manufactured and fabricated to contain no added urea-formaldehyde resins.

2.9 LOW-EMITTING MATERIALS - CEILING AND WALL SYSTEMS
A. Ceiling and Wall Systems: Maximum volatile organic compound content according to product and testing requirements of CA/DHS/EHLB/R-174 for the following:
   1. Gypsum board.
   2. Insulation.

2.10 EQUIPMENT AND APPLIANCES
A. Equipment and Appliances: ENERGY STAR compliant for appliances.
PART 3 - EXECUTION

3.1 SITES
A. Perform storm water management and erosion control Work according to local erosion and sedimentation control standards.
B. Limit site disturbance to the following areas:
   1. 40 feet beyond building perimeter.
   2. 10 feet beyond walkways, patios, surface parking, and utilities less than 12 inches diameter.
   3. 15 feet beyond primary roadway curbs and main utility trenches.

3.2 ENERGY
A. Perform Work to meet or exceed minimum energy efficiency and performance according to ASHRAE 90.1 or local energy code whichever is more stringent.
B. Perform Work without use of CFC-based refrigerants in HVAC building systems.
C. Perform ventilation Work according to ASHRAE 62.1.

3.3 MATERIALS
A. Recycle or salvage minimum of 25 percent by weight of non-hazardous construction, demolition, and land-clearing waste.

3.4 INDOOR ENVIRONMENT
A. Accept absorptive materials on-Site in manufacturer's sealed, protective packaging. Inspect for damage.
B. Store absorptive materials in enclosed, environmentally conditioned space to prevent moisture absorption.
C. Do not store or install absorptive materials within building until building is enclosed and materials are protected from exposure to elements.
D. Protect installed absorptive materials from damage with temporary exterior enclosure to prevent moisture absorption.
E. Perform ventilation Work according to ASHRAE 62.1.
F. Develop and implement Construction IAQ management plan including the following:
   1. Comply with minimum requirements of SMACNA IAQ.
   2. Protect stored and installed absorptive materials from moisture damage.
      a. Store materials on elevated platforms under cover and in dry location.
      b. When materials are not stored in enclosed location, cover tops and sides of material with secured waterproof sheeting.
   3. Protect HVAC equipment during construction.
      a. Shut down return side of HVAC system whenever possible during heavy construction or demolition.
      b. When HVAC system is operated during heavy construction, furnish disposable temporary filters.
   4. Replace filtration media immediately before occupancy.
   5. Conduct minimum two-week building flush-out with new filtration media at 100 percent outside air after construction ends and before occupancy.

END OF SECTION 01 8113
DIVISION 2
EXISTING CONDITIONS


THE CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS, SYSTEMS, EQUIPMENT, ITEMS, ARTICLES, OPERATIONS, AND/OR METHODS LISTED, IMPLIED, MENTIONED, OR SCHEDULED IN THE CONTRACT DOCUMENTS AND/OR NECESSARY AND/OR REQUIRED FOR THE SATISFACTORY COMPLETION OF THE WORK.

THE LISTING OF WORK, REQUIREMENTS, AND PRODUCTS IN THIS SECTION IS NOT INTENDED TO BE CONCLUSIVE. THE CONTRACTOR SHALL CHECK ALL OTHER PARTS OF THE CONTRACT DOCUMENTS AND SHALL PROVIDE ALL MISCELLANEOUS ITEMS OF WORK AND PRODUCTS NECESSARY FOR THE SATISFACTORY COMPLETION OF THE WORK DESCRIBED IN THE CONTRACT DOCUMENTS.
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Demolishing designated structures.
   2. Demolishing designated foundations.
   3. Demolishing designated slabs-on-grade.
   4. Demolishing, disconnecting and capping designated utilities.
   5. Protecting items designated to remain.
   6. Removing demolished materials.
B. Related Requirements:
   1. Section 02 4119.13 - Selective Structure Demolition: Demolishing designated components.

1.2 SCHEDULING
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Schedule Work to precede new construction.
C. Describe demolition removal procedures and schedule.

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Shop Drawings: Indicate:
   1. Demolition.
   2. Location and construction of barricades fences and temporary Work.
C. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for bracing, shoring, and underpinning.
D. Permits: Submit copies of permits required by regulatory agencies for demolition and sidewalk and street closings.
E. Qualifications Statements:
   1. Submit qualifications for demolition firm and licensed professional.

1.4 CLOSEOUT SUBMITTALS
A. Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Project Record Documents: Accurately record actual locations of capped utilities, subsurface obstructions.

1.5 QUALITY ASSURANCE
A. Conform to applicable code for demolition of structures, safety of adjacent structures, dust control, runoff control, disposal.
B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.
C. Permits: Obtain required permits from authorities having jurisdiction.

1.6 QUALIFICATIONS
A. Demolition Firm: Company specializing in performing Work of this Section with minimum five years' experience.
B. Licensed Professional: Design shoring, bracing, underpinning under direct supervision of professional engineer experienced in design of this Work and licensed at Project location.

1.7 EXISTING CONDITIONS
A. Buildings indicated to be demolished will be vacated before start of Work.
B. Owner assumes no responsibility for actual condition of buildings to be demolished.
C. Hazardous Materials: Known hazardous materials will be removed before start of Work.
D. Do not sell demolished materials on-Site.
E. Maintain existing sidewalks to greatest extent possible.

PART 2 - PRODUCTS

2.1 Not Used.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine existing buildings indicated to be demolished before demolition.
B. Determine where removals may result in structural deficiency or unplanned building collapse during demolition. Coordinate demolition sequence and procedures to prevent structures from becoming unstable.
C. Determine where demolition may affect structural integrity or weather resistance of adjacent buildings indicated to remain.
   1. Identify measures required to protect buildings from damage.
   2. Identify remedial work including patching, repairing, bracing, and other work required to leave buildings indicated to remain in structurally sound, weathertight, and watertight condition.
D. Verify hazardous material abatement is complete before beginning demolition.
E. Existing Building Documentation
   1. Document condition of adjacent structures indicated to remain.
   2. Make arrangements with building owners and occupants to survey interior and exterior of existing buildings.
   3. Employ land surveyor as specified in Section 01 3000 - Submittal Procedures to provide following documentation:
      a. Survey building exterior for position and elevation of principal elements before and after completion of demolition.

3.2 PREPARATION
A. Call local utility line information service at not less than three working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.
B. Notify affected utility companies before starting Work, and comply with utility's requirements.
C. Do not close or obstruct roadways, sidewalks or hydrants without permits.
D. Erect and maintain temporary barriers and security devices at locations indicated, including warning signs and lights, and similar measures, for protection of the public Owner and existing improvements indicated to remain.
E. Protect existing landscaping materials, trees, appurtenances, structures and other items indicated to remain.
F. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.
G. Test soils around underground tanks for contamination.

3.3 DEMOLITION
A. General:
   1. Use of explosives is not permitted.
   2. Conduct demolition to minimize interference with adjacent structures.
   3. Cease operations immediately when adjacent structures appear to be in danger. Notify Architect/Engineer. Do not resume operations until directed.
   4. Conduct operations with minimum interference to public or private accesses to occupied adjacent structures. Maintain protected continuous egress and access from adjacent structures.
   5. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon, or limit access to their property.
6. Sprinkling:
   a. Sprinkle Work with water to minimize dust.
   b. Provide hoses and water connections required for this purpose.

B. Capped Utilities:
   1. Disconnect, remove and cap designated utilities as indicated in the Drawings.
   2. Identify utilities at termination of demolition.
   3. Record termination or capped location on Record Documents.

C. Remove foundation walls and footings to minimum of four ft below finished grade within area of new construction.

D. Remove concrete slabs-on-grade.

E. Rough grade and compact areas affected by demolition to accommodate subsequent construction operations.

F. Continuously clean up and remove demolished materials from Site. Do not allow materials to accumulate on-Site.

G. Do not burn or bury materials on-Site; leave Site in clean condition.

3.4 SCHEDULES
   A. Buildings to be removed/demolished
      1. Existing comfort station.

END OF SECTION 02 4116
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Demolishing designated building equipment and fixtures.
   2. Demolishing designated construction.
   3. Cutting and alterations for completion of the Work.
   4. Removing designated items for Owner’s retention.
   5. Protecting items designated to remain.
   6. Removing demolished materials.
B. Related Sections:
   1. Section 02 4116 - Structure Demolition.

1.2 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Demolition Schedule: Indicate overall schedule and interruptions required for utility and building services.
C. Shop Drawings:
   1. Indicate demolition and removal sequence.
   2. Indicate location of items designated for Owner’s retention.
   3. Indicate location and construction of temporary work.

1.3 CLOSEOUT SUBMITTALS
A. Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition and subsurface obstructions.

1.4 QUALITY ASSURANCE
A. Conform to applicable code for demolition work, dust control, products requiring electrical disconnection and re-connection.
B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.
C. Obtain required permits from authorities having jurisdiction.

1.5 SCHEDULING
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Schedule Work to coincide with new construction.
C. Coordinate utility and building service interruptions with Owner.
   1. Schedule tie-ins to existing systems to minimize disruption.
   2. Coordinate Work to ensure fire sprinklers, fire alarms, smoke detectors, emergency lighting, exit signs and other life safety systems remain in full operation in occupied areas.

1.6 PROJECT CONDITIONS
A. Conduct demolition to minimize interference with adjacent building areas.
B. Cease operations immediately if structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.
PART 2 - PRODUCTS

2.1 Not Used.

PART 3 - EXECUTION

3.1 PREPARATION

A. Notify affected utility companies before starting work and comply with their requirements.
B. Mark location and termination of utilities.
C. Erect, and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the public, Owner, and existing improvements indicated to remain.
D. Erect and maintain weatherproof closures for exterior openings.
E. Prevent movement of structure; provide temporary bracing and shoring required to ensure safety of existing structure.
F. Provide appropriate temporary signage including signage for exit or building egress.
G. Do not close or obstruct building egress path.

3.2 SALVAGE REQUIREMENTS

A. Coordinate with Owner to identify building components and equipment required to be removed and delivered to Owner.
B. Tag components and equipment Owner designates for salvage.
C. Protect designated salvage items from demolition operations until items can be removed.
D. Carefully remove building components and equipment indicated to be salvaged.
E. Disassemble as required to permit removal from building.
F. Package small and loose parts to avoid loss.
G. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.
H. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.
I. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

3.3 DEMOLITION

A. Conduct demolition to minimize interference with adjacent building areas.
B. Maintain protected egress from and access to adjacent existing buildings at all times.
C. Do not close or obstruct roadways without prior approval of Owner.
D. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer.
E. Disconnect and remove designated utilities within demolition areas.
F. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate Record Drawings indicating location and type of service for capped utilities remaining after demolition.
G. Demolish in orderly and careful manner. Protect existing improvements, supporting structural members.
H. Carefully remove building components indicated to be reused.
   1. Disassemble components as required to permit removal.
   2. Package small and loose parts to avoid loss.
   3. Mark components and packaged parts to permit reinstallation.
   4. Store components, protected from construction operations, until reinstalled.
I. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.
J. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.
K. Remove temporary Work.

3.4 SCHEDULES

A. Remove, store and protect the following materials and equipment:
   1. Javelina Display.
a. Owner will crate this display prior to beginning of construction. The display is too large to fit through doors. Contractor will be responsible for protection of crated display and move as necessary to protect it and facilitate construction.

B. Salvage the following materials:
   1. Limestone veneer at existing Comfort Station.
      a. Remove, clean, and prep for re-installation at new Comfort Station.

C. Demolish the following materials and equipment:
   1. Flooring materials.
   2. Ceiling Materials.
   3. HVAC, Electrical, and Plumbing materials.
   4. Wood framed partitions and gypsum board from framing to remain.
   5. Doors, windows, storefront.
   6. Steel Framing and roofing at northwest vestibule.
   7. Other items indicated or implied on the Drawings.

D. Reference Drawings for more information.

END OF SECTION 02 4119.13
The Agreement, General Conditions Of The Contract For Construction, Supplementary Conditions Of The Contract For Construction, and all Addenda are a part of the Contract. The Contractor shall consult them in detail for instructions pertaining to the Work. The Contractor shall also consult all other divisions and sections of the Project Manual, and all Drawings in the execution of the work of the Contract.

The Contractor shall provide all labor, materials, systems, equipment, items, articles, operations, and/or methods listed, implied, mentioned, or scheduled in the Contract Documents and/or necessary and/or required for the satisfactory completion of the Work.

The listing of work, requirements, and products in this section is not intended to be conclusive. The Contractor shall check all other parts of the Contract Documents and shall provide all miscellaneous items of work and products necessary for the satisfactory completion of the Work described in the Contract Documents.
SECTION 03 1100
CONCRETE FORMING

PART 1 - GENERAL

1.1 WORK INCLUDED
A. Formwork for cast-in-place concrete, with shoring, bracing, and anchorage.
B. Openings for other affected work.
C. Form accessories.
D. Stripping forms.

1.2 WORK INSTALLED BUT FURNISHED UNDER OTHER SECTIONS
A. Section 05 5000 - Metal Fabrication: Metal fabrications attached to formwork.

1.3 RELATED WORK
A. Section 03 2000 - Concrete Reinforcing.
B. Section 03 3000 - Cast-In-Place Concrete.

1.4 REFERENCES
A. ACI 301 - Specifications for Structural Concrete for Buildings.
B. ACI 347 - Recommended Practice for Concrete Formwork.
C. PS 1 - Construction and Industrial Plywood.

1.5 SYSTEM DESCRIPTION
A. Design, engineer, and construct formwork, shoring, and bracing to meet design and code requirements, so that resultant concrete conforms to required shapes, lines, and dimensions.

1.6 QUALITY ASSURANCE
A. Construct and erect concrete formwork in accordance with ACI 301.

1.7 REGULATORY REQUIREMENTS
A. Conform to applicable codes for Monahans, Texas.

1.8 SUBMITTALS
A. Submit shop drawings under Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 6.3 and article 12.
B. Indicate pertinent dimensions, materials, and arrangement of joints and ties.

1.9 DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, and handle materials under provisions of Section 01 6000.
B. Deliver form materials in manufacturer's packaging with installation instructions.
C. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

PART 2 - PRODUCTS

2.1 FORM MATERIALS
A. Plywood: Douglas Fir species; solid one exterior side grade; sound, undamaged sheets with straight edges.
B. Lumber: SYP species; #2 grade; with grade stamp clearly visible.
C. Pan Type: Steel type: removable; of size and profile required.

2.2 FORMWORK ACCESSORIES
A. Form Ties: Snap-off metal of fixed length; cone type; 1-inch break back dimension; free of defects that will leave holes no larger than one-inch diameter in concrete surface.
B. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.
C. Fillets for Chamfered Corners: Wood strips type; 3/4 x 3/4 inch size; maximum possible lengths.
D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required; of strength and character to maintain formwork in place while placing concrete.

PART 3 - EXECUTION

3.1 INSPECTION
   A. Verify lines, levels, and measurements before proceeding with formwork.

3.2 PREPARATION
   A. Hand-trim sides and bottoms of earth forms; remove loose dirt prior to placing concrete.
   B. Arrange and assemble formwork to permit dismantling, stripping, so that concrete is not damaged during its removal.
   C. Arrange forms to allow stripping without removal of principal shores, where required to remain in place.

3.3 ERECTION
   A. Provide bracing to ensure stability of formwork. Strengthen formwork liable to be overstressed by construction loads.
   B. Camber slabs and beams to achieve ACI 301 tolerances.
   C. Provide temporary ports in formwork to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close ports with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.
   D. Provide chamfer strips on external corners of all exposed concrete.
   E. Construct formwork to maintain tolerances in accordance with ACI 301.

3.4 APPLICATION OF FORM RELEASE AGENT
   A. Apply form release agent on formwork in accordance with manufacturer's instructions. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.
   B. Do not apply form release agent where concrete surfaces are scheduled to receive special finishes or applied coverings which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS
   A. Provide formed openings where required for work embedded in or passing through concrete.
   B. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
   C. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

3.6 FORM REMOVAL
   A. Notify Architect/Engineer prior to removing formwork.
   B. Do not damage concrete surfaces during form removal.
   C. Remove formwork in same sequence as concrete placement to achieve similar concrete surface coloration.
   D. Do not remove forms and shoring until concrete has sufficient strength to support its own weight, and construction and design loads which may be imposed upon it. Remove load supporting forms when concrete has attained 75 percent of required 28-day compressive strength, provided construction is reshored.

3.7 CLEANING
   A. Clean forms to remove foreign matter as erection proceeds.
   B. Ensure that water and debris drain to exterior through clean-outports.
   C. During cold weather, remove ice and snow from forms. Do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and construction proceed within heated enclosure. Use compressed air to remove foreign matter.

END OF SECTION 03 11 00
SECTION 03 2000
CONCRETE REINFORCING

PART 1 - GENERAL

1.1 WORK INCLUDED
A. Reinforcing steel bars, for cast-in-place concrete.
B. Support chairs, bolsters, bar supports, and spacers, for supporting reinforcement.

1.2 RELATED WORK
A. Section 03 1100 - Concrete Forming.
B. Section 03 3000 - Cast-In-Place Concrete: Concrete placement and vapor barrier.

1.3 REFERENCES
A. ACI 301 - Specifications for Structural Concrete for Buildings.
B. ACI 315 - Details and Detailing of Concrete Reinforcement.
C. ANSI/ASTM A82 - Cold Drawn Steel Wire for Concrete Reinforcement.
D. ANSI/AWS D1.4 - Structural Welding Code Reinforcing Steel.
E. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
G. CRSI 63 - Recommended Practice for Placing Reinforcing Bars.
H. CRSI 65 - Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.

1.4 QUALITY ASSURANCE
A. Perform concrete reinforcement work in accordance with CRSI Manual of Standard Practice, and
   Documents 63 and 65.
B. Conform to ACI 301.

1.5 FIELD SAMPLES
A. Provide reinforcement for field sample specified in Sections 03 1100 and 03 3000.

1.6 SHOP DRAWINGS
A. Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph
   6.3 and article 12.
B. Indicate sizes, spacings, locations and quantities of reinforcing steel, bending and cutting
   schedules, splicing, stirrup spacing, supporting and spacing devices.

1.7 CERTIFICATES
A. Submit mill test certificates of supplied concrete reinforcing, indicating physical and chemical
   analysis.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Reinforcing Steel: ASTM A615, 60 ksi yield grade billet-steel deformed bars, uncoated finish.

2.2 ACCESSORY MATERIALS
A. Tie Wire: Minimum 16 gage annealed type, or acceptable patented system.
B. Metal Chairs, Bolsters, Bar Supports, and Spacers: Sized and shaped for strength and support of
   reinforcement during installation and placement of concrete including load bearing pad on bottom to
   prevent vapor barrier puncture. Supports to be spaced a maximum of 4'-0" on center each way.

2.3 FABRICATION
A. Fabricate in accordance with ACI 315, providing concrete cover specified in Section 03 30 00.
B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate
   location of splices on shop drawings.
PART 3 - EXECUTION

3.1 INSTALLATION
   A. Before placing concrete, clean reinforcement of foreign particles or coatings.
   B. Place, support, and secure reinforcement against displacement. Do not deviate from alignment or measurement.
   C. Do not displace or damage vapor barrier required by Section 03 3000.

END OF SECTION 03 2000
PART 1 - GENERAL

1.1 WORK INCLUDED
   A. Cast-in-place concrete foundation footings.
   B. Floors and slabs on fill on vapor barrier.
   C. Concrete fill in Reinforced Unit Masonry.

1.2 RELATED WORK
   A. Section 03 1100 - Concrete Forming.
   B. Section 03 2000 - Concrete Reinforcing.
   C. Section 03 3900 - Concrete Curing.

1.3 REFERENCES
   A. ACI 301 - Specifications for Structural Concrete for Buildings.
   B. ASTM C33 - Concrete Aggregates.
   C. ASTM C94 - Ready-Mixed Concrete.
   D. ASTM C150 - Portland Cement.
   E. ASTM C260 - Air-Entraining Admixtures for Concrete.
   F. ASTM C494 - Chemical Admixtures for Concrete.

1.4 QUALITY ASSURANCE
   A. Perform work in accordance with ACI 301.
   B. Obtain materials from same source throughout the Work.

1.5 REGULATORY REQUIREMENTS
   A. Conform to applicable codes for Monahans, Texas.

1.6 FIELD SAMPLES
   A. Uniform General Conditions of the Contract, especially paragraph 8.4.
   B. Use specified concrete.
   C. Obtain acceptance of surface finish.
   D. Maintain sample panel exposed to view for duration of concrete work. Remove when directed.

1.7 TESTS
   A. Uniform General Conditions of the Contract, especially article 8.2.
   B. Submit proposed mix design of each class of concrete to appointed firm for review prior to commencement of work.
   C. Testing firm will take cylinders and perform slump and air entrainment tests in accordance with ACI 301.
   D. Tests of cement and aggregates will be performed to ensure conformance with requirements stated herein.
   E. Three concrete test cylinders will be taken for every 75 or less cu yds of each class of concrete placed each day.
   F. One additional test cylinder will be taken during cold weather and cured on site under same conditions as concrete it represents.
   G. One slump test will be taken for each set of test cylinders taken.

1.8 PRODUCT DATA
   A. Submit product data under Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
   B. Provide product data for specified products.
   C. Submit manufacturers' instructions under provisions of Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS
   A. Cement: ASTM C150, normal - Type I Portland type; grey color.
   C. Water: Clean, potable, and not detrimental to concrete.

2.2 ADMIXTURES
   A. Air Entrainment: ASTM C260.
   B. Chemical Admixture: ASTM C494, Type A - water reducing.

2.3 ACCESSORIES
   A. Vapor Barrier:
      1. Vapor Barrier must have the following qualities
         a. WVTR less than or equal to 0.006 gr/ft²/hr as tested by ASTM E 96
         b. ASTM E 1745 Class A (Plastics)
      2. Vaport Barrier Products
         a. Stego Wrap (15-mil) Vapor Barrier by STEGO INDUSTRIES LLC, San Juan Capistrano, CA (877) 464-7834 www.stegoindustries.com
   B. Vapor Retarding Seam Tape
      1. Tape must have the following qualities:
         a. Water Vapor Transmission Rate ASTM E 96 0.3 perms or lower
   C. Vapor Proofing Mastic
      1. Mastic must have the following qualities:
         a. Water Vaport Transmission Rate ASTME 96 0.3 perms or lower
   D. Pipe Boots
      1. Construct piper boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer’s instruction.
   E. Non-shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 5000 psi in 28 days.

2.4 CONCRETE MIX
   A. Mix concrete in accordance with ASTM C94.
   B. Provide concrete of the following characteristics:
      1. Comprehensive Strength (28 days): 3000 psi
      2. Slump: Slabs 5”
         All others 4”
   C. Provide a minimum of 5 sacks of cement per cubic yard of concrete, with a maximum water cement ratio of 0.58 for non-air-entrained concrete and 0.46 for air-entrained concrete.
   D. Use accelerating admixtures in cold weather only when approved by Architect/Engineer. Use of admixtures will not relax cold weather placement requirements.
   E. Use set-retarding admixtures during hot weather only when approved by Architect/Engineer.
   F. Add air entraining agent to concrete mix for concrete work subject to freeze-thaw cycling.
   G. No water shall be added to concrete at the site without consent of the testing lab.
   H. Fly-Ash used in concrete mixes shall be limited to not more than 20% replacement.

PART 3 - EXECUTION

3.1 INSPECTION
   A. Verify anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.

3.2 PREPARATION
   A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.
      Apply bonding agent in accordance with manufacturer's instructions.
   B. At locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels, and set with Hilti HIT HY150 Adhesive or approved equal.
C. Install vapor barrier under interior slabs on fill. Lap joints minimum 6 inches tape and seal. Do not disturb or damage vapor barrier while placing concrete. Repair damaged vapor barrier.

3.3 PLACING CONCRETE
A. Notify Architect/Engineer minimum 36 hours prior to commencement of concreting operations.
B. Place concrete in accordance with ACI 301.
C. Hot Weather Placement: ACI 305.
D. Cold Weather Placement: ACI 306.
E. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
F. Maintain concrete cover around reinforcing as follows:
   - Walls (Exposed to Weather or Backfill) 2 inch
   - Footings and Concrete Formed Against Earth 3 inch
   - Slabs on Fill 1 1/2 inch
G. Place concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours such that cold joints occur.
H. Place floor slabs on fill in checkerboard pattern.
I. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.

3.4 FINISHING
A. Provide concrete surfaces to be left exposed with smooth rubbed finish.
B. Provide Class A tolerances to floor slabs according to ACI 301.
C. Pitch to drains 1/4 inch per foot nominal, or as shown on plans.

3.5 PATCHING
A. Notify Architect/Engineer immediately upon removal of forms.
B. Patch imperfections.

3.6 DEFECTIVE CONCRETE
A. Modify or replace concrete not conforming to required levels and lines, details, and elevations.
B. Repair or replace concrete not properly placed or not of the specified type and/or compressive strength, at no expense to owner.

3.7 FIELD QUALITY CONTROL
A. Uniform General Conditions of the Contract, especially article 8.2. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.8 PROTECTION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.
B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

END OF SECTION 03 3000
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Finishing concrete floors and floor toppings.
   2. Floor surface treatment.
B. Related Sections:
   1. Section 03 3000 - Cast-In-Place Concrete: Prepared concrete floors ready to receive finish; control and formed expansion and contraction joints and joint devices.
   2. Section 03 3543 – Polished Concrete Finishing
   3. Section 03 3900 - Concrete Curing.
   4. Section 07 9000 - Joint Protection.

1.2 REFERENCES
A. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
B. ASTM International:
   1. ASTM E1155 - Standard Test Method for Determining Fr Floor Flatness and Ft Floor Levelness Numbers.
C. California Department of Health Services:

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit data on concrete hardener and sealer compatibilities, and limitations.

1.4 CLOSEOUT SUBMITTALS
A. Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Operation and Maintenance Data: Submit data on maintenance renewal of applied coatings.

1.5 QUALITY ASSURANCE
A. Perform Work in accordance with ACI 301 and ACI 302.1.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
B. Applicator/Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Deliver materials in manufacturer's packaging including application instructions.

1.8 ENVIRONMENTAL REQUIREMENTS
A. Temporary Lighting: Minimum 200 W light source, placed 8 feet above floor surface, for each 425 sq ft of floor being finished.
B. Temporary Heat: Ambient temperature of 50 degrees F minimum.
C. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

1.9 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate the Work with concrete floor placement and concrete floor curing.
PART 2 - PRODUCTS

2.1 COMPOUNDS - HARDENERS AND SEALERS

A. Clear Sealer: Type SL-UT.
   1. Manufacturers:
      a. Scofield Systems; Cementone Clear Sealer.
      b. Triangle Coatings: W1-01 White Mountain Crystal Seal.
      c. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
   2. VOC: < 100 g/L.
   3. For application at exposed concrete that is not stained.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify floor surfaces are acceptable to receive the Work of this section.

3.2 FLOOR FINISHING

A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1.
B. Steel trowel surfaces receiving thin set terrazzo.
C. Steel trowel surfaces which are scheduled to be exposed.
D. In areas with floor drains, maintain design floor elevation at walls; slope surfaces uniformly to drains at 1/8 inch per foot nominal and as indicated on Drawings.
E. Broom finish at exterior concrete

3.3 FLOOR SURFACE TREATMENT

A. Apply sealer as scheduled on floor surfaces.

3.4 TOLERANCES

A. Measure for FF and FL tolerances for floors in accordance with ASTM E1155, within 48 hours after slab installation.
B. Finish concrete to achieve the following tolerances:
   1. Under Resilient, Thin-set Flooring, and areas not outlined otherwise in this article: FF 35 (specified overall) FF 24 (minimum local) and FL 35 (specified overall) FL 24 (minimum local).
   2. Exposed to View and Foot Traffic: FF 45 (specified overall) FF 30 (minimum local) and FL 35 (specified overall) FL 24 (minimum local).
   3. Areas where polished concrete finishing is scheduled: FF 50 (specified overall) FF 45 (minimum local) and FL 30 (specified overall) FL 25 (minimum local).
   4. Exposed to view in utility areas (mechanical, electrical, general storage): FF 25 (specified overall) FF 17 (minimum local) and FL 20 (specified overall) FL 15 (minimum local).
   5. Correct slab surface when actual FF or FL number for floor installation measures less than required.
C. Correct defects in defined traffic floor by grinding, removal and replacement of defective Work, or other methods approved by Architect. Areas requiring corrective Work will be identified. Re-measure corrected areas by same process.

3.5 SCHEDULES

A. Clear Sealer: Clear sealer type SL-UT
   1. Locations: All interior concrete floors not scheduled to receive another floor finish.
B. Reference finish schedule and floor finish plan for more information.

END OF SECTION 03 3500
1.1 SUMMARY
A. Section Includes:
   1. Polished Concrete Floor System.
B. Related Sections:
   1. Section 03 3000 - Cast-In-Place Concrete: Prepared concrete floors ready to receive finish; control and formed expansion and contraction joints and joint devices.
   2. Section 03 3900 - Concrete Curing.
   3. Section 07 9000 - Joint Protection.

1.2 REFERENCES
A. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
B. American National Standards Institute (ANSI)
C. ASTM International:
   1. ASTM C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
D. California Department of Health Services:
E. National Floor Safety Institute (NFSI)

1.3 SYSTEM DESCRIPTION
A. Installation of polished concrete floor system for existing interior concrete floors by dry grinding and polishing with various size grit metal-bonded and resin-bonded diamonds and application of concrete densifier.

1.4 PERFORMANCE REQUIREMENTS
A. Improve performance of floor by installation of polished concrete floor system as measured by the following criteria:
   1. Static Coefficient of Friction, ASTM C1028:
      a. Dry Surface: 0.47
      b. Wet Surface: 0.62
   2. Specular Gloss/Reflectance, ASTM D523:
      a. 20 degrees: 6.4 degrees.
      b. 60 degrees: 40.3 degrees.
      c. 85 degrees: 84.7 degrees
   3. Floor Surface Profile, ASTM E1155:
      a. Floor Flatness Number (Ff): 50 (specified overall), 45 (minimum local).
      b. Floor Levelness Number (Fl): 35 (specified overall), 30 (minimum local).

1.5 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit data on concrete densifier, sealer, including compatibilities, and limitations.
C. Manufacturer's Installation Instructions: Surface preparation and installation instructions.
D. Manufacturer's Certifications:
   1. Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
2. Letter of certification from the National Floor Safety Institute confirming the system has been tested and passed phase Two Level of certification when tested by Method 101-A. ANSI B-101.1 2009 non-slip properties.
E. Installer's Certification: Submit IPCI certification of installer and installer's employees.
F. Installer's Project References: Submit installer's list of successfully completed polished concrete floor system projects, including project name and location, name of architect, and type and quantity of polished concrete floor system installed.
G. Maintenance Manual: Submit installer's maintenance manual, including maintenance and cleaning instructions for polished concrete floor system.

1.6 CLOSEOUT SUBMITTALS
A. Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Operation and Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

1.7 QUALIFICATIONS
A. Installers Qualifications:
   1. Certified IPCI installer.
   2. Employ IPCI Certified Craftsmen for installation of polished concrete floor system.
   3. Employ a minimum of one IPCI Certified Craftsmen for installation of polished concrete floor system.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
B. Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
C. Keep materials from freezing.
D. Protect materials during handling and application to prevent contamination or damage.

1.9 ENVIRONMENTAL REQUIREMENTS
A. Temporary Lighting: Minimum 200 W light source, placed 8 feet above floor surface, for each 425 sq ft of floor being finished.
B. Temporary Heat: Ambient temperature of 50 degrees F minimum.
C. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

1.10 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate the Work with concrete placement, floating, troweling and curing to ensure cured surface is acceptable for polishing. Ensure curing compounds, sealers, hardeners, etc. are compatible with polishing system.
C. It shall be the sole responsibility of the general contractor to provide temporary surface protection for those floor areas scheduled to receive a polished concrete finish during the course of construction in preparation for the concrete finishing. Reference Surface Preparation Requirements in Part 3 of this Section.

PART 2 - PRODUCTS

2.1 INSTALLER
A. Consult IPCI to find certified IPCI installers
   1. International Polished Concrete Institute, PO Box 1174, Norris, Tennessee 37828. Toll Free (866) 421-9550. Fax (865) 494-0872. Website www.ipcionaline.org. E-mail info@ipcionaline.org.
   2. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.2 EQUIPMENT TO BE USED FOR INSTALLATION
A. Floor Grinder:
   1. Model: Concrete Polishing Solutions "G-320". (or approved equal)
2. Type: Multi-orbital, planetary-action, opposing-rotational, diamond-headed floor grinder.
3. Weight: 850 pounds.
5. Grinding Width: 32 inches.
6. Motor: 15 HP.
7. Maximum RPM: 1,750.
8. Head: 3-head system contours to floor surface.

B. Vacuum System:
1. Model: Concrete Polishing Solutions “CAT5 Dust Extractor”. (or approved equal)
2. Filtration: Direct-connect, HEPA filtration system.

C. Diamond Tooling for Coating Removal, Initial Grinding, and Preparing Floor for Polishing:
1. Concrete Polishing Solutions “MFL” 16-grit metal-bonded diamonds. (or approved equal)
2. Concrete Polishing Solutions “MFL” 40-grit metal-bonded diamonds. (or approved equal)
3. Concrete Polishing Solutions “MFL” 80-grit metal-bonded diamonds. (or approved equal)
4. Concrete Polishing Solutions “MFL” 150-grit metal-bonded diamonds. (or approved equal)

D. Diamond Tooling for Polishing Concrete:
1. Concrete Polishing Solutions “GST” 100-grit resin-bonded diamonds. (or approved equal)
2. Concrete Polishing Solutions “GST” 200-grit resin-bonded diamonds. (or approved equal)
3. Concrete Polishing Solutions “GST” 400-grit resin-bonded diamonds. (or approved equal)
4. Concrete Polishing Solutions “GST” 800-grit resin-bonded diamonds. (or approved equal)

2.3 MATERIALS
A. Concrete Densifier:
1. Concrete Polishing Solutions “Armor Densifier MFL”. (or approved equal)
   a. Permanent sealing, densifying, and hardening compound for concrete.
   b. Odorless.
   c. VOC: 0.
   d. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
2. Concrete Sealer:
   a. Concrete Polishing Solutions “Armor Stain Shield MFL”. (or approved equal)
   b. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Examine floor to receive polished concrete floor system.
B. Notify Architect of conditions that would adversely affect installation or subsequent use.
C. Do not begin surface preparation or installation until unacceptable conditions are corrected.
   1. Concrete Compressive Strength: 3,500 psi to 5,000 psi.
   2. Lightweight Concrete: Not allowed if aggregate exposure is required.
   3. Concrete Curing: Minimum 8 days water cured.
   4. Concrete Adjacent to Floor Penetrations: Trowelled flat and level with surrounding concrete.
   5. Concrete Adjacent to Drains, clean-outs, etc.: Finish level to the top of the structure.

3.2 SURFACE PREPARATION
A. Protection prior to polishing:
   1. The contractor shall provide temporary protective floor coverings to protect the concrete floor surfaces from chemical and/or oil contamination & physical surface damage due to impact and/or abrasion.
   2. Temporary coverings shall be properly & effectively secured in place to prevent removal or adjustment utilizing non-mechanical fastening means only. Refer also to the Delivery, Handling, and Storage requirements in Part 1 of this Section.
B. Protection: Protect surrounding areas and adjacent surfaces from the following:
   1. Minimal accumulation of dust from grinding and polishing.
   2. Contact with overspray of concrete densifier.
3. Contact with overspray of concrete sealer.

C. Rehabilitate Existing Concrete Floors:
   1. Remove existing floor coverings, including carpet, tile, VCT, etc.
   2. Remove all adhesives, float, paint, extraneous mortar or grout, etc. to expose a bare concrete surface.
   3. Where minor cracking, spalling, dips, etc. are in the concrete surface, fill with Sika-Quik EZ Patch or approved equal.
   4. Where trenching, coring, or filling of existing holes, etc. is required, rehabilitate existing floor fill with concrete patching as specified in Section 03 3000.

D. Preparation: Prepare surfaces in accordance with installer’s instructions.

E. Clean Surfaces: Remove dirt, dust, debris, oil, grease, curing agents, bond breakers, paint, coatings, and other surface contaminants which could adversely affect installation of polished concrete floor system.

### 3.3 INSTALLATION

A. Install polished concrete floor system in accordance with installer’s instructions at locations indicated on the Drawings.

B. Aggregate Exposure:

C. Polished Concrete Floor System: IPCI Sheen Level 3 – Median Gloss.
   1. Preparation Step:
      a. Remove existing floor coatings by grinding with 16-grit metal-bonded diamonds.
      b. Remove existing floor coatings and level floor by grinding with 40-grit metal-bonded diamonds.
      c. Open-up concrete to accept concrete densifier by grinding with 80-grit metal-bonded diamonds.
   2. Apply concrete densifier to deeply saturate floor.
   3. Remove residue of concrete densifier dried on floor surface by grinding with 150-grit metal-bonded diamonds.
   4. Floor Closure Polishing:
      a. Remove 150-grit metal-bonded diamond scratches by grinding with 100-grit resin-bonded diamonds.
      b. Remove 150-grit metal-bonded and 100-grit resin-bonded diamond scratches by grinding with 200-grit resin-bonded diamonds.
      c. Prepare floor for polishing by grinding with 400-grit resin-bonded diamonds.
      d. Achieve light-reflective finish when viewed from a distance of 30 feet by grinding with 800-grit resin-bonded diamonds.
   5. Apply concrete sealer.

D. Hand Tooling: When applicable for project, utilize similar grinding and polishing process to blend, with a variable speed polisher, the edges of perimeter areas where obstructions lie.

### 3.4 FIELD QUALITY CONTROL

A. Inspect completed polished concrete floor system with Owner, Contractor, Architect, and Installer.

B. Review procedures with Architect to correct unacceptable areas of completed polished concrete floor system.

C. Uniform General Conditions of the Contract, especially article 8.2.
   1. Testing: Test the following from completed polished concrete floor system:
      a. Static Coefficient of Friction, ASTM C 1028:
         1) Dry Surface: 0.47
         2) Wet Surface: 0.62
      b. Specular Gloss/Reflectance, ASTM D523:
         1) 20 degrees: 6.4 degrees
         2) 60 degrees: 40.3 degrees
         3) 85 degrees: 84.7 degrees
      c. Floor Surface Profile, ASTM E1155:
         1) Floor Flatness Number ($F_r$): 50 (specified overall), 45 (minimum local).
2) Floor Levelness Number (FL): 35 (specified overall), 30 (minimum local).

2. Test Results:
   a. Report test results in writing to Owner, Contractor, and Architect within 24 hours after tests.
   b. Compare test results from tests performed before and after installation of polished concrete floor system.

3.5 PROTECTION
A. Protect cast concrete from damage before polishing. Protect completed polished concrete floor system from damage until Substantial Completion.
   1. Do not allow vehicle and pedestrian traffic on unprotected floor.
   2. Do not allow construction materials, equipment, and tools on unprotected floor.
   3. Pipe cutting machines are strictly prohibited from placement/operation on the concrete.
   4. Steel shall not be placed on the slab to avoid rust stains.
   5. Acids and acid detergents shall not be used nor come in contact with the slab.
   6. Drop cloths must be utilized to prevent overspray or spillage.
   7. Contractor shall advise all trades that the slab must be protected at all times.
B. Immediately remove mortar splatter, spilled liquids, oil, grease, paint, coatings, and other surface contaminants which could adversely affect completed polished concrete floor system.
C. Repair damaged areas of completed polished concrete floor system to satisfaction of Architect.

3.6 SCHEDULES
A. Reference finish schedules and floor finish plans in the drawings.
B. Polished Concrete in Visitors Center Building as indicated in the drawings.

END OF SECTION 03 3543
PART 1   GENERAL

1.1 WORK INCLUDED
   A. Concrete curing materials and methods.
   B. Surfaces of concrete not finished with sealer and hardener as specified in 03 3300.

1.2 RELATED WORK
   A. Section 03 3000 - Cast-In-Place Concrete.
   B. Section 03 3500 - Concrete Floor Finishes.

1.3 REFERENCES
   A. ACI 301 - Specifications for Structural Concrete for Buildings.
   B. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
   C. ASTM D2103 - Polyethylene Film and Sheeting.
   D. FS TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces.

1.4 QUALITY ASSURANCE
   A. Conform to requirements of ACI 301.

1.5 PRODUCT DATA
   A. Submit product data under provisions of the Uniform General Conditions of the Contract.
   B. Submit manufacturers' installation instructions under provisions of the UGC.

1.6 ENVIRONMENTAL REQUIREMENTS
   A. Maintain ambient temperature at 70 degrees F for three days.

PART 2 - PRODUCTS

2.1 MATERIALS
   A. Water: Clean and not detrimental to concrete.
   B. Membrane Curing Compound: ASTM C30

2.2 ACCEPTABLE PRODUCTS
   A. Master Builders:
   B. L&M Construction Chemicals: Surfaseal
   C. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

PART 3 - EXECUTION

3.1 INSPECTION
   A. Verify concrete surfaces are ready for curing.

3.2 MEMBRANE CURING COMPOUND
   A. Apply curing compound in two coats with second coat at right angles to first.
   B. Apply in accordance with manufacturers' instructions.

END OF SECTION 03 3900
DIVISION 4
MASONRY


THE CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS, SYSTEMS, EQUIPMENT, ITEMS, ARTICLES, OPERATIONS, AND/OR METHODS LISTED, IMPLIED, MENTIONED, OR SCHEDULED IN THE CONTRACT DOCUMENTS AND/OR NECESSARY AND/OR REQUIRED FOR THE SATISFACTORY COMPLETION OF THE WORK.

THE LISTING OF WORK, REQUIREMENTS, AND PRODUCTS IN THIS SECTION IS NOT INTENDED TO BE CONCLUSIVE. THE CONTRACTOR SHALL CHECK ALL OTHER PARTS OF THE CONTRACT DOCUMENTS AND SHALL PROVIDE ALL MISCELLANEOUS ITEMS OF WORK AND PRODUCTS NECESSARY FOR THE SATISFACTORY COMPLETION OF THE WORK DESCRIBED IN THE CONTRACT DOCUMENTS.
1. **PART 1 - GENERAL**

1.1 **SUMMARY**

A. Section Includes: Mortar for masonry.

B. Related Requirements:
   1. Section 04 2000 - Unit Masonry: Installation of mortar.
   2. Section 04 4213 - Masonry Supported Stone Cladding: Installation of mortar.

C. American Concrete Institute:

D. ASTM International:

1.2 **SUBMITTALS**

A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Design Data: Submit required environmental conditions, admixture limitations, and design mix if property specification of ASTM C270 is to be used.

D. Test and Evaluation Reports:
   1. Indicate compliance of component mortar materials to requirements of ASTM C270.

E. Qualifications Statement:
   1. Submit qualifications for manufacturer.

1.3 **SUSTAINABLE DESIGN SUBMITTALS**

A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.

B. Manufacturer's Certificate: Certify that following products meet or exceed specified sustainable design requirements:
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.

C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for following products:
      a. Products with recycled material content.

1.4 **QUALITY ASSURANCE**

A. Comply with ACI 530/530.1.

1.5 **QUALIFICATIONS**

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:
   1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
   2. Provide additional protection according to manufacturer instructions.
1.7 AMBIENT CONDITIONS
   A. Cold Weather Requirements: Comply with ACI 530/530.1 if ambient temperature or temperature of masonry units is less than 40 degrees F.
   B. Hot Weather Requirements: Comply with ACI 530/530.1 if ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

PART 2 - PRODUCTS

2.1 MORTAR
   A. Manufacturers:
      1. Ash Grove
      2. Buzzi Unicem USA/Alamo Cement
      3. Capitol Aggregates
      4. Cemex USA
      5. GCC
      6. LaFarge Holcim
      7. Martin Marietta
      8. Texas Lehigh Cement Company.
      9. The Quikrete Companies.
      10. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.2 SUSTAINABILITY CHARACTERISTICS
   A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
   B. Material and Resource Characteristics:
      1. Recycled Content Materials: Furnish materials with maximum available recycled content.

2.3 MATERIALS
   A. Portland Cement:
      1. Comply with ASTM C150, Type I.
      2. Color: Gray.
   B. Mortar Aggregate:
      1. Comply with ASTM C144.
      2. Type: Standard masonry.
   C. Hydrated Lime: Comply with ASTM C206, Type S.
   D. Water: Clean and potable.
   E. Water Repellents:
      1. Type: Liquid.
      2. Dry-Block Mortar Admixture, as manufactured by GCP Applied Technologies as basis of design.
   F. Calcium Chloride: Not allowed.

2.4 MIXES
   A. Mortar for Structural Masonry: Comply with ASTM C270, Type S using proportion specification.
   B. Mortar for Non-Structural Masonry: Comply with ASTM C270, Type S using proportion specification.
   C. Pointing Mortar: Comply with ASTM C270, Type N using proportion specification.

PART 3 - EXECUTION

3.1 PREPARATION
   A. Mortar Mixing:
      1. Thoroughly mix mortar ingredients according to ASTM C270 in quantities needed for immediate use.
      2. Achieve uniformly damp sand immediately before mixing process.
      3. Add admixtures to achieve uniform mix and coloration.
      4. Retemper only within two hours of mixing.
3.2 INSTALLATION
   A. According to ACI 530/530.1.

3.3 FIELD QUALITY CONTROL
   A. Uniform General Conditions of the Contract, especially article 8.2.
   B. Testing:
      1. Frequency: One set of specified tests for every 5,000 sq. ft. of completed wall area.
      2. Mortar Mix: Comply with ASTM C780 for aggregate ratio and water content, air content, consistency, and compressive strength.

3.4 ATTACHMENTS
   A. Exterior Cavity and Multi-wythe Walls: CMU and stone masonry with Type S mortar and Type N pointing mortar.
   B. Interior Veneer Walls: CMU and stone masonry with Type S mortar and Type N pointing mortar.

END OF SECTION 04 0513
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes: Grout for masonry.
B. Related Requirements:
   1. Section 04 2000 - Unit Masonry: Installation of grout.
   2. Section 08 1213.13 - Standard Hollow Metal Frames: Grouting of steel door frames.

1.2 REFERENCE STANDARDS
A. American Concrete Institute:
B. ASTM International:
   6. Delete if structural does not allow blended hydraulic cements.
   8. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
C. Test and Evaluation Reports: Submit compliance with grout property requirements according to ASTM C476, component grout materials according to ASTM C476, and test and evaluation reports according to ASTM C1019.

1.4 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify that following products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for following products:
      a. Products with recycled material content.

1.5 QUALITY ASSURANCE
A. Perform Work according to ACI 530/530.1.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
B. Store materials according to manufacturer instructions.
C. Protection:
   1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.7 AMBIENT CONDITIONS
   A. Cold Weather Requirements: According to ACI 530/530.1 if ambient temperature or temperature of masonry units is less than 40 degrees F.
   B. Hot Weather Requirements: According to ACI 530/530.1 if ambient temperature is greater than 100 degrees F or if ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

PART 2 - PRODUCTS

2.1 MASONRY GROUT
   A. Manufacturers:
      1. Ash Grove
      2. Buzzi Unicem USA/Alamo Cement
      3. Capitol Aggregates
      4. Cemex USA
      5. GCC
      6. Lafarge Holcim
      7. Martin Marietta
      8. Texas Lehigh Cement Company.
      9. The Quikrete Companies.
      10. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.2 SUSTAINABILITY CHARACTERISTICS
   A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
   B. Material and Resource Characteristics:
      1. Recycled Content Materials: Furnish materials with maximum available recycled content.

2.3 MATERIALS
   A. Portland Cement: Comply with ASTM C150, Type I.
   B. Grout Aggregate: Comply with ASTM C404, fine and coarse.
   C. Fly Ash: Comply with ASTM C618.
   D. Water: Clean and potable.
   E. Calcium Chloride: Not allowed.

2.4 MIXES
   A. Grout:
      1. Grout for Non-Structural Masonry:
         a. Compressive Strength: 3,000 psi at 28 days.
         b. Slump: 5 to 8 inches.
      2. Grout for Structural Masonry:
         a. Compressive Strength: 3000 psi at 28 days.
         b. Slump: 5 to 8 inches.
         c. Mixing: According to ASTM C476, fine, coarse.
      3. Application:
         a. Coarse Grout: Grouting spaces with minimum 4-inch dimension in each direction.
         b. Fine Grout: Grouting other spaces.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Request inspection of spaces to be grouted.

3.2 INSTALLATION
   A. Mixing:
1. Mix transit-mixed grout according to ASTM C94, as modified to use ingredients complying with ASTM C476.
2. Thoroughly mix site prepared grout ingredients in quantities needed for immediate use according to ASTM C476.
3. Add admixtures and mix uniformly.
B. Comply with ACI 530/530.1.

3.3 FIELD QUALITY CONTROL
A. Uniform General Conditions of the Contract, especially article 8.2.
B. Testing:
   1. Mix: Comply with ASTM C1019 for compressive strength, and comply with ASTM C143 for slump.

3.4 ATTACHMENTS
A. Masonry Bond Beams and Grouted Core Cells: 3,000 psi grout, fine aggregate.
B. Masonry Pilasters: 4,000 psi grout, coarse aggregate.

END OF SECTION 04 0516
1.1 SUMMARY
A. Section includes:
   1. Concrete masonry units
   2. Decorative concrete masonry.
   3. Reinforcement, anchorage, and accessories.
   4. Includes interior and exterior, load bearing and non-load bearing.
B. Related Sections:
   1. Section 03 2000 – Concrete Reinforcing: Product requirements for steel reinforcing in masonry cores for installation by this section.
   2. Section 03 3000 - Cast-In-Place Concrete: Concrete Foundation.
   5. Section 04 4213 - Masonry-Supported Stone Cladding: Stone Veneer supported by work of this section.
   6. Section 05 1200 - Structural Steel Framing: Product requirements for steel anchors for placement by this section.
   7. Section 05 5000 - Metal Fabrications: Product requirements for loose steel lintels, and fabricated steel items, for placement by this section.
   8. Section 05 5200 – Metal Railings: Metal Railings secured to masonry construction.
   9. Section 07 2113 - Board Insulation: Insulation for cavity spaces.
   10. Section 07 2726 – Fluid Applied Weather Barriers: Weather barriers applied to the masonry surfaces.
   11. Section 07 6200 - Sheet Metal Flashing and Trim: Product requirements for reglets for flashings for placement by this section.
   12. Section 07 9000 - Joint Protection: Rod and sealant at control joints.
   13. Section 08 1213.13 – Standard Hollow Metal Frames: Product requirements for door frame/window anchors for placement by this section.
   14. Section 08 4113 – Aluminum Framed Entrances and Storefronts.

1.2 REFERENCES
A. American Concrete Institute:
   1. ACI 315 – Details and Detailing of Concrete Reinforcement.
   2. ACI 530 - Building Code Requirements for Masonry Structures.
   3. ACI 530.1 - Specifications for Masonry Structures.
B. ASTM International:
   1. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   4. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
   5. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.
   6. ASTM C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.

1.3 COORDINATION
A. Coordinate masonry work with installation of window and door anchors and installation of structural framing supported by masonry.

1.4 PRE-INSTALLATION MEETINGS
A. Convene minimum one week prior to commencing work of this section.
B. Notify Architect/Engineer four days in advance of meeting date.
C. Shall be in conjunction with the pre-installation meeting for the stone cladding as specified in Section 04 4213.
D. Required attendees: Owner, Architect, General Contractor, and Masonry sub-contractor.

1.5 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data:
1. Submit data for masonry units and fabricated wire reinforcement, wall ties, anchors, flashings, and other accessories.
2. Provide printed recommendation from masonry units manufacturer for masonry cleaners.
C. Shop Drawings:
1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Include wall elevations indicating size and location of reinforcing, and length and location of reinforcing bar laps.
3. Fabricating Flashing: Detail corner units, end dam units, and other special conditions for fabricated flashings.

D. Samples: Submit four samples of decorative block, units to illustrate color, texture and extremes of color range.
E. Submit detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.
F. Manufacturer's Certificate: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
1. Masonry Units:
   a. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Reinforcing bars.
4. Joint reinforcement.

1.6 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
1. Materials Resources Certificates:
   a. Certify recycled material content for recycled content products.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
1. Provide cost data for the following products:
   a. Products with recycled material content.

1.7 QUALITY ASSURANCE
A. Perform Work in accordance with ACI 530 Building Code Requirements for Masonry Structures and ACI 530.1 Specification for Masonry Structures.
B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
1.8 QUALIFICATIONS
A. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.9 MOCKUP
A. Section 8.4 of the Uniform General Conditions of the Contract.
B. Construct cavity masonry wall mockup, minimum 8feet long by 9feet high, including masonry, mortar and accessories, structural backup, wall openings, flashings, wall insulation, weather barrier.
1. A mockup is required for each type of exterior wall.
2. Mock-up shall include all typical joints and transitions, including sill, head or top of wall, and where adjoining dissimilar materials. If the mock-up is to be erected within the project’s wall construction, the Contractor shall erect the mock-up to whatever size is required to illustrate all typical joints and transitions, but shall be at minimum the size indicated above.
C. Locate where directed by Architect/Engineer.
D. Accepted mockup in the building construction may be incorporated as completed Work.

1.10 DELIVERY, STORAGE, AND HANDLING
A. Accept decorative units on site. Inspect for damage.
B. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
F. Do not store reinforcing material directly on ground. Utilize blocking and other methods to prevent rust on accessories prior to installation.

1.11 ENVIRONMENTAL REQUIREMENTS
A. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.
  1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
B. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

1.12 EXISTING CONDITIONS
A. Field Measurements: Verify elevations, dimensions, and alignment of foundations and other supporting construction prior to beginning Work. Indicate field measurements on Shop Drawings.

1.13 MASONRY UNITS - GENERAL
A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

PART 2 - PRODUCTS
2.1 PERFORMANCE REQUIREMENTS
A. Concrete Masonry Compressive Strength: 2,000 psi; determined by unit strength method.
  1. Concrete Masonry Units: 3,250 psi minimum net area compressive strength.
B. Consult structural drawings for additional information regarding performance requirements.

2.2 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.

2.3 CONCRETE MASONRY ASSEMBLIES
A. Manufacturers:
   1. Best Block, a Quikcrete Company Standard Gray and Polished Series as basis of design
   2. Anchor, an Oldcastle Company., Standard CMU, Trendstone Plus, Versastone Plus
   3. Cemex USA, Grey Block, Polished Designer Stone.
   4. Texas Building Products, Gray Block, Polished Block.
   5. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.4 COMPONENTS
A. Hollow Load Bearing Concrete Masonry Units (CMU): ASTM C90; normal weight
   1. For all units manufacture with Dry Block block admixture, manufactured by WR Grace or equal.
B. Solid Load-Bearing Concrete Masonry Units (CMU): ASTM C90; normal weight.
   1. For all units manufacture with Dry Block block admixture, manufactured by WR Grace or equal.
C. Hollow and Solid Non-Load Bearing Concrete Masonry Units (CMU): ASTM C129; normal weight.
   1. For all units manufacture with Dry Block block admixture, manufactured by WR Grace or equal.
D. Decorative Concrete Masonry Units: ASTM C90; normal weight. For all units manufacture with Dry Block block admixture, manufactured by WR Grace or approved equal; Burnt Umber P7 color by Best Block as basis of design to the following design:
   1. Polished face.
E. Concrete Masonry Unit Size and Shape:
   1. Standard Hollow Units:
      a. Nominal modular size of 4x8x16 and 8x8x16 inches.
      b. Furnish special units for: Bond beams and lintels.
   2. Solid Units:
      a. Nominal modular size of 8x4x16.
      b. Chamfer edges as indicated in Drawings.

2.5 ACCESSORIES
A. Single Wythe Joint Reinforcement: ASTM A951/A951M; ladder type; steel; 0.148 inch diameter side rods with 0.148 inch diameter cross ties; hot dip galvanized.
B. Multiple Wythe Joint Reinforcement: ASTM A951/A951M; ladder type; steel; without moisture drip; eye and pintle type; 0.148 inch diameter side rods with 0.148 inch diameter cross ties; hot dip galvanized.
C. Reinforcing Steel: As specified in Section 03 2000.
D. Strap Anchors: bent steel shape, 1-1/4 inch wide x 1/4 inch thick, length as required; ASTM A153/A153M hot dip galvanized.
E. Wall Ties: Corrugated formed sheet metal, 7/8x7 inch size x 16 gage thick; ASTM A153/A153M hot dip galvanized for use at specialized conditions where wire wall ties specified are not appropriate.
F. Wall Ties: ASTM A82/A82M; steel wire 0.148 inch diameter, eye and pintle type; ASTM A153/A153M hot dip galvanized, appropriate companion piece to multi-wythe joint reinforcement.
G. Veneer Ties: Gasketed and steel screw and wire tie system designed for anchorage to masonry construction; screw barrel sized for thickness of continuous insulation in air space; ASTM A82; steel wire, 3/16-inch diameter; ASTM A153, hot-dip galvanized. These ties to be used in cases where the primary ties integrated with the ladder reinforcing are not sufficient to achieve the required density of ties.
H. Mortar: As specified in Section 04 0513.
I. Grout: As specified in Section 04 0516.
J. Polymeric Flashing system with Integral Drainage Mat: Sheet flashing with the following properties:
1. This product is one option Contractor may select for through wall flashing. Through wall
   flashing must be one system and product at all multi-wythe flashing conditions for the entire
   project.
2. Polymeric membrane w/ Elvoy Kee for UV resistance; 40 mil thick.
3. Fibrous polyester drainage mat bonded to one side.
4. Integral stainless steel drip edge, 28 gage.
5. Integral zinc coated termination bar.
6. Pre-formed corner boots and end dams.
7. Mortar Net - TotalFlash.
8. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and
   8.3.6.

K. Copper Flashing system with Integral Drainage Mat: Sheet flashing with the following properties:
1. This product is one option Contractor may select for through wall flashing. Through wall
   flashing must be one system and product at all multi-wythe flashing conditions for the entire
   project. Must be used in conjunction with a termination bar and sealant, and drip edge
   specified herein.
2. Copper sheet; 5 oz/ sq ft.
3. Fibrous non-woven drainage mat bonded to one side.
4. Fiberglass facing bonded to one side.
5. Zinc coated termination bar.
7. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and
   8.3.6.

L. Copper/Fabric Flashings: 5 oz/sq ft rolled sheet copper bonded to asphalt coated fiberglass
   fabric;
1. This product is one option Contractor may select for through wall flashing. Through wall
   flashing must be one system and product at all multi-wythe flashing conditions for the entire
   project. Must be used in conjunction with a termination bar and sealant, drip edge, and Cavity Drain
   Material specified herein.
2. Dur-O-Wall - Copper Fabric Thru-Wall Flashing.
3. Hohmann & Bamard, Inc. - C-Fab Flashing.
4. Wire-Bond - Copper Fabric Flashing.
5. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and
   8.3.6.

M. Copper/Fabric Flashings: 5 oz/sq ft rolled sheet copper bonded to fiberglass fabric;
1. This product is one option Contractor may select for through wall flashing. Through wall
   flashing must be one system and product at all multi-wythe flashing conditions for the entire
   project. Must be used in conjunction with a termination bar and sealant, drip edge, and Cavity Drain
   Material specified herein.
2. Advanced Building Products - Copper Fabric Flashing.
3. Hohmann & Bamard, Inc. - Copper-Tuff SA.
4. York - Multi-Flash 500 Series.
5. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and
   8.3.6.

N. Stainless Steel Drip Edge: 26 gauge formed drip edge for use with copper flashings.
1. Dur-O-Wall - DA1525.
2. Hohmann & Bamard, Inc. - DP.
3. Wire-Bond - #4165.
4. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and
   8.3.6.
5. This product to be used in conjunction with types of through wall flashing as indicated.
O. Corner & End Dams: Elastomeric, type 304 stainless steel, or copper units for use at ends of walls, inside and outside corners.
   1. Advanced Building Products, Inc. - Cop-R-Comers & End Dams.
   2. Hohmann & Bamard, Inc. - Copper Comers & End Dams.
   3. Hohmann & Bamard, Inc. - Stainless Steel Comers & End Dams.
   5. Mortar Net USA, Ltd. - Complete Flash; Distributor: Deane Masonry Products, (512) 699-1080.
   6. Wire-bond - Comers & End Dams (Stainless Steel).
   7. York - Stainless Steel Comers & End Dams.
   8. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

P. Lap Sealant: Silyl terminated polyether type as specified in Section 07 9000.

Q. Preformed Control Joints: Rubber, or Neoprene material. Furnish with corner and tee accessories, heat or cement fused joints as appropriate for material used. For use in CMU construction.

R. Weeps: Polyester or polyethylene non-woven fibrous mesh.
   2. CavClear/Archovations Inc. - Weep Vents.
   4. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

S. Cavity Vents: Polyester or polyethylene non-woven fibrous mesh installed between head joints at top of wall.
   2. CavClear/Archovations Inc. - Weep Vents.
   4. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

T. Nailing Strips: Specified in Section 06 100.

U. Cleaning Solution: Not harmful to masonry work or adjacent materials and as recommended by the masonry manufacturer for the products and colors specified.

V. Spray on Sealant: as recommended by manufacturer of Polished Face CMU.

W. Steel Lintels: Size hot-dip galvanized loose steel in accordance with Structural drawings.

2.6 MIXES
A. Mix mortar and grout ingredients in accordance with Sections 04 0513 and 04 0516.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify field conditions are acceptable and are ready to receive work. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   2. Verify that foundations are within tolerances specified.

B. Verify items provided by other sections of work are properly sized and located.
   1. Verify that foundations are within tolerances specified.
   2. Verify that reinforcing dowels are properly placed.
   3. Verify built-in items are in proper location, and ready for roughing into masonry work. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. Direct and coordinate placement of metal anchors supplied to other sections.
B. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.

3.3 INSTALLATION-GENERAL
A. Establish lines, levels, and coursing indicated. Protect from displacement.
B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.
C. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
D. Build chases and recesses to accommodate items specified in this and other Sections.
E. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
F. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
G. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.
H. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
   1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
   2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
   3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
   5. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
   6. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
   7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.
I. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
J. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
K. Fill space between steel door frames and masonry solidly with mortar, unless otherwise indicated.
L. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

3.4 LAYING MASONRY WALLS
A. Coursing of Concrete Masonry Units:
   1. Select type of bond. Stacked bond is typical. Select options appropriate to height of CMU units (4" or 8").
   2. Bond:
      a. Stacked Bond typical.
      b. Alternate #1: Running bond for bench core at Pavilion.
3. Coursing: One unit and one mortar joint to equal 8 inches.
4. Mortar Joints: Flush at backup wall face to receive weather proofing. Concave at all other locations.

B. Coursing of Decorative Units:
1. Bond: Stacked Bond.
2. Coursing: One unit and one mortar joint to equal 8 inches.

C. Placing and Bonding:
1. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at comers, jambs, and, where possible, at other locations.
2. Lay solid masonry units in full bed of mortar, with full head joints.
3. Lay hollow masonry units with face shell bedding on head and bed joints.
4. Buttering comers of joints or excessive furrowing of mortar joints are not permitted.
5. Remove excess mortar as work progresses.
6. Interlock intersections and external comers except at walls specified for stack bond.
7. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
8. Perform job site cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit comers or edges.
9. Cut mortar joints flush where wall tile is scheduled, cement parging is required, resilient base is scheduled and only at the area where base will be applied, cavity insulation vapor retarder adhesive is applied, or bitumen dampproofing is applied.
10. Isolate top of masonry from horizontal structural framing members and slabs or decks with compressible joint filler.

D. Weeps and Vents: Furnish weeps and vents in outer wythe at 24 inches oc horizontally above through-wall flashing, above shelf angles and lintels, at bottom of walls, and at top of wall.

E. Cavity Wall: Do not permit mortar to drop or accumulate into cavity air space or to plug weeps. Build inner wythe ahead of outer wythe to receive cavity insulation and air/vapor retarder adhesive.
1. Install cavity drain material continuously at bottom of each cavity and above through wall flashing.

F. Joint Reinforcement and Anchorages - Single Wythe and Multi-Wythe Masonry:
1. Install horizontal joint reinforcement 16 inches oc.
2. Place masonry joint reinforcement in first horizontal joints above base of wall.
3. Place masonry joint reinforcement in first horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
4. Place joint reinforcement continuous in first joint below top of walls.
5. Place masonry joint reinforcement in horizontal joints on either side of openings at 8” oc vertically. Extend minimum 16 inches each side of opening.
6. Place joint reinforcement continuous in first joint below top of walls.
7. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere.
8. Lap joint reinforcement ends minimum 6 inches.
9. Reinforce stack bonded unit joint comers and intersections with strap anchors 16 inches oc.
10. Cut and bend reinforcing units as directed by manufacturer for continuity at comers, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.
11. Tie vertical reinforcing steel to reinforcing steel to provide continuity of steel prior to grouting. Pouring grout and inserting steel into grout while pouring or before it has set is not acceptable.
12. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

G. Joint Reinforcement and Anchorages - Cavity Wall Masonry:
1. Install horizontal joint reinforcement 16 inches oc.
2. Place masonry joint reinforcement in first horizontal joints above base of wall.
3. Place masonry joint reinforcement in first horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
4. Place joint reinforcement continuous in first joint below top of walls.
5. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere.
6. Lap joint reinforcement ends minimum 6 inches.
7. Provide for continuity of horizontal joint reinforcement at corners with prefabricated L-shaped units, and at T perpendicular intersections with prefabricated T-shaped units.
8. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.
9. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches oc.
10. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

11. Hook pintles of masonry veneer ties into eyes of horizontal joint reinforcement of masonry backing to bond veneer at maximum 16 inches oc vertically and 16 inches oc horizontally. Place wall ties at maximum 8 inches oc vertically within 8 inches of jamb of wall openings.

H. Masonry Flashings: Cavity Walls
1. Extend flashings horizontally through outer wythe above ledge or shelf angles and lintels, at bottom of walls, and over stainless steel drip.
2. Turn flashing up minimum 8 inches and seal to masonry backing with termination bar and sealant.
3. Lap end joints minimum 6 inches and seal watertight.
4. For Polymeric Flashing System with integral drainage mat, use manufacturer's pre-formed end dams and corner boots.
5. For copper based flashing, turn flashing, fold, and seal at corners, bends, and interruptions.
6. Apply self-stick SBS/polyethylene detailing membrane at all vertical joints and transitions in the back-up wall. Apply in accordance with manufacturer's instructions.

I. Lintels:
1. Install concrete masonry bond beam, and loose steel lintels over openings, sizes as indicated. Size loose steel in accordance with Section 05 5000 Metal Fabrications and structural drawings.
2. Install reinforced unit masonry lintels over openings where steel or cast stone concrete lintels are not scheduled or indicated.
   a. Openings Up To 48 inches Wide: Place two No. 5 reinforcing bars 1 inch from bottom web.
   b. Openings Greater than 48 and Up To 96 inches Wide: Place two No. 6 reinforcing bars 1 inch from bottom web.
   c. Openings Over 96 inches: Reinforce openings as detailed.
3. Do not splice reinforcing bars.
4. Support and secure reinforcing bars from displacement.
5. Place and consolidate grout fill without displacing reinforcing.
6. Allow masonry lintels to attain specified strength before removing temporary supports.
7. Maintain minimum four inch bearing on each side of opening where the bearing surface is steel.
8. Maintain minimum six inch bearing on each side of opening where the bearing surface is concrete.
9. Maintain minimum eight inch bearing on each side of opening where the bearing surface is masonry.

J. Grouted Components:
1. Adjust number and size of bars as necessary to match structural drawings.
2. Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
3. Reinforce bond beam with 2 No. 5 bars, 1 inch from bottom web.
4. Reinforce vertical cells with one No. 5 bars, placed at the adjacent cells at corners and intersections of walls, at two cells adjacent to ends of walls and control/expansion joints, and at 32 inch on center minimum or as indicated on the drawings.
5. Lap splices bar diameters required by code and as indicated on the drawings, the greater requirement prevailing. Lap splices must be securely tied with wire top at top and bottom of splice. Do not grout untied splices.
6. Support and secure reinforcing bars from displacement.
7. Place and consolidate grout fill without displacing reinforcing.
8. At bearing locations, fill masonry cores with grout for minimum 12 inches both sides of opening.
9. Limit pour height of vertical grout to no more than 60 inches.

K. Reinforced Masonry: All exterior walls, load bearing walls, and walls otherwise indicated on the structural drawings as structural walls.
1. Lay masonry units with cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
2. Place reinforcement bars as indicated on Drawings.
3. Splice reinforcement in accordance with Section 03 2000 and the structural drawings. Lap splices bar diameters required by code and as indicated on the drawings, the greater requirement prevailing. Lap splices must be securely tied with wire top at top and bottom of splice. Do not grout untied splices.
4. Support and secure reinforcement from displacement.
5. Place and consolidate grout fill without displacing reinforcing.
6. Place grout in accordance with ACI 530.1 Specification for Masonry Structures.
7. Install in accordance with requirements outlined in the structural drawings.

L. Control Joints:
1. Install control joints at the following maximum spacings, unless otherwise indicated on Drawings:
   a. Exterior Walls: 20 feet on center for concrete masonry and within 24 inches on one side of each interior and exterior corner for concrete masonry.
   b. Interior Walls: 30 feet on center.
   c. At changes in wall height.
2. Do not continue horizontal joint reinforcement through control joints.
3. Install preformed control joint device in continuous lengths. Seal butt and corner joints.
4. Size control joint in accordance with Section 07 9000 for sealant performance.
5. Form expansion joint by installing expansion joint material.

M. Built-In Work:
1. As work progresses, install built-in metal door and glazed frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates, and other items to be built-in the work and furnished by other sections.
2. Install built-in items plumb and level.
3. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout or mortar. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
4. Do not build in materials subject to deterioration.

N. Cutting and Fitting:
1. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.
2. Obtain Architect/Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

O. Sealing Polished Face Concrete Masonry Units:
1. After erection of wall, clean masonry units as indicated in this specification and manufacturer's recommendations. Allow walls to dry thoroughly.
2. Apply two coats of sealant by airless sprayer. Follow sealant manufacturer's instructions for application.

### 3.5 ERECTION TOLERANCES

A. Maximum Variation from Alignment of Columns and Pilasters: 1/4 inch.
B. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.
C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
F. Maximum Variation of Joint Thickness: 1/8 inch.
G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
H. Maximum Variation for Steel Reinforcement:
   1. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.
   2. Plus or minus 1/2 inch when distance from centerline of steel to opposite face of masonry is 8 inches or less.
   3. Plus or minus 1 inch when distance is between 8 and 24 inches.
   4. Plus or minus 1-1/4 inch when distance is greater than 24 inches.
   5. Plus or minus 2 inches from location along face of wall.

3.6 FIELD QUALITY CONTROL
A. Uniform General Conditions of the Contract, especially article 8.2.
   1. Testing of Mortar: In accordance with Section 04 0513.
   2. Testing of Grout: In accordance with Section 04 0516.

3.7 CLEANING
A. Uniform General Conditions of the Contract, especially paragraph 3.3.9.
B. Remove excess mortar and mortar smears as work progresses.
C. Replace defective mortar. Match adjacent work.
D. Clean soiled surfaces with cleaning solution.
E. Use non-metallic tools in cleaning operations.

3.8 PROTECTION OF FINISHED WORK
A. Uniform General Conditions of the Contract, especially paragraph 3.3.
B. Protect exposed external corners subject to damage.
C. Protect base of walls from mud and mortar splatter.
D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.
E. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when work is not in progress.

3.9 SCHEDULES
A. Exterior Walls:
   1. Comfort Station:
      a. Cavity Wall masonry with exterior wythe of stone as specified in Section 04 4213 and interior wythe 8” polished face CMU.
      b. Stack bond.
   2. Visitors Center:
      a. Interior veneer of cavity wall masonry at interior side of existing masonry walls, 4” polished face CMU.
      b. Stack bond.

B. Interior Partitions: Single wythe 8” polished face concrete masonry units at Comfort Station.
C. Alternate #1, Benches at Pavilion:
   1. Multi-wythe masonry with exterior wythe of stone as specified in Section 04 4213 and core wythe 8” standard grey CMU.
      a. Running bond.
   2. Bench tops of 8x4x16 polished solid CMU with chamfered edges.
D. Reference Drawings for more information.

END OF SECTION 04 2000
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Field stone veneer at exterior masonry walls.
      a. Salvaged from demolition of existing comfort station.
      b. Salvaged from demolition of West wall of exhibit space and new window openings at North
         wall of Visitor Center.
      c. New from quarry as necessary to supplement salvaged material.
   2. Metal anchors and accessories.
   3. Mortar and joint pointing.
B. Related Requirements:
   1. Section 02 4119.13 – Selective Building Demolition: Removal/salvage of existing limestone
      veneer from Comfort Station and Visitors Center for re-use at new Comfort Station and the
      Visitors Center West Wall.
   2. Section 04 0513 - Masonry Mortaring: Bedding and pointing mortar.
   3. Section 04 2000 - Unit Masonry: Requirements for masonry supporting wall and horizontal joint
      reinforcements.
   4. Section 05 5000 - Metal Fabrications: Product requirements for metal-fabricated items for
      building into stone masonry for placement by this Section.
   5. Section 07 2113 – Board Insulation: Insulation within cavity wall construction.
   7. Section 07 6200 - Sheet Metal Flashing and Trim: Product requirements for sheet metal sill
      flashings for placement by this Section.
   8. Section 07 9000 - Joint Protection: Sealant for perimeter, control, and expansion joints.

1.2 REFERENCE STANDARDS
A. American Concrete Institute:
   1. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures and
      Related Commentaries.
B. ASTM International:

1.3 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate Work of this Section with 04 2000.

1.4 PREINSTALLATION MEETINGS
A. Convene minimum one week prior to commencing Work of this Section.
B. Notify Architect/Engineer four days in advance of meeting date.
C. Shall be in conjunction with the pre-installation meeting for the unit masonry as specified in
   Section 04 2000.
D. Required attendees: Owner, Architect, General Contractor, and Masonry sub-contractor.

1.5 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special
   Conditions of the Contract.
B. Product Data: Submit data on stone units, mortar products, reinforcement, wall ties, anchors,
   flashings.
C. Samples:
   1. Submit two stone samples, illustrating minimum and maximum stone sizes, general color range
      and texture, markings, and matching existing field stone installed at Visitors Center and old
      Comfort Station.
D. Fabricator’s Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

1.6 QUALITY ASSURANCE
A. Perform Work in accordance with ACI 530 Building Code Requirements for Masonry Structures and ACI 530.1 Specification for Masonry Structures.

1.7 QUALIFICATIONS
A. Installer: Company specializing in performing Work of this Section with minimum three years' experience.

1.8 MOCKUP
A. Section 8.4 of the Uniform General Conditions of the Contract.
B. Construct masonry veneer mockup, minimum 8 feet long by 9 feet high, including masonry, mortar and accessories, structural backup, wall openings, flashings, wall insulation, weather barrier.
1. Included as part of the mock-up required by Section 04 2000.
2. A mockup is required for each type of exterior wall.
3. Mock-up shall include all typical joints and transitions, including sill, head or top of wall, and where adjoining dissimilar materials. If the mock-up is to be erected within the project’s wall construction, the Contractor shall erect the mock-up to whatever size is required to illustrate all typical joints and transitions, but shall be at minimum the size indicated above.
C. Locate where directed by Architect/Engineer.
D. Accepted mockup in the building construction may be incorporated as completed Work.

1.9 DELIVERY, STORAGE, AND HANDLING
A. Inspection: Accept materials on Site and inspect for damage.
B. Store materials according to manufacturer’s instructions.
C. Protect stone from discoloration during storage on Site.
D. Provide ventilation to prevent condensation from forming on stone.

1.10 AMBIENT CONDITIONS
A. Cold Weather Requirements: According to ACI 530/530.1, when ambient temperature or temperature of masonry units is less than 40 degrees F.
B. Hot Weather Requirements: According to ACI 530/530.1, when ambient temperature is greater than 100 degrees F or when ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

PART 2 - PRODUCTS

2.1 MORTAR-PLACED STONE ASSEMBLIES
A. Manufacturers:
   1. Aguado Stone, Georgetown, TX
   2. Big Country Stone, Abilene, TX
   3. Champion Stone Company, Lueders, TX
   5. Texas Stone Quarries, Garden City, TX
   6. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.2 MATERIALS
A. Limestone:
   1. Salvaged:
      a. Field stone limestone veneer at existing Comfort Station, to be demolished; field stone limestone veneer at existing West wall at the exhibit hall of the Visitor Center, to be demolished; field stone limestone veneer at existing North wall of the Visitor Center where new window openings are located. Reference Section 02 4119.13.
2. New to supplement salvaged:
   a. Description: Texas limestone to match existing at Visitors Center.
   b. Comply with ASTM C568 Classification II - Medium Density.
   c. Grade: Rustic.
   d. Free of defects detrimental to appearance or durability.
   e. Color: White.
   f. Surface Finish: Cleft.

2.3 Fabrication
A. Nominal Thickness:
   1. 5 inch at all building veneers.
   2. 1.5 inch at stone clad benches included in Alternate #1.
B. Nominal Face Size: 4 by 8 inches.
C. Pattern and Coursing: Field Stone to match existing.
D. Beds and Joints: Fabricated for 3/8 inch.
E. Bed and Joint Surfaces:
F. Backs: Rough or split.
G. Form stone comes to irregular joint profile, and clean jagged corners from stone in preparation for setting.
H. Slope exposed top surfaces of stone and horizontal sill surfaces for shedding water.
I. Drip Slot:
   1. Cut drip slot in bottom surface of exterior units projecting more than 1/2 inch over window or door frame.
   2. Size: Not less than 3/8 inch wide and 1/4 inch deep for full width of projection.

2.4 Mixes
A. Mortar and Grout: As specified in Section 04 0513 - Masonry Mortaring.

2.5 Accessories
A. Horizontal Joint Reinforcement: As specified in Section 04 2000 - Unit Masonry.
B. Wall Ties: As specified in Section 04 2000 - Unit Masonry.
C. Other Anchors in Direct Contact with Stone: As specified in Section 04 2000 - Unit Masonry.
D. Flashings: As specified in Section 07 6200 - Sheet Metal Flashing and Trim.
E. Through-Wall Flashings: As specified in Section 04 2000 - Unit Masonry.
F. Cavity Vents: As specified in Section 04 2000 - Unit Masonry.
G. Weeps: As specified in Section 04 2000 - Unit Masonry:
H. Weather barrier: As specified in Section 07 2726 – Fluid Applied Weather Barrier.
I. Cleaning Solution: Nonacid and not harmful to stone, joint materials, or adjacent surfaces.

Part 3 - Execution

3.1 Examination
A. Verify that support Work and Site conditions are ready to receive Work of this Section.
B. Verify that items built in under other Sections are properly located and sized.

3.2 Preparation
A. Establish indicated lines, levels, and coursing, and protect from disturbance.
B. Weather Barrier:
   1. As specified in Section 07 2726 – Fluid Applied Weather Barrier.

3.3 Installation
A. Flashings:
   1. Install flashings of longest practical length and seal watertight to backup.
   2. Lap end joints minimum 6 inches and seal watertight.
B. Stone:
   1. Split stone at Site to produce clean faces.
   2. Size stone units to fit opening dimensions and perimeter conditions.
3. Wet absorptive stone in preparation for placement to minimize suction of moisture from mortar.
4. Arrangement:
   a. Arrange stone pattern in color uniformity and in uniform blend of stone unit sizes, and minimize visual variations. Match pattern of existing stone veneer at Visitors Center.
   b. Comply with approved mockup.
C. Install setting bed and pointing mortar as specified in Section 04 0513 - Masonry Mortaring.
D. Fill dowel holes in stone units with mortar.
E. Arrange stone in field stone random mosaic pattern, with consistent joint width.
F. Set stone in full mortar setting bed to fully support stone over bearing surface using setting buttons or shims to maintain correct joint width.
G. Reinforcement and Anchorage:
   1. Attach wall ties to backup to bond veneer to backup, at maximum 16 inches o.c. vertically and 16 inches o.c. horizontally.
   2. Place wall ties at maximum 3 inches o.c. each way around perimeter of openings, within 12 inches of openings.
H. Joints:
   1. Rake out mortar joints 5/8 to 3/4 to inch, and brush joints clean to accommodate pointing mortar.
   2. Fill joints with pointing mortar except where sealant is indicated.
   3. Pack mortar into joints and work into voids.
   4. Neatly tool surface to raked joint.
   5. At joints to be sealed, clean mortar out of joint before mortar sets; brush joints clean or use compressed air to remove loose particles.
   6. Seal joints indicated with sealant and backer rod.
   7. Perform sealant work as specified in Section 07 9000 - Joint Protection.
I. Accessories:
   1. Install cavity vents at top of each cavity space below shelf angles, at spacing of 24 inches o.c. horizontally.
   2. Install weeps in vertical stone joints at 24 inches o.c. horizontally, immediately above horizontal flashings, above shelf angles and supports, and at bottom of walls.
   3. Do not permit mortar accumulation in cavity space.

3.4 FIELD QUALITY CONTROL
A. Uniform General Conditions of the Contract, especially article 8.2.
B. Testing of Mortar: As specified in Section 04 0513 - Masonry Mortaring.

3.5 CLEANING
A. Uniform General Conditions of the Contract, especially paragraph 3.3.9.
B. Remove excess mortar as Work progresses and upon completion of Work.
C. Clean soiled surfaces with nonacid cleaning solution and low-pressure rinse of less than 1,200 psig.
D. Obtain Architect's approval for cleaning procedures using high-pressure wash or acid-based solutions.
E. Use nonmetallic tools in cleaning operations.

3.6 PROTECTION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.
B. Protect exposed external corners subject to damage.
C. Protect base of walls from mud and mortar splatter.
D. Protect stone and other items built into masonry walls from mortar droppings and staining caused by mortar.
E. Coverings:
   1. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry.
   2. Provide coverings where masonry is exposed to weather when Work is not in progress.
   3. Maintain protection on tops of completed exterior walls until installation of permanent waterproof cap materials.
3.7 SCHEDULES
A. Exterior Walls:
   1. Comfort Station:
      a. Cavity Wall masonry with 5" stone with interior wythe 8" polished face CMU as specified in
         Section 04 2000.
   2. Visitors Center:
      a. Exterior veneer: 5 inch stone as required to augment existing at new and replacement
         windows and storefront.
B. Interior Walls:
   1. Visitors Center
      a. Interior veneer at West end of 203 Exhibit. Re-install existing stone and augment with new 5
         inch stone as necessary.
C. Alternate #1, Benches at Pavilion:
   1. Multi-wythe masonry with exterior wythe of 1.5 inch stone as specified and core wythe 8"
      standard grey CMU and polished CMU bench tops as specified in Section 04 2000.
D. Reference Drawings for more information.

END OF SECTION 04 4213

THE CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS, SYSTEMS, EQUIPMENT, ITEMS, ARTICLES, OPERATIONS, AND/OR METHODS LISTED, IMPLIED, MENTIONED, OR SCHEDULED IN THE CONTRACT DOCUMENTS AND/OR NECESSARY AND/OR REQUIRED FOR THE SATISFACTORY COMPLETION OF THE WORK.

THE LISTING OF WORK, REQUIREMENTS, AND PRODUCTS IN THIS SECTION IS NOT INTENDED TO BE CONCLUSIVE. THE CONTRACTOR SHALL CHECK ALL OTHER PARTS OF THE CONTRACT DOCUMENTS AND SHALL PROVIDE ALL MISCELLANEOUS ITEMS OF WORK AND PRODUCTS NECESSARY FOR THE SATISFACTORY COMPLETION OF THE WORK DESCRIBED IN THE CONTRACT DOCUMENTS.
PART 1 - GENERAL

1.1 WORK INCLUDED
A. Structural steel framing members, structural steel support members, and with required bracing, welds, and fasteners.
B. Baseplates, and shear stud connectors.

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS
A. Section 03 1100 - Concrete Formwork: Anchorages cast in concrete

1.3 RELATED WORK
A. Section 03 3000 - Cast-in-Place Concrete: Grouting base plates.
B. Section 05 5000 - Metal Fabricators.

1.4 REFERENCES
A. ASTM A36 - Structural Steel.
B. ASTM A53 - Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.
C. ASTM - A325 - High Strength Bolts for Structural Steel Joints.
D. ASTM - A500 - Cold Formed Welded and Seamless Carbon Steel Structural Tubing In Round and Shapes.
E. AWS D1.1 - Structural Welding Code.

1.5 SHOP DRAWINGS
A. Submit shop drawings under provisions of the Uniform General Conditions of the Contract.
B. Indicate profiles, sizes, spacing and locations of structural members, connections, attachments and fasteners.
C. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Structural Steel Members: ASTM A36.
B. Structural Tubing: ASTM 500, Grade B.
D. Welding Materials: AWS D1.1; type required for materials being welded.

2.2 FABRICATION
A. Fabricate structural steel members in accordance with AISC Specification.
B. All welding shall be performed by welders certified within previous six months in accordance with AWS specifications.

2.3 FINISH
A. Clean and prepare surfaces of all rust, scale, grease and foreign matter in accordance with SSPC-SP6 Commercial Blasting Cleaning requirements.
B. Shop prime structural steel with 2 coats of primer, with a minimum wet thickness of 4 mil.
C. Do not prime surfaces to be field welded or in contact with concrete.
D. Field touch up all damaged areas with primer after erection. The primer used shall not exceed VOC thresholds per current SCAQMD Rule 1113.

PART 3 - EXECUTION

3.1 ERECTION
A. Erect Structural steel in accordance with AISC Specification.
B. Make provision for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and true alignment until completion of erection and installation of permanent bracing.
C. Do not field cut or alter structural members without approval of Architect/Engineer.
D. After erection, prime welds, abrasions, and surfaces not-shop primed, except surfaces to be in contract with concrete. Use a primer consistent with shop coat and shall not exceed VOC thresholds per current SCAQMD Rule 1113.

END OF SECTION 05 1200
PART 1 - GENERAL

1.1 WORK INCLUDED
   A. Shop fabricated ferrous metal items, prime painted.

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS
   A. Furnish metal fabrications to be cast in concrete to Section 03 3000 - Cast-In-Place Concrete.

1.3 RELATED WORK
   A. Section 05 1200 - Structural Steel Framing: Structural anchor bolts.
   B. Section 09 9000 – Painting and Coating: Paint finish.

1.4 REFERENCES
   A. ASTM A36 - Structural Steel.
   B. ASTM A53 - Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.
   D. ASTM A325 - High Strength Bolts for Structural Steel Joints.
   E. ASTM A386 - Zinc-Coating (Hot-Dip) on Assembled Steel Products.
   F. ASTM A500 - Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   G. ASTM A501 - Hot-formed Welded and Seamless Carbon Steel Structural Tubing.
   H. AWS D1.1 - Structural Welding Code.

1.5 SHOP DRAWINGS
   A. Submit shop drawings under provisions of Uniform General Conditions of the Contract.
   B. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   C. Include erection drawings, elevations, and details where applicable.
   D. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.

PART 2 - PRODUCTS

2.1 MATERIALS
   A. Steel Sections: ASTM A36.
   B. Steel Tubing: ASTM A500, Grade B.
   D. Welding Materials: AWS D1.1; type required for materials being welded.
   E. Primer: Zinc Chromate. The primer shall not exceed VOC thresholds per current SCAQMD Rule 1113.

2.2 FABRICATION
   A. Verify dimensions on site prior to shop fabrication.
   B. Fabricate items with joints tightly fitted and secured.
   C. Fit and shop assemble in largest practical sections, for delivery to site.
   D. Grind exposed welds flush and smooth with adjacent finished surface. Ease exposed edges to small uniform radius.
   E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of structure, except where specifically noted otherwise.
   F. Make exposed joints butt tight, flush, and hairline.
   G. Supply components required for anchorage of metal fabrications. Fabricate anchorage and related components of same material and finish as metal fabrication, except where specifically noted otherwise.
2.3 FINISH
A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing in accordance with SSPC-SP2 Cleaning Requirements.
B. Do not prime surfaces in direct contact bond with concrete or where field welding is required.
C. Prime paint items scheduled with two coats, minimum of 4 mil. wet thickness. The primer shall not exceed VOC thresholds per current SCAQMD Rule 1113
D. Exterior and Canopy Steel framing members shall be hot-dipped galvanized steel.

PART 3 - EXECUTION
3.1 PREPARATION
A. Obtain Architect/Engineer approval prior to site cutting or making adjustments not scheduled.
B. Clean and strip site primed steel items to bare metal where site welding is scheduled.
C. Make provision for erection loads with temporary bracing. Keep work in alignment.
D. Supply items required to be cast into concrete with setting templates, to appropriate Sections.

3.2 INSTALLATION
A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Perform field welding in accordance with AWS D1.1.
C. After installation, touch-up field welds, scratched or damaged surfaces with primer. The primer shall not exceed VOC thresholds per current SCAQMD Rule 1113

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Steel pipe railings, balusters, and fittings.
B. Related Requirements:
   1. Section 03 3000 - Cast-In-Place Concrete: Execution requirements for placement of anchors, as specified in this Section, in concrete.
   2. Section 04 2000 – Unit Masonry: Mounting substrate.
   4. Section 09 9000 - Painting and Coating: Paint finish.

1.2 REFERENCE STANDARDS
A. ASTM International:
   3. ASTM A569 - Standard Specification for Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip Commercial.
B. National Association of Architectural Metal Manufacturers:
   1. NAAMM Metal Finishes Manual.
C. National Ornamental & Miscellaneous Metals Association:
   1. NOMMA Guideline 1 - Joint Finishes.
D. SSPC: The Society for Protective Coatings:
   1. SSPC - Steel Structures Painting Manual.
   2. SSPC Paint 15 - Steel Joint Shop Primer/Metal Building Primer.
   3. SSPC Paint 20 - Zinc-Rich Coating, Type I - Inorganic and Type II - Organic.

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1.4 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify that the products meet or exceed specified sustainable design requirements.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.5 QUALITY ASSURANCE
A. Perform Work of this Section according to ASTM E985.
B. Finish joints according to NOMMA Guideline 1.

1.6 QUALIFICATIONS
A. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' experience.
B. Erector: Company specializing in performing Work of this Section with minimum three years' experience.
1.7 **EXISTING CONDITIONS**
   A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

**PART 2 - PRODUCTS**

2.1 **PERFORMANCE AND DESIGN CRITERIA**
   A. Design handrail, guardrail, and attachments to resist forces as required by applicable code. Apply loads non-simultaneously to produce maximum stresses.
      1. Guard Top Rail and Handrail Concentrated Load: 200 lb. applied at any point in any direction.
      2. Guard Top Rail Uniform Load: 50 plf applied in any direction.
      3. Intermediate Rails, Panels, and Baluster Concentrated Load: 50 lb. applied to 1 sq. ft. area.

2.2 **SUSTAINABILITY CHARACTERISTICS**
   A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
   B. Material and Resource Characteristics:
      1. Recycled Content Materials: Furnish materials with maximum available recycled content.

2.3 **MATERIALS**
   A. Steel Railing System:
      3. Fittings: Elbows, T-shapes, wall brackets, escutcheons; machined steel.
      5. Splice Connectors: Steel welding collars.
         a. 1-1/2" X 5/8" steel strip.
         b. 1-1/2" X 1/8" steel strip.
      7. Expanded Metal Mesh
         a. 3/4" #13 Galvanized expanded metal mesh with overall thickness of 0.212 with max open area of 79% as manufactured by McNichols Company.
         b. Mesh shall conform to ASTM A569 & ASTM F1267 Type I class I, standard expanded metal.
      8. Perforated Metal:
         a. 16 ga. carbon steel.
         c. 33% open area.
     10. Touchup Primer: Match shop primer.

2.4 **FABRICATION**
   A. Fit and shop-assemble components in largest practical sizes for delivery to Site.
   B. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate Site assembly and installation.
   C. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
   D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
   E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
   F. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations not encouraging water intrusion.
   G. Interior Components: Continuously seal joined pieces by continuous welds.
   I. Accurately form components to each other and to building structure.
J. Accommodate expansion and contraction of members and building movement without damage to connections or members.

PART 3 - EXECUTION

3.1 EXAMINATION  
A. Verify that field conditions are acceptable and are ready to receive Work.  
B. Verify that concealed blocking and reinforcement are installed and correctly located to receive wall-mounted handrails.

3.2 PREPARATION  
A. Clean and strip primed steel items to bare metal where Site welding is required.  
B. Supply items required to be cast into concrete embedded in masonry with setting templates to appropriate Sections.

3.3 INSTALLATION  
A. Install components plumb and level, accurately fitted, free from distortion or defects.  
B. Anchor railings to structure with anchors, plates, angles, and fittings.  
C. Field-weld anchors as indicated on Shop Drawings. Touch up welds with primer. Grind welds smooth.  
D. Conceal bolts and screws whenever possible.  
E. Assemble with spigots and sleeves to accommodate tight joints and secure installation.  
F. For hand rails set in concrete, core drill 1" larger diameter than post to a minimum depth of 4". Install post with anchor setting concrete.

3.4 TOLERANCES  
A. Maximum Variation from Plumb: 1/4 inch per story, noncumulative.  
B. Maximum Offset from Alignment: 1/4 inch.  

3.5 ATTACHMENTS  
A. Railings along flatwork north of the new Comfort Station.  
   1. Re-use/re-install existing panels along north face of flatwork.  
   2. New panels to match existing to extend north panels to west and along west edge of flatwork.  
B. Railings along flatwork SW corner of flatwork on north of Visitor Center.  
C. Two entry screens at vestibules to the Comfort Station.  
D. See Drawings for more information.

END OF SECTION 05 5200
DIVISION 6
WOOD AND PLASTICS AND COMPOSITES

The Agreement, General Conditions Of The Contract For Construction, Supplementary Conditions Of The Contract For Construction, and all Addenda are a part of the Contract. The Contractor shall consult them in detail for instructions pertaining to the Work. The Contractor shall also consult all other divisions and sections of the Project Manual, and all Drawings in the execution of the work of the Contract.

The Contractor shall provide all Labor, materials, systems, equipment, items, articles, operations, and/or methods listed, implied, mentioned, or scheduled in the Contract Documents and/or necessary and/or required for the satisfactory completion of the Work.

The listing of work, requirements, and products in this section is not intended to be conclusive. The Contractor shall check all other parts of the Contract Documents and shall provide all miscellaneous items of work and products necessary for the satisfactory completion of the Work described in the Contract Documents.
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes wall, and roof sheathing; sill gaskets and flashings; preservative treatment of wood; fire retardant treatment of wood; miscellaneous framing and sheathing; telephone and electrical panel back boards; and concealed wood blocking for support of wall cabinets, wood trim, and treated wood blocking and curbs in roof assemblies.
B. Related Sections:
   1. Section 04 2000 - Unit Masonry: Setting anchors in masonry.
   2. Section 06 2000 – Finish Carpentry: Finishes applied to work of this section.
   3. Section 07 2126 – Blown Insulation: Insulation applied after work of this section.
   4. Section 07 3200 – Composite Roof Tile Systems: Roof deck sheathing.
   5. Section 07 5419 – Fully Adhered Multi-ply Roof System: Wood curbs and cants.
   6. Section 07 6200 – Sheet Metal Flashing and Trim.
   7. Section 08 1213.13 – Standard Hollow Metal Frames: Door openings to receive wood blocking.
   8. Section 08 4113 – Aluminum Framed Entrances and Storefronts: Openings to receive wood blocking.
   9. Section 09 2116 – Gypsum Board Assemblies: Gypsum panels applied to work of this section.

1.2 REFERENCES
A. American Wood-Preservers’ Association:
   1. AWPA M4 - Standard for the Care of Preservative-Treated Wood Products.
B. ASTM International:
C. Green Seal:
   1. GS-36 - Aerosol Adhesives.
D. National Lumber Grades Authority:
   1. NLGA - Standard Grading Rules for Canadian Lumber.
E. Northeastern Lumber Manufacturers Association:
   1. NELMA - Standard Grading Rules for Northeastern Lumber.
F. The Redwood Inspection Service:
G. South Coast Air Quality Management District:
   1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.
H. Southern Pine Inspection Bureau:
   1. SPIB - Standard Grading Rules for Southern Pine Lumber.
I. U.S. Department of Commerce National Institute of Standards and Technology:
J. West Coast Lumber Inspection Bureau:
   1. WCLIB - Standard Grading Rules for West Coast Lumber.
K. Western Wood Products Association:
   1. WWPA G-5 - Western Lumber Grading Rules.

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit data on sizes and grade of lumber, wood preservative materials, and application instructions.
C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
1.4 **SUSTAINABLE DESIGN SUBMITTALS**
   A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
   B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
      1. Indoor Air Quality Certificates:
         a. Certify volatile organic compound content for each interior adhesive and sealant and related primer.
         b. Certify each composite wood and agrifiber product contains no added urea-formaldehyde resins.

1.5 **QUALITY ASSURANCE**
   A. Perform Work in accordance with the following:
      4. Wood Structural Panels: DOC PS 1 or DOC PS 2.
   B. In lieu of grade stamping exposed to view lumber and wood structural panels, submit manufacturer's certificate certifying Products meet or exceed specified requirements.
   C. Surface Burning Characteristics:
      1. Fire Retardant Treated Materials: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
   D. Apply label from agency approved by authority having jurisdiction to identify each preservative treated and fire retardant treated material.

PART 2 - PRODUCTS

2.1 **SUSTAINABILITY CHARACTERISTICS**
   A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
   B. Indoor Environmental Quality Characteristics:
      1. Interior Adhesives: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
      2. Interior Aerosol Adhesives: Maximum volatile organic compound content in accordance with GS-36.
      3. Interior Composite Wood and Agrifiber Products: Contain no added urea-formaldehyde resins.

2.2 **LUMBER MATERIALS**
   A. Lumber Grading Rules: AF&PA, NELMA, NLGA, RIS, SPIB, WC LIB, WWPA, and NELMA.
   B. Non-structural Light Framing: Stress Group E, #2 grade, 2x4 and 2x6 as indicated 19 percent maximum moisture content.
   C. Studding: Stress Group E, #2 grade, 2x4 and 2x6 as indicated 19 percent maximum moisture content.

2.3 **FIREBLOCKING AND DRAFTSTOPPING**
   A. Fireblocking: Solid lumber, structural wood panel, or particleboard.
      1. Solid lumber nominal 2 inches thick.
      2. Two layers of solid lumber nominal 1 inch thick with broken lapped joints.
      3. Structural wood panel 23/32 inch thick with joints backed by structural wood panel.
      4. Particleboard 3/4 inch thick with joints backed by particleboard.
   B. Draftstopping: Gypsum board, wood structural panel or particleboard.
      2. Wood structural panel, 3/8 inch thick.

2.4 **ACCESSORIES**
   A. Fasteners and Anchors:
1. Fasteners: ASTM A153/A153M, hot-dipped galvanized steel for high humidity and SBX treated wood locations, type 304 or 316 stainless steel for ACQ treated wood locations, and unfinished steel elsewhere.

2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.

3. Anchors: Toggle bolt type for anchorage to hollow masonry. Expansion shield and lag bolt type for anchorage to solid masonry or concrete. Bolt or ballistic fastener for anchorages to steel.

B. Under Track Isolation Strip: Kinetics Noise Control Model RWS under all wood framed partitions.

2.5 FACTORY WOOD TREATMENT

A. Wood Preservative (Pressure Treatment): AWPA U1, Commodity Specification A-Sawn Products or F-Wood Composites using water-borne ACQ preservative at ground contact conditions or conditions of high humidity or expected contact with water, and SBX preservative at all other conditions.

B. Wood Preservative (Surface Application): Clear.

C. Fire Retardant Treatment: Chemically treated and pressure impregnated, having flame spread of 25 or less when tested in accordance with ASTM E 84 and showing no evidence of significant progressive combustion when test is continued for an additional 20 minute period, Interior Type.

D. Moisture Content After Treatment: Redried.
   1. Lumber: Maximum 19 percent.
   2. Structural Panels: Maximum 15 percent.

PART 3 - EXECUTION

3.1 FRAMING

A. Fasten framing in accordance with applicable code and as indicated in the structural drawings.

B. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.

C. Place horizontal members, crown side up.

D. Construct load bearing framing and curb members full length without splices.

E. Double members at openings over 16 inches wide. Space short studs over and under opening to stud spacing.

F. Construct corners and intersections with three or more multiple studs to assure full drywall bearing.

G. Construct double joist headers at floor and ceiling openings and under wall stud partitions parallel to floor joists. Frame rigidly into joists.

H. Place two beads of acoustical sealant and an Acoustic Isolation strip between runners and substrates, top and bottom, to achieve an acoustic seal.

I. Place undertrack isolation strip directly on concrete under sill track.

J. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.

K. Coordinate curb installation with installation of decking and support of deck openings, roofing vapor retardant, parapet construction, and mechanical and electrical devices.

3.2 FIREBLOCKING AND DRAFTSTUFFING

A. Install fireblocking to cut off concealed draft openings.

1. Concealed Framed Wall and Furred Spaces: Install fireblocking vertically at floor and ceiling levels and horizontally at maximum 10 feet on center.

2. Connections Between Horizontal and Vertical Spaces: Install fireblocking between vertical walls and partitions and the following:
   a. Horizontal floor and roof framing,
   b. Soffits, dropped ceilings, cove ceilings and other horizontal concealed spaces.


3.3 SITE APPLIED WOOD TREATMENT

A. Treat site-sawn cuts. Apply preservative to site-sawn cuts in accordance with AWPA M4.

B. Allow preservative to dry prior to erecting members.
3.4 TOLERANCES
   A. Framing Members: 1/4 inch from indicated position, maximum.
   B. Surface Flatness of Floor: 1/4 inch in 10 feet maximum, and 1/2 inch in 30 feet maximum.

END OF SECTION 06 1000
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Exterior Finish Carpentry:
      a. Standing and running trim.
      b. Siding.
   2. Interior Finish Carpentry:
      a. Standing and running trim.
   3. Other items indicated in the schedule at the end of this section or indicated on the drawings.
B. Related Requirements:
   1. Section 06 1000 - Rough Carpentry: Grounds and support framing.
   2. Section 06 4100 - Architectural Wood Casework: Shop fabricated custom cabinet work.
   3. Section 08 0152.91 - Wood Window Restoration.
   4. Section 09 2116 - Gypsum Board Assemblies: Adjacent substrates.
   5. Section 09 9000 - Painting and Coating: Painting and finishing of finish carpentry items.

1.2 REFERENCE STANDARDS
A. ASTM International:
B. Architectural Woodwork Institute:
   1. AWI AWS - Architectural Woodwork Standards.
C. Green Seal:
   1. GS-11 - Product Specific Environmental Requirements.
   2. GS-36 - Aerosol Adhesives.
D. Hardwood Plywood and Veneer Association:
   1. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.
E. South Coast Air Quality Management District:
F. U.S. Department of Commerce National Institute of Standards and Technology:
G. Window and Door Manufacturers Association:
   1. WDMA I.S.4 - Water-Repellent Treatment for Millwork.

1.3 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

1.4 SEQUENCING
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Sequence work to ensure utility connections are achieved in orderly and expeditious manner.

1.5 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data:
   1. Submit data on fire retardant treatment materials and application instructions.
C. Shop Drawings:
   1. Indicate materials, component profiles, fastening methods, jointing details, and accessories, to minimum scale of 1-1/2 inch to 1 ft.
D. Samples:
   1. Submit two samples of finish plywood, 8 x 10 inch in size illustrating wood grain and specified finish.
   2. Submit two samples of wood trim 10 inch long.

1.6 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resource Certificates:
      a. Certify recycled material content for recycled content products.
   2. Indoor Air Quality Certificates:
      a. Certify volatile organic compound content for each interior adhesive and sealant and related primer.
      b. Certify volatile organic compound content for each interior paint and coating.
      c. Certify each composite wood and agrifiber product contains no added urea-formaldehyde resins.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.7 QUALITY ASSURANCE
A. Perform work in accordance with AWI AWS Section 6 Custom Grade.
B. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
C. Apply label from agency approved by authority having jurisdiction to identify each preservative treated and fire retardant treated material.

1.8 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Fabricator: Company specializing in fabricating products specified in this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING
A. Protect work from moisture damage.
B. Maintain storage space relative humidity within ranges indicated in AWI AWS Section 2.

1.10 ENVIRONMENTAL REQUIREMENTS
A. During and after installation of Work of this section, maintain same temperature and humidity conditions in building spaces as will occur after occupancy.
   1. Maintain relative humidity within ranges indicated in AWI AWS Section 2.

1.11 EXISTING CONDITIONS
A. Verify field measurements prior to fabrication. Indicate field measurements on shop drawings.

PART 2 - PRODUCTS
2.1 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.
C. Indoor Environmental Quality Characteristics:
   1. Interior Adhesives: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
2. Interior Aerosol Adhesives: Maximum volatile organic compound content in accordance with GS-36.
3. Interior Flat and Non-Flat Paints: Maximum volatile organic compound content in accordance with GS-11.
4. Interior Composite Wood and Agrifiber Products: Contain no added urea-formaldehyde resins.

2.2 EXTERIOR FINISH CARPENTRY
A. Exterior Wood Moulding & Trim Manufacturer List:
1. Mason’s Mill & Lumber Co. – 713.462.6975.
2. Cox Interior – 800.733.1751.
3. Texas Door & Trim, Inc. – 214.342.9393.
5. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
B. Exterior Standing and Running Trim: Softwood lumber trim, boards, and lumber.
   1. Profile: Sizes and profiles as indicated on Drawings.
      a. Match profile of existing vertical battens at Section House.
      b. Match existing board size for siding.
   2. Opaque Finished Trim: AWI AWS Section 6; Custom Grade.

2.3 INTERIOR FINISH CARPENTRY
A. Interior Wood Moulding & Trim Manufacturer List:
1. Mason’s Mill & Lumber Co. – 713.462.6975.
2. Cox Interior – 800.733.1751.
3. Texas Door & Trim, Inc. – 214.342.9393.
5. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
B. Interior Standing and Running Trim: Hardwood lumber and plywood.
   1. Profile: Sizes and profiles as indicated on Drawings.
   2. Match species and finish of products specified in Section 06 4100.
   3. Transparent Finished Trim: AWI AWS Section 6; Custom Grade.

2.4 FABRICATION
A. Fabricate finish carpentry to AWI AWS Section 6 Custom Grade.
B. Shop assemble work for delivery to site, permitting passage through building openings.
C. Fit exposed plywood edges with matching hardwood edging. Use one piece for full length only.
D. Shop prepare and identify components for book match grain matching during site erection.
E. When necessary to cut and fit on site, fabricate materials with ample allowance for cutting.
   Furnish trim for scribing and site cutting.

2.5 FINISHES
A. Sand work smooth and set exposed nails and screws.
B. Apply wood filler in exposed nail and screw indentations.
C. On items to receive transparent finishes, use wood filler matching surrounding surfaces and of types recommended for applied finishes.
D. Finish work in accordance with AWI AWS Section 5; Custom Grade;
   1. Stained Transparent Type at interior applications:
      a. System 5; Conversion varnish.
      b. System 6; Synthetic penetrating oil, top coat with either system 5 or 12 at interior applications or an exterior grade product of system 11 for exterior applications.
      c. System 12; Water-based polyurethane.
   2. Opaque Type at exterior applications:
      a. Paint per Section 09 9000.
E. Prime paint surfaces in contact with cementitious materials.
2.6 ACCESSORIES
   A. Wall Adhesive: Cartridge type, compatible with wall substrate, capable of achieving durable bond.
   B. Fasteners and Anchors:
   C. Concealed Joint Fasteners: Threaded steel.
   D. Lumber for Shimming and Blocking: Softwood lumber.
   E. Primer: type In accordance with Section 09 9000 at exterior applications.
   F. Wood Filler: Solvent base, tinted to match surface finish color.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify adequacy of backing and support framing.
   B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.2 PREPARATION
   A. Prime paint surfaces of wood items and assemblies to be in contact with cementitious materials.

3.3 INSTALLATION
   A. Install work in accordance with AWI AWS Section 6 and Custom Grade and manufacturer's instructions.
   B. Set and secure materials and components in place, plumb and level.
   C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.
   D. Install trim with nails at 30 inch on center and wall adhesive by gun application.
   E. Install prefinished paneling with full bed contact adhesive applied to substrate.
   F. Preparation For Site Finishing:
      2. Site Finishing at exterior applications: Refer to Section 09 9000.

3.4 TOLERANCES
   A. Conform to AWI AWS Section 6 requirements for the following:
      1. Smoothness.
      2. Gaps.
      3. Flushness.
      4. Flatness.

3.5 SCHEDULE OF ATTACHMENTS
   A. Exterior Finish Carpentry: Replacement of existing boards and trim.
      1. Match profiles and sizes of the existing to be retained.
      2. Enclosing Soffit Spaces: As detailed.
      3. Window Casings and Moldings: Hardwood; prepare for paint finish.
      4. Replace up to 5% of vertical boards at Section House.
      5. Replace up to 25% of vertical batten trim at Section House.
      6. Replace up to 10% of door, window, and eave/gable trim at Section House.
   B. Interior Finish Carpentry:
      1. False Box Beams at heads of partitions: Hardwood plywood and trim; prepare for transparent finish. Species and finish to match casework specified section 06 4100.
      2. At wall separating rooms 105 and 201, match species and finish of existing reddish stained panels that wall.

END OF SECTION 06 2000
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Custom casework.
      a. Transparent finished casework.
   2. Cabinet hardware.

B. Related Requirements:
   1. Section 04 2000 - Unit Masonry: Substrate backing walls.
   2. Section 06 1000 - Rough Carpentry: Grounds and support framing.
   3. Section 06 6119 - Quartz Surfacing Fabrications: Applied countertops and trim.
   4. Section 09 2116 - Gypsum Board Assemblies: Substrate backing wall.
   5. Section 22 4200 - Plumbing Fixtures: Plumbing fixtures.
   6. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Power, signal, and
data wiring.
   7. Section 26 0533 - Raceways and Boxes: Conduit and boxes for electrical devices integrated
   into cabinetry.
   8. Section 27 0533 - Conduits and Backboxes for Communications Systems: Conduit and boxes
   for communications and data devices integrated into cabinetry.

1.2 REFERENCE STANDARDS

A. American National Standards Institute:
   1. ANSI A135.4 - Basic Hardboard.
   2. ANSI A156.9 - Cabinet Hardware.
      a. APA-The Engineered Wood Association:
      a. Architectural Woodwork Institute:
   4. AWI AWS - Architectural Woodwork Standards.
      a. ASTM International:
   5. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel
      Hardware.
   6. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and
      Steel.

B. California Department of Health Services:
   1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from
      Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

C. Green Seal:
   1. GS-11 - Product Specific Environmental Requirements.
   2. GS-36 - Aerosol Adhesives.

D. Hardwood Plywood and Veneer Association:
   1. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.

E. National Electrical Manufacturers Association:
   1. NEMA LD 3 - High Pressure Decorative Laminates.

F. National Fire Protection Association:
   1. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling
      Interior Finish to Room Fire Growth.

G. South Coast Air Quality Management District:
   1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

H. U.S. Department of Commerce National Institute of Standards and Technology:
1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data:
   1. Submit data on fire retardant treatment materials and application instructions.
   2. Submit data for hardware accessories.
C. Shop Drawings:
   1. Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.
D. Samples:
   1. Submit minimum 2 x 3 inch size samples for color selection.
   2. Submit two, 8 x 10 inch size samples, illustrating cabinet finish.
E. Qualification Statements:
   1. Submit fabricator and installer experience qualifications.

1.4 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Indoor Air Quality Certificates:
      a. Certify volatile organic compound content for each interior adhesive and sealant and related primer.
      b. Certify each composite wood and agrifiber product contains no added urea-formaldehyde resins.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.5 QUALITY ASSURANCE
A. Perform work in accordance with AWI AWS, Section 10; Custom Grade.
B. Surface Burning Characteristics: Maximum 200/450 flame spread/smoke developed index when tested in accordance with ASTM.

1.6 QUALIFICATIONS
A. Fabricator: Company specializing in fabricating products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Protect units from moisture damage.
B. Maintain storage space relative humidity within ranges indicated in AWI AWS Section 2.

1.8 AMBIENT CONDITIONS
A. During and after installation of Work of this section, maintain same temperature and humidity conditions in building spaces as will occur after occupancy.
   1. Maintain relative humidity within ranges indicated in AWI AWS Section 2.

1.9 EXISTING CONDITIONS
A. Verify field measurements prior to fabrication. Indicate field measurements on shop drawings.

PART 2 - PRODUCTS
2.1 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.
C. Indoor Environmental Quality Characteristics:
1. Adhesives and Sealants: Maximum volatile organic compound content in accordance with product and testing requirements of CA/DHS/EHLB/R-174.
2. Paints and Coatings: Maximum volatile organic compound content in accordance with product and testing requirements of CA/DHS/EHLB/R-174.
3. Composite Wood and Agrifiber Products: Maximum volatile organic compound content in accordance with product and testing requirements of CA/DHS/EHLB/R-174.

D. Indoor Environmental Quality Characteristics:
1. Interior Adhesives: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
2. Interior Aerosol Adhesives: Maximum volatile organic compound content in accordance with GS-36.
3. Interior Flat and Non-Flat Paints: Maximum volatile organic compound content in accordance with GS-11.
4. Interior Composite Wood and Agrifiber Products: Contain no added urea-formaldehyde resins.

2.2 CUSTOM CASEWORK
A. Transparent Finished Custom Casework: Face framed construction; flush overlay style; AWI AWS Section 10; Custom Grade.
1. Exterior and Interior Exposed Surfaces: Birch lumber and plywood.
3. Door and Drawer Matching: Sequenced.

B. Casework Construction Details:
1. Drawer Side Joinery: Multiple dovetailed.
2. Drawer and Door Edge Profile: Square with thick applied band.
3. Toe Base Finish: Match cabinet face finish.

C. Quartz Surfacing Counter Tops: As specified in section 06 6119.

2.3 FABRICATION
A. Fabricate casework to AWI AWS Section 10 Custom Grade.
B. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
C. Fit exposed plywood edges with matching veneer edging. Use one piece for full length only.
D. Cap exposed high pressure decorative laminate finish edges with material of same finish and pattern.
E. Door and Drawer Fronts: 3/4 inch thick.
F. When necessary to cut and fit on site, fabricate materials with ample allowance for cutting. Furnish trim for scribing and site cutting.
G. Fabricate cabinets with cutouts for plumbing fixtures, inserts, appliances, outlet boxes, fixtures and fittings. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

2.4 FINISHES
A. Sand work smooth and set exposed nails and screws.
B. Apply wood filler in exposed nail and screw indentations.
C. On items to receive transparent finishes, use wood filler matching surrounding surfaces and of types recommended for applied finishes.
D. Finish work in accordance with AWI AWS Section 5; Custom Grade; Stained Transparent Type:
1. System 5; Conversion varnish.
2. System 6; Synthetic penetrating oil, top coat with either system 5 or 12.
3. System 12; Water-based polyurethane.
E. Colors:
1. Typical color of finished surfaces: Match VT Industries Wheat WH18 as specified in Section 08 1416.
2. Accents on front of transaction desk:
   a. Gradation of stain colors, Colors to be selected.
   b. Painted accent panel as indicated, color per Section 09 9000.
F. Prime paint surfaces in contact with cementitious materials.
2.5 ACCESSORIES
   A. Veneer Edge Band: AWI AWS; standard wood veneer edge band matching face veneer.
   B. Fasteners and Anchors:
      1. Fasteners: ASTM B695, Class 55 mechanically galvanized steel for high humidity and treated
         wood locations, unfinished steel elsewhere.
   C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; standard finish in
      concealed locations and US 26D finish in exposed locations.
   D. Concealed Joint Fasteners: Threaded steel.
   E. Grommets: Plastic material for cut-outs.
   F. Shelf Standards and Rests: Formed aluminum channels and rests, cut for fitted rests spaced at 1/2
      inch centers; satin finish. Knape & Vogt 255AL and 256AL.
   G. Drawer and Door Pulls: Zinc pull, satin finish. "U" shaped pull, 3 inch centers. Amerock AME-90042
      solid zinc.
   H. Cabinet Locks: Keyed cylinder, tumbler lock two keys for each lock, master keyed, bronze with
      satin finish. CompX-National C8173-26D and CompX-National C8178-26D.
   I. Catches: Magnetic. Stanley 810160 (SP41 class) and 810190 (SP46 class).
   J. Catches: Clip type. Amerock B-P3675-2G.
   K. Drawer Slides: Galvanized steel construction, ball bearings separating tracks, full extension type.
      Knape & Vogt 8400.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify adequacy of backing and support framing.
   B. Verify location and sizes of utility rough-in associated with work of this section.

3.2 PREPARATION
   A. Prime paint surfaces of casework items and assemblies to be in contact with cementitious
      materials.

3.3 INSTALLATION
   A. Install casework in accordance with AWI AWS Section 10 Custom Grade.
   B. Set and secure casework and counter tops in place; rigid, plumb, and level.
   C. Use fixture attachments in concealed locations for wall mounted components.
   D. Use concealed joint fasteners to align and secure adjoining cabinet units and counter tops.
   E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not
      use additional overlay trim for this purpose.
   F. Secure cabinet and counter bases to floor using appropriate angles and anchorages.
   G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species
      to match surrounding wood; finish flush with surrounding surfaces.

3.4 TOLERANCES
   A. Conform to AWI AWS Section 10 requirements for the following:
      1. Smoothness.
      2. Gaps.
      3. Flushness.
      4. Flatness.
      5. Alignment

3.5 ADJUSTING
   A. Adjust moving or operating parts to function smoothly and correctly in accordance with AWI AWS
      chapter 10.

3.6 CLEANING
   A. Uniform General Conditions of the Contract, especially paragraph 3.3.9.
   B. Clean casework, counters, shelves, hardware, fittings, and fixtures.
3.7 ATTACHMENTS

A. Break Room #304:
   1. Base and upper units
      a. 24 inch deep module at base units.
      b. 14 inch deep module at upper units.
      c. No locks, use magnetic catches.

B. Open Office #301:
   1. Base and upper units
      a. 24 inch and 30 inch deep modules at base units.
      b. 14 inch deep module at upper units.
      c. Locks at all doors.
      d. Use magnetic catches and clip type catches for double units with locks.

C. Reference Drawings for more information.

END OF SECTION 06 4100
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes quartz fabrications.
   1. Quartz Countertops.
   2. Quartz Trim.
   3. Setting materials and accessories.
B. Related Sections:
   2. Section 06 1000 - Rough Carpentry: Framing and wood blocking and supports.
   3. Section 06 4100 - Architectural Wood Casework: Cabinets with quartz countertop and backsplash.
   4. Section 07 9000 - Joint Protection: Perimeter sealant to adjacent construction.
   5. Section 09 2116 – Gypsum Board Assemblies: Substrate for attachment in conjunction with Section 06 1000.
   6. Section 22 4200 - Plumbing Fixtures: Plumbing drains and fixture trim.
   7. Section 26 0120 – Basic Electrical Requirements: Coordination of electrical items in casework.

1.2 REFERENCES
A. American National Standards Institute
   1. ANSI Z124.3 – Plastic lavatories.
   2. ANSI Z124.6 – Plastic sinks
B. ASTM International:
C. National Electrical Manufacturers Association:
   1. NEMA MG 1 - Motors and Generators.
D. South Coast Air Quality Management District:
   1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.3 PERFORMANCE REQUIREMENTS
A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for purpose specified and indicated.

1.4 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit data on specified component products. Include color selector from manufacturer’s full line.
C. Shop Drawings: Indicate dimensions, thicknesses, required clearances, tolerances, materials, colors, finishes, fabrication details, field jointing, adjacent construction, methods of support, integration of plumbing and electrical components, and anchorages.
D. Samples: Submit two samples representative of countertop, 4x4 inch in size illustrating color, texture, and finish.
E. Manufacturer's Installation Instructions: Submit preparation of opening required, rough-in sizes; tolerances for item placement, temporary bracing of components, and setting instructions.

1.5 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
1. **Materials Resources Certificates:**
   a. Certify recycled material content for recycled content products.

2. **Indoor Air Quality Certificates:**
   a. Certify volatile organic compound content for each interior adhesive and sealant and related primer.

C. **Product Cost Data:** Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.

1. Provide cost data for the following products:
   a. Products with recycled material content.

1.6 **CLOSEOUT SUBMITTALS**
A. Refer to the Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Operation and Maintenance Data: Submit list of approved cleaning materials and procedures required; list of substances harmful to component materials, include instructions for stain removal, and surface and gloss restoration.

1.7 **QUALITY ASSURANCE**
A. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.8 **QUALIFICATIONS**
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Fabricator: specializing in fabricating products specified in this section with minimum three years documented experience and approved by the manufacturer.

1.9 **DELIVERY, STORAGE, AND HANDLING**
A. Observe manufacturer’s recommendations to prevent chipping or breakage.
B. Do not allow finished surfaces to rub during shipping or handling.
C. Store in racks in near vertical position.
D. Store in clean, dry, interior area.
E. Maintain temperature between 40 and 100 degrees F.

1.10 **FIELD MEASUREMENTS**
A. Verify field measurements prior to fabrication.
B. Verify field measurements are as indicated on shop drawings.

1.11 **SEQUENCING**
A. Sequence work to coordinate with the work of Section 06 4100.

1.12 **WARRANTY**
A. Uniform General Conditions of the Contract, especially paragraph 13.5.
B. Furnish ten year manufacturer warranty for each type of unit against product defects.

**PART 2 - PRODUCTS**

2.1 **QUARTZ FABRICATIONS**
A. Manufacturers:
   1. Silestone – Basiq Series as basis of design.
   2. Caesarstone.
   3. Cambria - Classic
   7. Okite.
   8. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
2.2 SUSTAINABILITY CHARACTERISTICS
   A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
   B. Materials and Resources Characteristics:
      1. Recycled Content Materials: Furnish materials with maximum available recycled content.
   C. Indoor Environmental Quality Characteristics:
      1. Interior Adhesives: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.

2.3 COMPONENTS
   A. Quartz: Pure crushed quartz aggregate to comprise at least 93% of the finished product.
   B. Resin: Polyester binding resin up to 7% of the finished product.
   C. Panel properties:
      1. ANSI A124.3.4.2.1 Stain resistance: Pass
      2. ANSI A124.6.5.3 Wear and Cleanability: Pass
      3. ASTM C170 Compressive Strength: 21,000 psi minimum.
      4. ASTM C880 or D790 Flexural Strength: 5,300 psi minimum.
      5. ASTM E84: Class A.
   D. Adhesive: Manufacturer’s recommended type. Joint adhesives shall be cartridge dispensed in color to match material.
   E. Accessories as necessary and recommended by manufacturer.

2.4 FABRICATION
   A. Fabricate components to greatest extent practical to sizes and shapes as indicated or required.
   B. Form joints between components using manufacturer’s required or recommended joint adhesive.
   C. Radius to ease corners and edges.
   D. Cut holes for sinks, faucets, grommets for wiring, and other accessories. Ease edges.
   E. Tolerances:
      1. Thickness of panel: 1/8 inch.
      2. Panel face dimension: 1/16 inch.
      3. Rectangular Face variation: 1/16 inch maximum out of square.

2.5 SHOP FINISHING
   A. Color: Color Blanco City by Silestone as basis of design.
   B. Texture: Polished.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify dimensions by field measurement prior to installation.
   B. Verify existing conditions under Section 06 4100 are ready for the work of this section.
   C. Verify existing conditions under provisions of Section 22 4200 and 26 0120.
   D. Verify joint preparation and affected dimensions are acceptable.

3.2 PREPARATION
   A. Clean surfaces to receive fabrications. Remove loose and foreign matter that could interfere with adhesion.
   B. Protect finish surfaces from scratching by masking where necessary.
   C. Provide anchoring devices for installation and embedding.
   D. Provide templates and rough-in measurements.

3.3 INSTALLATION
   A. Align work plumb and level.
   B. Rigidly anchor to substrate to prevent misalignment.
   C. Install per manufacturer’s recommendations.
   D. Form and fill joints between quartz panels with manufacturer’s recommended sealant with maximum 1/8 inch gap.
   E. Seal to adjacent construction in accordance with Section 07 9000.
3.4 **ERECTION TOLERANCES**
   A. Maximum Variation From Indicated Dimension: 1/8 inch.
   B. Maximum Offset From Indicated Position: 1/8 inch.

3.5 **CLEANING**
   A. Uniform General Conditions of the Contract, especially paragraph 3.3.9.
   B. Clean exposed surfaces.

3.6 **SCHEDULES**
   A. Countertops at Break Room 304:
      1. ¾" thick counter.
      2. 4" high backsplash.
      3. Includes cut-out for sink specified in section 22 4200.
   B. Countertop at Employee Toilet Room 106:
      1. ¾" thick counter.
      2. 4" high backsplash.
      3. Includes cut-out for under-counter lavatory specified in section 22 4200.
   C. Countertops at Open Office Room 301:
      1. ¾" thick counter.
      2. No backsplash (sealant joint to masonry wall).
      3. Includes multi-height counters and turn-down (vertical).
      4. Grommets for cable management.
   D. Reference Drawings for more information.

END OF SECTION 06 6119
DIVISION 7
THERMAL AND MOISTURE PROTECTION

The Agreement, General Conditions Of The Contract For Construction, Supplementary Conditions Of The Contract For Construction, and all Addenda are a part of the Contract. The Contractor shall consult them in detail for instructions pertaining to the Work. The Contractor shall also consult all other divisions and sections of the Project Manual, and all Drawings in the execution of the work of the Contract.

The Contractor shall provide all labor, materials, systems, equipment, items, articles, operations, and/or methods listed, implied, mentioned, or scheduled in the Contract Documents and/or necessary and/or required for the satisfactory completion of the Work.

The listing of work, requirements, and products in this section is not intended to be conclusive. The Contractor shall check all other parts of the Contract Documents and shall provide all miscellaneous items of work and products necessary for the satisfactory completion of the Work described in the Contract Documents.
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes crystalline capillary waterproofing coating for concrete.

1.2 REFERENCES
A. ASTM International:
   2. ASTM C267 - Standard Test Methods for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes
B. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
C. USACE
   1. CRD C48 – Standard Test Method for Water Permeability of Concrete

1.3 PERFORMANCE REQUIREMENTS
A. Chemical Resistance: ASTM C267
   3 days  7 days  28 days  56 days
   Control Samples  0.0  0.0  +0.1  +0.3
   Acid Exposed    +0.1 -0.2  -1.1  -4.8
   Salt Exposed    +0.3  +0.8  +0.6  +0.7
B. Compressive Strength: ASTM C109 psi
   3 days  7 days  28 days  56 days
   Control Samples 2,110 3,870 5,200 5,780
   Acid Exposed    2,280 3,540 5,160 5,500
   Salt Exposed    2,020 3,490 5,540 5,720
C. Permeability: CRD C48
   1. Negative Direction: Virtually impermeable; no visible degradation; no water flow. Slight dampening after 420 hrs at 200 psi hydrostatic pressure
   2. Positive Direction: Virtually impermeable under 125 psi hydrostatic pressure. After 300 hrs at 200 psi, flow measured 0.075 cm3/hr over final 120 hours

1.4 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Manufacturer’s product data sheets with materials and test results.

1.5 QUALIFICATIONS
A. The manufacturer of the specified product shall be ISO 9001 certified and have in existence a recognized ongoing quality assurance program independently audited on a regular basis.
B. Contractor shall be qualified in the field of concrete repair and protection with a successful track record of 5 years or more. Contractor shall maintain qualified personnel who have received product training by manufacturer’s representative.

1.6 DELIVERY, STORAGE, AND HANDLING
A. All materials must be delivered in original, unopened containers with the manufacturer’s name, labels, product identification, and batch numbers. Damaged material must be removed from the site immediately.
B. Store all materials off the ground and protect from rain, freezing or excessive heat until ready for use.
C. Condition the specified product as recommended by the manufacturer.
PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. BASF MasterSeal 500 as basis of design
B. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.2 MATERIALS
A. Crystalline capillary waterproofing coating with the following characteristics:
   1. Withstands positive and negative hydrostatic pressure for dual-sided waterproofing.
   2. Resists de-icing salts, making suitable for winter environments.
   3. Protects against sewage and industrial wastes for use in wastewater treatment applications.
   4. Contains no chlorides, reducing the risk of corrosion.
   5. Penetrates concrete, seals capillaries and hairline cracks, and remains waterproof even if surfaces are damaged.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Surfaces must be clean and sound.

3.2 PREPARATION
A. Waterblasting is preferred for surface preparation to mechanically clean and roughen the surface, leaving the surface saturated with water.
B. Remove all paint, oil, dirt, laitance and other contaminants.
C. Surfaces must be dampened before application of MasterSeal 500.

3.3 INSTALLATION
A. Mix components to a slurry coat in accordance with manufacturer’s instructions.
B. Application:
   1. MasterSeal 500 slurry coat may be applied with a brush (synthetic bristle), broom or plaster sprayer at a rate of 1.5 lbs/yd² (0.83 kg/m²). Work slurry well into openings, rough surfaces, joints and routed out areas.
   2. Apply second coat, when required, after first coat has reached initial set (usually within 1 hour). If first coat has dried out, moisten surface before applying second coat.
C. Curing:
   1. MasterSeal 500 must remain moist to allow the crystals to form. All MasterSeal 500 applications must be kept moist for a minimum of 48 hours. After initial set, moist cure MasterSeal 500 using water spray. Fog-spray the treated surface 3-4 times daily for the 48-hour period. For warmer climates, more frequent spraying may be required.
   2. Protect freshly applied MasterSeal 500 from extreme weather conditions, such as rain, strong winds, high temperatures and freezing for a period of not less than 48 hours after application.
   3. For certain applications, MasterSeal 500 can be wet cured for 24 hours, followed by application of an ASTM C 309-approved water-based curing agent. Contact BASF Technical Service when curing using this method.

3.4 SCHEDULE
A. West wall of Room 203:
   1. Apply to back side of existing parging in wall cavity.
B. Existing perimeter masonry walls:
   1. After removal of paint from interior surface of existing 4” CMU at the Visitors Center, apply to interior surface of existing CMU.

END OF SECTION 07 1616
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes rigid board insulation at cavity wall construction, exterior wall behind interior masonry wall finish.
B. Related Sections:
   1. Section 04 2000 – Unit Masonry.
   2. Section 04 4213 – Masonry Supported Stone Cladding.
   3. Section 07 2116 - Blanket Insulation.
   4. Section 07 2726 – Fluid Applied Weather Barriers: weather barrier materials applied to substrate before insulation.

1.2 REFERENCES
A. ASTM International:
B. Green Seal:
   1. GS-36 - Aerosol Adhesives.
C. South Coast Air Quality Management District:
   1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.3 SYSTEM DESCRIPTION
A. Materials of This Section: Provide continuity of thermal barrier at building enclosure elements in conjunction with thermal insulating materials in Sections 07 2116 and 07 5419.
B. Materials of This Section: Provide thermal protection to weather seal materials at building enclosure elements in conjunction with weather barrier materials in Section 07 2726.

1.4 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit data on product characteristics, performance criteria, limitations, adhesives.
C. Manufacturer's Installation Instructions: Submit special environmental conditions required for installation, and installation techniques.
D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
   2. Indoor Air Quality Certificates:
      a. Certify volatile organic compound content for each interior adhesive and sealant and related primer.
   3. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
      a. Provide cost data for the following products:
         1) Products with recycled material content.
1.6 QUALITY ASSURANCE
A. Insulation Installed in Concealed Locations Surface Burning Characteristics:
   1. Foam Plastic Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
   2. Other Insulation: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.7 ENVIRONMENTAL REQUIREMENTS
A. Do not install adhesives when temperature or weather conditions are detrimental to successful installation.

1.8 SEQUENCING
A. Sequence Work to ensure weather barrier materials and sheet metal flashing within cavity are in place before beginning Work of this section.

1.9 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate Work with Section 07 2726 for weather barrier materials.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE BOARD INSULATION
A. Manufacturers:
   1. Dow Chemical - Extruded-Polystyrene Insulation, Model: CavityMate Plus.
   2. Pactiv/Green Guard - Extruded-Polystyrene Insulation, Model: Type IV 25 PSI Insulation Board.
   3. Owens Corning - Extruded-Polystyrene Insulation, Model: Foamular 250 XPS.
   4. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.2 POLYISOCYANurate BOARD INSULATION
A. Manufacturers:
   5. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.3 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.
C. Indoor Environmental Quality Characteristics:
   1. Interior Adhesives: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
   2. Interior Aerosol Adhesives: Maximum volatile organic compound content in accordance with GS-36.

2.4 COMPONENTS
A. Extruded Polystyrene Insulation: ASTM C578 Type VI; cellular type, conforming to the following:
   1. Board Density: 1.8 lb/cu ft.
   2. Board Size: 16x96 inch.
   3. Board Thickness: 1.5 inches.
   4. Thermal Resistance: R of 5.0 per inch.
   5. Water Absorption: In accordance with ASTM D2842; 0.7 percent by volume maximum.
B. Polyisocyanurate Insulation: ASTM C1289 Type I, rigid board, conforming to the following:
1. Board Density: 2.0 lb/cu ft.
2. Board Size: 16x96 inch.
3. Board Thickness: 0.75 inches.
4. Facing: Factory applied skin of aluminum foil on one face.
5. Compressive Strength: Minimum 20 psi.
   a. R of 7.5 when measured with ½” reflective air space.
8. Water Absorption: In accordance with ASTM D2842; less than 1-1/2 percent by volume maximum.

2.5 ACCESSORIES
   A. Adhesive Type: Type recommended by insulation manufacturer for application.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify substrate, adjacent materials, and insulation boards are dry and ready to receive insulation and adhesive.
   B. Verify substrate surface is flat, free of honeycomb, fins, irregularities, materials or substances affecting adhesive bond.

3.2 INSTALLATION - EXTERIOR WALLS
   A. Adhere 3 inch wide strip of polyethylene sheet over joint with double beads of adhesive each side of joint.
      1. Tape seal joints between sheets.
      2. Extend sheet full height of joint.
   B. Apply adhesive in three continuous beads per board length. Daub adhesive tight to protrusions.
   C. Install boards on wall surface, vertically. Place membrane surface of insulation against adhesive.
   D. Place boards in method to maximize contact bedding. Stagger end joints. Butt edges and ends tight to adjacent board and to protrusions.
   E. Cut and fit insulation tight to protrusions or interruptions to insulation plane.
   F. Place 4 inch wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames. Tape seal in place to ensure continuity of vapor retarder and air seal.
   G. Tape insulation board joints.

3.3 INSTALLATION - CAVITY WALLS
   A. Adhere 4 inch wide strip of polyethylene sheet over control joint with double beads of adhesive each side of joint between sheets. Extend sheet full height of joint.
   B. Apply adhesive in three continuous beads per board length. Daub adhesive tight to protrusions to ensure continuity of vapor retarder and air seal.
   C. Install boards horizontally between wall reinforcement.
   D. Place membrane surface facing out, tape seal board joints.
   E. Place boards in method to maximize contact bedding. Stagger end joints. Butt edges and ends tight to adjacent board and no protrusions. Place impale fastener locking discs.
   F. Cut and fit insulation tight to protrusions or interruptions to insulation plane.
   G. Place 4 inch wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames. Tape seal in place to ensure continuity of vapor retarder and air seal.

3.4 PROTECTION OF INSTALLED CONSTRUCTION
   A. Uniform General Conditions of the Contract, especially paragraph 3.3.
   B. Do not permit damage to insulation prior to covering.
3.5 SCHEDULES

A. Perimeter Insulation at Visitors Center: Extruded polystyrene, 1.5” Thick, bead adhesive application, apply to the interior side of the existing CMU back-up wall.

B. Cavity Wall Insulation: Foil-faced polyisocyanurate, 0.75” thick, bead adhesive application, apply to exterior side of the CMU back-up wall.

C. Reference Drawings for more information.

END OF SECTION 07 2113
PART 1 GENERAL

1.1 SUMMARY
A. Section includes:
   1. Batt insulation in exterior wall construction.
   2. Batt insulation for filling perimeter window and door shim spaces, crevices in exterior wall and roof.
   3. Section includes batt insulation in interior wall construction for acoustical control.
B. Related Sections:
   1. Section 06 1000 – Rough Carpentry.
   2. Section 07 2113 - Board Insulation.
   3. Section 07 2726 - Fluid Applied Weather Barriers.
   4. Section 08 1213.13 – Standard Hollow Metal Frames.
   5. Section 08 4113 – Aluminum Framed Entrances and Storefronts.
   7. Section 09 2116 - Gypsum Board Assemblies.

1.2 REFERENCES
A. ASTM International:

1.3 SYSTEM DESCRIPTION
A. Materials of This Section: Provide continuity of thermal barrier at building enclosure elements in conjunction with thermal insulating materials in Sections 07 2113, 07 2126.
B. Materials of This Section: Provide acoustical attenuation within interior partitions and between specified rooms.

1.4 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate the Work with Section 06 1000 for installation of framing and sheathing, Section 09 2116 for installation of gypsum panels.

1.5 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit manufacturer data on product characteristics, performance criteria, and limitations.
C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.
1.7 QUALITY ASSURANCE

A. Insulation Installed in Concealed Locations Surface Burning Characteristics:
   1. Batt Insulation: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

B. Insulation Installed in Exposed Locations Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
   1. Attic Floor Insulation: Minimum 0.12 watt per sq cm critical radiant flux when tested in accordance with ASTM E970.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years’ experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer’s original packaging and inspect for damage.

B. Store according to manufacturer instructions.

C. Protection:
   1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
   2. Remove insulation that becomes wet or damp.
   3. Provide additional protection according to manufacturer instructions.

PART 2 PRODUCTS

2.1 BATT INSULATION

A. Manufacturers: Cotton Batt Insulation
   1. Applegate/Mr. Insulation: Cotton Armour.
   4. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

B. Manufacturers: Sheeps Wool Batt Insulation
   1. Black Mountain USA, LLC: SheepRoll.
   2. Coler Natural Insulation: Sheep Wool Batt or Sheep Wool Roll.
   6. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.

2.3 COMPONENTS

A. Batt Insulation: ASTM C665 and C739; preformed cotton fiber batt or roll; friction fit, conforming to the following:
   1. Minimum Thermal Resistance: R3.5 per inch.
   2. Fire Rating: Flame Spread - 5 (Class A), Smoke Developed - 35 (Class A)
   3. Mold/Mildew/Fungi Resistance: Pass - No Growth (ASTM C739)
   5. Odor Emission: Pass (ASTM C739)
7. Retardant used acts as an excellent pest inhibitor.
8. No added urea-formaldehyde.
10. Size
   a. 16 and 24 inch nominal wide batts or rolls sized to fit wall framing, length in manufacturer’s standard lengths as appropriate for conditions of the project.
B. Batt Insulation: ASTM C739; preformed sheeps wool fiber batt or roll; friction fit, conforming to the following:
   1. Thermal Resistance: Minimum R of as scheduled.
   2. Size
      a. 16 and 24 inch nominal wide batts or rolls sized to fit wall framing, length in manufacturer’s standard lengths as appropriate for conditions of the project.

PART 3 EXECUTION

3.1 EXAMINATION
A. Verify substrate, adjacent materials, and insulation are dry and ready to receive insulation.

3.2 INSTALLATION
A. Install in exterior crevice spaces of door/window/storefront framing without gaps or voids. Do not compress insulation.
B. Install in interior partitions scheduled to fit framing spacing and depth for acoustical attenuation.
C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within plane of insulation.

3.3 SCHEDULES
A. Cotton batts or sheep’s wool batts may be used at Contractor’s option. All batt insulation in project must be of one type.
B. Exterior Doors, Windows, and Storefront:
   1. Batt sized to fit and fill window/door frame cavity.
C. Interior Wood Framed Walls scheduled for sound attenuation batts:
   1. 3-1/2” to 5-1/2” unfaced sound attenuation batts in walls framed with wood 2x4 and wood 2x6.

END OF SECTION 07 2116
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes foamed-in-place surface applied foam insulation to provide a perimeter wall assembly thermal seal, and crevice foam insulation.
B. Related Sections:
   1. Section 04 2000 - Unit Masonry.
   2. Section 04 4213 – Masonry-Supported Stone Cladding
   3. Section 05 1200 – Structural Steel.
   4. Section 05 5000 – Metal Fabrications
   5. Section 08 4113 – Aluminum Framed Entrances and Storefronts
   6. Section 08 5619 – Pass-Thru Windows

1.2 PERFORMANCE REQUIREMENTS
A. Conform to applicable code for flame and smoke, and concealment requirements.

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit product description, insulation properties and preparation requirements.
C. Manufacturer's Installation Instructions: Submit special procedures and perimeter conditions requiring special attention.
D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE
A. Insulation Installed in Concealed Locations Surface Burning Characteristics:
   1. Foam Plastic Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
   2. Apply label from agency approved by authority having jurisdiction to identify each foam plastic component.

1.5 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.6 ENVIRONMENTAL REQUIREMENTS
A. Do not install insulation when ambient temperature is lower than 20 degrees F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Crevice Insulation
   1. DAP, DA Ptex Plus Multi-Purpose Foam Sealant.
   2. Dupont, Great Stuff Gas & Cracks.
   3. LocTite, Tite Foam Gaps & Cracks Insulating Foam Sealant.
   4. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

B. Manufacturers: Big Gap Insulation
   1. DAP, Touch ‘n Foam Max Fill.
   2. Dupont, Great Stuff Big Gap Filler
   3. LocTite, Tite Foam Big Gaps Insulating Foam Sealant.
4. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify Work within construction spaces or crevices is complete prior to insulation application.
   B. Verify surfaces are clean, dry, and free of matter capable of inhibiting insulation or overcoat adhesion.

3.2 PREPARATION
   A. Mask and protect adjacent surfaces from overspray or dusting.

3.3 INSTALLATION
   A. Apply in conformance with manufacturers written instructions.
   B. Fill crevice cavities and gaps in walls or as indicated.
      1. Use Crack and Crevice sealant for gaps up to 1”.
      2. Use Big Gap sealant for gaps greater than 1” up to 3”.

3.4 PROTECTION OF INSTALLED CONSTRUCTION
   A. Uniform General Conditions of the Contract, especially paragraph 3.3.
   B. Do not permit subsequent construction Work to disturb applied insulation.

3.5 SCHEDULE
   A. Gaps and Crevices: Fill those gaps and crevices not otherwise filled with other insulation or grout at perimeter wall assemblies and where indicated on Drawings.

END OF SECTION 07 2119
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
1. Attic: Loose insulation pneumatically placed through access holes.
B. Related Sections:
1. Section 06 1000 - Rough Carpentry: Framing and sheathing for walk boards installed before insulation.

1.2 REFERENCE STANDARDS
A. ASTM International:
B. U.S. Code of Federal Regulations:
1. 16 CFR 1209 - Interim Safety Standard for Cellulose Insulation.
2. 16 CFR 1404 - Cellulose Insulation.

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit manufacturer information on product characteristics, performance criteria, limitations.
C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
D. Manufacturer Instructions: Submit procedure for preparation and installation.
E. Qualifications Statement:
1. Submit qualifications for manufacturer.
2. Submit qualifications for installer.

1.4 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate:
1. Certify that products meet or exceed specified sustainable design requirements.
2. Materials Resources Certificates:
   a. Certify recycled material content for recycled content products.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
1. Provide cost data for following products:
   a. Products with recycled material content.
D. Furnish and label cellulose loose-fill insulation according to 16 CFR 1209 and 16 CFR 1404.
E. Surface-Burning Characteristics of Insulation Installed in Concealed Locations:
1. Cellulose Loose-Fill Insulation: Maximum 450 smoke-developed index when tested according to ASTM E84.
2. Other Loose-Fill Insulation: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
F. Surface-Burning Characteristics of Insulation Installed in Exposed Locations:
1. Cellulose Loose-Fill Insulation: Maximum 450 smoke-developed index when tested according to ASTM E84.
2. Other Loose-Fill Insulation: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
3. Attic Floor Insulation: Minimum 0.12 W per sq. cm critical radiant flux when tested according to ASTM E970.
G. Apply label from agency approved by authority having jurisdiction to identify each package of cellulose loose-fill insulation.

1.5 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
   B. Store materials according to manufacturer instructions.
   C. Protection:
      1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
      2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 BLOWN INSULATION
   A. Manufacturers:
      1. US GreenFiber, LLC – 515LD as basis of design.
      2. Igloo – Cellulose.
      5. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.2 SUSTAINABILITY CHARACTERISTICS
   A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
   B. Material and Resource Characteristics:
      1. Recycled Content Materials: Furnish materials with maximum available recycled content.

2.3 COMPONENTS
   A. Fiber Fill Insulation:
      1. Description:
         a. Type: Cellulose fiber.
         b. Bulk for pneumatic placement.
      2. Comply with ASTM C739.
      3. Thermal Resistance: R-value of 3.7 sq. ft. x h x deg. F/Btu per inch thickness.
   B. Cellulosic fiber:
      1. Minimum recycled content, 84%
      2. Formaldehyde free.
   C. Ventilation Baffles: Formed metal.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.
   B. Verify light fixtures have thermal cutout device to restrict overheating in soffit or ceiling spaces.
   C. Verify that spaces are unobstructed to allow for placement of insulation.

3.2 INSTALLATION
   A. Place insulation pneumatically, tight in joist spaces to density of 2.6 pcf.
   B. Baffles and Services:
      1. Place insulation against baffles; do not impede natural attic ventilation to soffit.
      2. Place insulation against and behind mechanical and electrical services within plane of insulation.
   C. Completely fill intended spaces, leaving no gaps or voids.
3.3 CLEANING
   A. Remove loose insulation residue.

3.4 ATTACHMENTS
   A. Attic Space at Section House: Install insulation between ceiling joists to achieve R-value of 38.

END OF SECTION 07 2126
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes air leakage criteria for primary air seal building enclosure materials and assemblies; materials and installation methods supplementing other air seal materials and assemblies; and air seal materials to connect and seal openings, joints, and junctions between other air seal materials and assemblies.
   1. Fluid-applied vapor permeable weather barrier membrane.
   2. Joint treatment:
      a. Joint tape.
      b. Joint compound.
   3. Flashing:
      a. Vapor permeable fluid-applied elastomeric flashing.
      b. Flexible flashing.
      c. Sheet flashing.
   4. Sealant
B. Related Sections:
   1. Section 04 2000 – Unit Masonry: Joints between masonry walls.
   2. Section 04 4213 – Masonry-Supported Stone Cladding.
   3. Section 05 1200 – Structural Steel Framing: Structural steel protruding past framed substrate.
   4. Section 07 9000 - Joint Protection: Sealant materials and installation techniques.
   5. Section 08 1213.13 - Standard Hollow Metal Frames.
   6. Section 08 4113 - Aluminum-Framed Entrances and Storefronts.

1.2 REFERENCES
A. ASTM International:
B. AATCC – American Association of Textile Chemists and Colorists
   1. Test Method 127 Water Resistance: Hydrostatic Pressure Test
C. TAPPI
D. Sealant, Waterproofing and Restoration Institute:
   1. SWRI - Sealant Specification.

1.3 DEFINITIONS
A. Air Barrier: Continuous network of materials and joints providing air tightness, with adequate strength and stiffness to not deflect excessively under air pressure differences, to which it will be subjected in service. It can be comprised of single material or combination of materials to achieve performance requirements.
1.4 PERFORMANCE REQUIREMENTS
A. Water Vapor Transmission: 25 perms, when tested in accordance with ASTM E 96, Method B at 25 mils DFT (Dry Film Thickness)
B. Water Penetration Resistance: Greater than 1000 cm when tested in accordance with AATCC Test Method 127. No leakage at 15 psf when tested in accordance with ASTM E 331.
C. Air Penetration Resistance (Material):
   1. 0.0002 cfm/ft² at 75 Pa, when tested in accordance with ASTM E 2178.
   2. Air infiltration greater than 10,000 seconds per 100cc, when tested in accordance with TAPPI Test Method T-460.
D. Air Penetration Resistance (System/Assembly)
   1. ≤ 0.01 cfm/ft² at 75 Pa, when tested in accordance with ASTM E 2357.
   2. ≤ 0.01 cfm/ft² at 75 Pa, Type I Air Barrier, when tested in accordance with ASTM E 1677.
E. Provide continuity of air seal materials and assemblies in conjunction with materials described in Section 04 2000, 04 4213, 08 1213.13, and 08 4113.

1.5 PRE-INSTALLATION MEETINGS
A. Convene minimum one week prior to commencing work of this section. Schedule to coincide with regular progress meetings.
B. Attendees shall include Contractor, Architect, certified installer, Owner’s Representative, and weather barrier manufacturer’s designated field representative.
C. Review all related project requirements and submittals, status of substrate work and preparation, areas of potential conflict and interface, availability of weather barrier system materials and components, installer’s training requirements, equipment, facilities and scaffolding, and coordinate methods, procedures and sequencing requirements for full and proper installation, integration and protection.
D. Notify Architect/Engineer four days in advance of meeting date.

1.6 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit data on material characteristics, performance criteria, and limitations.
C. Manufacturer’s Installation Instructions: Submit preparation, installation requirements and techniques, product storage and handling criteria.
D. Manufacturer’s Field Service Reports: Provide site reports from authorized field service representative indicating observation of weather barrier system installation.
E. Closeout Submittals:
   1. Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
   2. Weather Barrier WARRANTY: Manufacturer’s executed warranty form with authorized signatures and endorsements indicating date of Substantial Completion.

1.7 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer’s Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.8 QUALITY ASSURANCE
A. Perform Work in accordance with SWRI - Sealant and Caulking Guide Specification requirements for materials and installation.
1.9 QUALIFICATIONS
A. Installer: Company specializing in performing Work of this section certified by manufacturer for installation.

1.10 MOCKUP
A. Section 8.4 of the Uniform General Conditions of the Contract.
B. Install mock-up using approved weather barrier system including membrane, flashing, joint and detailing compound and related weather barrier accessories according to weather barrier manufacturer’s current printed instructions and recommendations.
C. Install in conjunction with mockups required in sections 04 2000, 04 4213, 08 4113, and for each type of exterior wall where work of this section is incorporated.
   1. Mock-up shall include all typical joints and transitions, including sill, head or top of wall, and where adjoining dissimilar materials.
   2. Manufacturer’s designated representative prior must perform visual inspection and analysis of mock-up as required for warranty.

1.11 DELIVERY, STORAGE, AND HANDLING
A. Deliver weather barrier materials and components in manufacturer’s original, unopened, undamaged containers with identification labels intact.
B. Store weather barrier materials as recommended by manufacturer.

1.12 ENVIRONMENTAL REQUIREMENTS
A. Maintain temperature and humidity recommended by materials manufacturers before, during and after installation.

1.13 SEQUENCING
A. Sequence Work to permit installation of materials in conjunction with related materials and seals.
B. Schedule installation of exterior cladding within nine months of weather barrier system installation.

1.14 WARRANTY
A. Uniform General Conditions of the Contract, especially paragraph 13.5.
B. Manufacturer’s warranty for weather barrier for a period of ten (10) years from date of Substantial Completion.

1.15 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate the Work of this section with sections referencing this section.

PART 2 - PRODUCTS
2.1 WEATHER BARRIERS
A. Manufacturers:
   1. Dupont Tyvek Fluid Applied WB System as basis of design.
   2. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
B. All components of weather barrier system must be from a single manufacturer and manufacturer’s system.

2.2 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.

2.3 COMPONENTS
A. Liquid Weather Barrier Components.
   1. Tensile Strength: Minimum 169 lbs/in², when tested in accordance with ASTM D 412.
   2. Estimated Elongation: 420% in accordance with ASTM D 412.
   3. Hardness: Passes at a Shore A hardness of 71, when tested in accordance with ASTM D 2240.
5. UV Resistance: 9 months.
6. Volatile Organic Content (VOC): Less than 2% (25-30 g/L) when measured in accordance with ASTM C 1250.
7. Adhesion Strength (Concrete): Greater than 33 psi when measured in accordance with ASTM D 4541.
8. Low Temperature Crack Bridging: Pass, when tested in accordance with ASTM C 1305.

B. Fluid Applied Weather Barrier:
   1. DuPont™ Tyvek® Fluid Applied WB as basis of design.

C. Flashings:
   1. DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound as basis of design.
   2. DuPont™ Tyvek® Fluid Applied Flashing – Brush Grade as basis of design.

D. Joint Compound:
   1. DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound as basis of design.

E. Sealant
   1. DuPont™ Sealant for Tyvek® Fluid Applied Systems as basis of design.

2.4 ACCESSORIES
A. Joint Tape:
   1. Product: Self-adhered fiberglass mesh tape as recommended by weather barrier manufacturer.

B. Sheet Flashings: Straight and flexible flashings applied to transitions at material transitions, corners, and over gaps exceeding 1 inch.
   1. Product: DuPont™ StraightFlash™ as design basis.
   2. Primer as recommended by product manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

3.2 PREPARATION
A. Complete surface preparation, priming, flashing and detailing of openings, cracks, and material transitions prior to beginning installation of fluid-applied weather barrier system.
B. Surfaces shall be clean and free of frost, oil, grease, mold and efflorescence prior to application of fluid-applied weather barrier system.

3.3 INSTALLATION - DETAILING
A. Corners:
   1. Apply primer to outside and inside corners, extend 2 inches on each side of corner. Center sheet flashing over corner and press firmly in place per manufacturer’s recommendations.

B. Joint Treatment:
   1. Non-movement joints in masonry and transition to columns and beams.
      a. Joints 1/4 inch wide or less: Apply fluid-applied joint compound a minimum of 2 inches wide by 60 mils thick to each side of joint or crack.
      b. Apply primer 2 inches on each side of joint. Center sheet flashing over joint and press firmly in place per manufacturer’s recommendations.

C. Apply fluid-applied joint compound to cladding anchors prior to installation of weather barrier membrane per manufacturer’s instructions.
D. Apply fluid-applied joint compound around penetrations in exterior walls forming a fillet bead minimum ½ inch onto each surface.

E. Installation – Vapor permeable fluid-applied elastomeric flashing at openings:
   1. At jambs and head of rough opening: Apply 25 mil thickness of fluid-applied flashing to full depth of opening and 2 inches onto outside face of opening.
   2. At sills: Apply primer to substrates as recommended by manufacturer. Cut sheet flashing to fit directly between jambs of opening. Install sheet flashing to full width of sill opening and down
onto outside face of opening a minimum of 2 inches. Cover sheet flashing with 25 mil thickness of vapor permeable fluid-applied elastomeric flashing per fluid-applied weather barrier manufacturer’s instructions.

F. Allow Fluid-Applied Flashing, Joint Compound and Sealant to cure for minimum 24 hours before coating with Fluid-applied Weather Barrier.

3.4 INSTALLATION – FLUID APPLIED WEATHER BARRIER
A. Install fluid-applied weather barrier prior to installation of windows, doors, and louvers.
B. Mask and protect any adjacent finished surfaces from fluid-applied weather barrier material.
C. Install fluid-applied weather barrier over exterior face of required exterior wall substrates in accordance with weather barrier manufacturer recommendations and instructions.
D. Install fluid-applied weather barrier by power-rolling method to achieve 25 mils providing a consistent and uniform thickness.
E. Repair any voids, holidays, or non-uniform installations or damage by other trades to proper mil thickness prior to installation of final cladding assemblies.

3.5 PROTECTION & CLEANING OF INSTALLED CONSTRUCTION
A. Protect weather barrier from contact with incompatible materials and sealants not approved per weather barrier manufacturer’s recommendation.
B. Protect installed weather barrier system from damage during construction prior to cladding installation.
   1. If damaged or exposed to UV beyond nine (9) months, clean and prepare surfaces and install additional, full-thickness, fluid-applied weather barrier application in accordance with weather barrier manufacturer’s instructions.
C. Remove masking materials and adjacent protection after weather barrier installation.

3.6 SCHEDULE
A. Cavity wall construction at the Comfort Station.
B. Reference Drawings for more information.

END OF SECTION 07 2726
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Formed composite polymeric shake roofing tiles.
   2. Underlayment.
   3. Interlayment.
   4. Valley protection.
   5. Nailers.
   6. Metal flashings and accessories.

B. Related Requirements:
   1. Section 06 1000 - Rough Carpentry: Roof sheathing.
   2. Section 07 6200 - Sheet Metal Flashing and Trim.

1.2 REFERENCE STANDARDS

A. ASTM International:

B. NRCA (National Roofing Contractors Association)
   1. NRCA Roofing and Waterproofing Manual.

C. Sheet Metal and Air Conditioning Contractors' National Association:

D. Underwriters Laboratories Inc.:

1.3 PREINSTALLATION MEETINGS

A. Convene minimum one week prior to commencing Work of this Section.
B. Notify Architect/Engineer four days in advance of meeting date.
C. Required attendees: Owner, Architect, General Contractor, and Roofing sub-contractor.

1.4 SUBMITTALS

A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit shake properties, configurations, special shapes, and securement methods.
C. Shop Drawings: Indicate specially configured metal flashings, joint locations, fastening locations, installation details, and tile layout with location of cut and special-shaped tiles identified.
D. Samples: Submit two full-size roof shake units, illustrating color, surface finish and texture, and tile configuration.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
F. Manufacturer's Instructions: Submit installation techniques.
G. Qualifications Statements:
   1. Submit qualifications for manufacturer and installer.
   2. Submit manufacturer's approval of installer.
H. Warranty: Submit manufacturer's project number indicating warranty is available for this project prior to ordering materials and beginning installation.

1.5 SUSTAINABLE DESIGN SUBMITTALS

A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.6 QUALITY ASSURANCE
B. Roof Covering Fire Classification: Minimum Class A when tested according to ASTM E108 or UL 790.
C. Apply label from agency approved by authority having jurisdiction to identify each roof assembly component.
D. Shake Blending: Factory-blend shakes and package accordingly so that shakes taken from one pallet show the same range in colors as those taken from other pallets, and match approved samples.

1.7 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience.
B. Installer: Company specializing in performing Work of this Section with minimum three years' experience and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Deliver materials in manufacturer's packaging; include installation instructions.
B. Inspection: Accept roof tiles on-site and inspect for damage.
C. Store roof shakes according to manufacturer's instructions.

1.9 WARRANTY
A. Uniform General Conditions of the Contract, especially paragraph 13.5.
B. Furnish fifty-year manufacturer's warranty for roof shakes.
   1. Minimum first 10 years cover materials and labor.

PART 2 - PRODUCTS
2.1 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Material and Resource Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.

2.2 POLYMERIC ROOF SHAKES
A. Manufacturers:
   1. CeDUR
   2. Substitutions: Not permitted.
B. Roof Shakes: CeDUR Roofing Shakes as manufactured by CeDUR.
   2. Compliance:
      a. Fire Rating: UL 790, Class A fire resistance.
   4. Length: 23-1/2 inches typical, 15 inches at starter courses.
   5. Thickness:
      a. Typical Shakes:
         1) Nominal 3/4 inch at butt end.
2) Nominal 1/8 inch at tapered end.
   b. Starter Course:
      1) Nominal 3/8 inch at butt end.
      2) Nominal 1/8 inch at tapered end.
   c. Exposure: 10 inches.
6. Ridges and Hips:
   a. Preformed Hip and Ridge Medium
      1) Size:
         a) Length: 13 inches.
         b) Coverage: 5 inches.
         c) Angle of ridge: 38 degrees.
      2) Exposure: 10 inches.
      3) Thickness: 3/4 inch uniform.
8. Insulative Value: R 2.0 minimum for installed assembly.
C. Performance and Design Criteria:
   1. Wind Resistance: Conform to applicable code to resist wind loads on roof tiles.

2.3 UNDERLAYMENT/INTERLAYMENT
A. Polymer Underlayment: One of two options listed below with a minimum upper service temperature of 300 degrees F.
   1. 30 mil high density cross laminate polyethylene with butyl rubber based or modified asphalt adhesive membrane.
      b. Grace Construction Products; Ultra.
   2. 50 mil high density cross laminate coal tar elastomeric, modified asphalt adhesive membrane.
      a. Hyload; Hybase SAM
B. Interlayment:
   2. Type: Type II, No. 30 unperforated asphalt felt.

2.4 ACCESSORIES
A. Shake Nails:
   1. Standard round wire, corrosion resistant.
   2. Shank Diameter: Minimum 11 gage.
   3. Head Diameter: Minimum 0.313 inch.
   4. Length: Sufficient to penetrate through roof sheathing.
   5. Penetrating Preservative Treated Wood: Type 304 stainless steel.
B. Flashing Materials:
   1. Sheet Flashings: As specified in Section 07 6200 - Sheet Metal Flashing and Trim.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify that roof penetrations are in place and flashed to deck surface.
B. Verify that roof openings are correctly framed prior to installing Work of this Section.
C. Verify that deck is of sufficient thickness to accept fasteners.
D. Verify that deck surfaces are dry, unfrozen, and free of ridges, warps, and voids.

3.2 PREPARATION
A. Seal roof deck joints wider than 1/16 inch using deck tape.
B. Broom-clean deck surfaces.

3.3 INSTALLATION
A. Install roof system according to The NRCA Steep Roofing Manual and SMACNA Architectural Sheet Metal Manual.
B. Apply underlayment over entire roof area in single layer laid perpendicular to slope; weather lap edges 4 inches in the horizontal and 6 inches in the vertical. Secure with self-stick adhesive or nail in place in accordance with manufacturer’s instructions. Minimize nail quantity.

C. Valley Protection Installation:
   1. Place one ply of underlayment, minimum 36 inches wide, centered over valleys in addition to other underlayment; weather-lap joints minimum 2 inches, and nail in place minimum 18 inches o.c., 1 inch from edges.
   2. Place sheet metal flashing, minimum 24 inches wide, centered over open valleys; weather-lap joints minimum 4 inches, and nail in place 18 inches o.c., 1 inch from edges.

D. Metal Flashing Installation:
   1. Install flashings as specified in Section 07 6200 - Sheet Metal Flashing and Trim.

E. Shake Installation:
   1. Install roof shakes according to The NRCA Steep Roofing Manual and manufacturer’s instructions.
   2. Place shake square with building lines and parallel with roof slope; place filler and closure pieces as required.
   3. Project shake 1-1/2 inches beyond face of facia boards.
   4. The first course of the shakes should be laid directly on the starter shakes with the butt of the shake flush with the butt of the starter shake. Shakes should be laid individually with a rack type system, also known as rack-style, stair-stepping, or pyramiding; to prevent same size shake directly on top of another and laid so that the alignment markers are covered.
      a. For a rack style installation start with two shakes at the eave and place one shake above at the recommended 10 inch exposure. Place the next shake at the eave and work towards the peak diagonally increasing one course with each shift either right or left. The pattern should look like one half of a pyramid or one long diagonal row of shakes on the roof.
   5. Fasten shake according to applicable code to resist wind forces.
      a. Fasten a minimum 1 inch from shakes edge and place in the fastening zone 1 inch above the butt line of the course to follow. Fasteners shall be of sufficient length to fully penetrate a minimum of 3/4 inch into and/or through the decking. Do not fasten through the void area between shakes and roof deck unsupported by the Shake course below. Fasteners are to be driven flush to the product surface and not over driven or under driven. Fasteners are to be driven perpendicular to material face.
   6. Shakes shall be laid with an approximate 1/4 inch to 3/8 inch gap between each shake. The gaps between shakes on adjacent courses should offset by a minimum of 1-1/2 inches. To assure proper horizontal alignment snap chalk lines for each course.
   7. After applying the starter shakes, a minimum 18 inch wide strip of interlay of ASTM D 226 Type II No. 30 felt shall be laid over the top portion of the starter shakes, the butt end of the interlay course extending up-slope onto the underlayment, approximately 9 inches above the fascia (for a 1 inch overhang). After installing the field shakes over the starter shakes, position the bottom edge of the next interlay on the 10 inch line of the interlay previously instated, with successive courses laid on the 10 inch line (or less depending on roof layouts less than 10").
   8. Place tiles so color variations are evenly distributed over entire roof area. Shade variation may occur differently from pallet to pallet and within individual pallets; blend tiles between bundles and pallets to insure even distribution of color variations.
      a. Blending: Color “mapping” or “blotching” in appearance is not acceptable.
   9. Coordinate installation of roof-mounted components or Work projecting through roof with weathertight placement of counterflashings.
10. Complete installation to provide weathertight service.

3.4 ATTACHMENTS
   A. Section House: All steep slope roofing over building and porch.
   B. Reference Drawings for more information.
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes fully adhered PVC with Elvaloy finish ply and flashing ply with a modified asphalt base ply. System also includes underlayment board, tapered insulation, and recover board.

B. Related Sections:
1. Section 03 3000 – Cast-In-Place Concrete: Concrete assembly substrate.
2. Section 06 1000 - Rough Carpentry: Wood nailers and parapet sheathing.
4. Section 07 9000 – Joint Protection.

1.2 REFERENCES
A. American Society of Civil Engineers (ASCE):
   1. ASCE 7.

B. ANSI

C. ASTM International:
   1. Services
  20. ASTM D1204 – Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.

D. Federal Specifications
1. HH-I-1972 – Insulation Board, Thermal, Faced, Polyurethane or Polysiocyanurate.

E. FM Global:
1. FM DS 1-28 - Wind Loads to Roof Systems and Roof Deck Securement.
2. FM 4470.

F. National Roofing Contractors Association (NRCA):
1. NRCA - The NRCA Roofing and Waterproofing Manual.

G. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

H. Single-ply Roofing Institute (SPRI):

I. Standards Council of Canada:

J. Underwriters Laboratories Inc.:
1. UL - Fire Resistance Directory.

1.3 SYSTEM DESCRIPTION
A. PVC Elveloy Membrane Roofing System: Two ply membrane system with hot mop applied modified bitumen base sheet, and hot mop applied PVC Elveloy membrane as finish ply.

1.4 DESIGN REQUIREMENTS
A. Low Slope Membrane Roof Edge Securement: Conform to SPRI ES-1 for wind speeds determined from applicable code and indicated on structural drawings.
B. FM DS 1-28 - Wind Loads to Roof Systems and Roof Deck Securement.
C. Roof Assembly Fire Classification: Minimum Class A when tested in accordance with ASTM E108 or UL 790.

1.5 PERFORMANCE REQUIREMENTS
A. Roof Assembly Classification:
1. FM Class 1A Construction.
1.6 PRE-INSTALLATION MEETINGS
   A. Convene minimum two weeks prior to commencing Work of this section.
   B. Shall be in conjunction with the pre-installation meeting for the sheet metal trim as specified in
      sections 07 6200 and as indicated on the drawings.
   C. Required attendees: Owner, Architect, General Contractor, and sub-contractors installing roofing,
      sheet metal trim, gutters, and scuppers, board insulation installer, roofing manufacturer’s
      representative.
   D. Notify Architect/Engineer four days in advance of meeting date.

1.7 SUBMITTALS
   A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special
      Conditions of the Contract.
   B. Product Data:
      1. Submit membrane materials, base flashing materials, venting base sheet, resins, and reinforcing
         scrim.
      2. Submit bitumen to be used in hot mopping. Include manufacturers equiviscous temperature
         (EVT).
      3. Submit sealants and fasteners.
      4. Submit latest edition of manufacturer’s specifications and installation procedures. Submit only
         those items applicable to this project.
   C. Shop Drawings:
      1. Indicate setting plan for layout of seams, direction of laps.
      2. Provide manufacturer’s approved details of all perimeter conditions, projection conditions, and
         any additional special job conditions which require details other than indicated in the
         drawings.
      3. Manufacturer’s Installation Instructions: Ensure special precautions required for seaming
         membrane is included.
   D. Schedule:
      1. Provide detailed project sequencing, staging, material loading, manpower plans, and detailed
         project construction schedule for approval.
   E. Manufacturer’s Certificate: Certify products meet or exceed specified requirements.
   F. Submit test results showing compliance with minimum FM 1-90, wind uplift rating, FM/UL fire
      classification and FM/UL fire rating required.
   G. Submit a written statement from the roofing materials manufacturer approving the installer,
      specifications and drawings as described and/or shown for this project and stating the intent to
      guarantee the completed project.
   H. Warranty:
      1. Submit a completed manufacturer’s application for roof guarantee form along with shop
         drawings of the roofs showing all dimensions, penetrations, and details. The form shall contain
         all the technical information applicable to the project including deck types, roof slopes, base
         sheet and/or insulation assemblies proposed for installation. The form shall also contain
         accurate and complete information requested including proper names, addresses, zip codes
         and telephone numbers.
      2. The project must receive approval by the membrane manufacturer, through this process, prior
         to shipment of materials to the project site. Submit draft warranty for review specific to the work
         of this project/section. A sample warranty is not acceptable.
   I. Manufacturer’s Field Reports: Indicate procedures followed, ambient temperatures and wind
      velocity during application.

1.8 SUSTAINABLE DESIGN SUBMITTALS
   A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design
      submittals.
   B. Fabricator’s Certificate: Certify products meet or exceed specified sustainable design
      requirements.
      1. Materials Resources Certificates:
         a. Certify recycled material content for recycled content products.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.  
   1. Provide cost data for the following products:  
      a. Products with recycled material content.

1.9 CLOSEOUT SUBMITTALS  
   A. Refer to the Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.  
   B. Within ten days of the date of Substantial Completion of the project, deliver to the Owner three copies of the manufacturer’s printed instructions regarding care and maintenance of the roof.

1.10 QUALITY ASSURANCE  
   A. Perform Work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer’s published installation instructions.  
   B. Follow insurance underwriter’s requirements acceptable for use with specified products or systems.  
   C. The contractor shall follow local, state, and federal regulations, safety standards, and codes for the removal, handling, and disposal of asbestos containing materials, if present. When a conflict exists, use the stricter document.  
   D. Roof Assembly Fire Classification: Minimum Class A when tested in accordance with ASTM E108 or UL 790.  
   E. Apply label from agency approved by authority having jurisdiction to identify each roof assembly component.

1.11 QUALIFICATIONS  
   A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years experience and satisfactory performance record.  
      1. The manufacturer must be UL listed.  
      2. The manufacturer must have FM Approvals for the membrane roofing system specified. Approval must have been in effect at least 10 years.  
   B. Applicator: Company specializing in performing Work of this section.  
      1. Application must have a minimum of five years successful experience installing products similar to specified products. This experience must include a minimum of 5 projects of similar scope as this Project and with a satisfactory performance record.  
      2. Applicator must have successfully completed at least two projects with the roofing system specified. The projects must be warranted by the manufacture of the products.  
      3. Must be certified in writing by and in good standing with the manufacturer.  
      4. Must be acceptable to the roof materials manufacturer to meet the manufacturer’s warranty requirements.

1.12 MANUFACTURER FIELD SERVICES  
   A. The membrane/flashing system manufacturer shall provide direct trained company personnel to attend necessary job meetings, perform periodic inspections as necessary, and conduct a final inspection upon successful completion of the project.  
   B. Manufacturer’s Observation Reports: Beginning with the commencement of the roofing system installation for the project and continuing through the completion of the roofing system installation and all its associated components, the Roofing System Manufacturer or their appointed representative shall provide written field observation reports including digital photos as follows; and this shall be confirmed in writing by the manufacturer and made part of the roofing submittals.  
      1. Keep the Architect / Owner informed as to the progress, status, and quality of work as observed.  
      2. Provide jobsite observations no less than (2) hours per week throughout the installation of the roofing system and its associated components. Reports shall include detailed weekly reports to the Architect, Contractor, and Subcontractor along with digital photographs of work in progress. These reports and photographs shall be descriptive of actual work in progress, status, and condition, and be presented in a written format with digital color photographs.  
      3. It will be the sole responsibility of each bidder to ensure these conditions are to be met by the roofing system manufacturer or their appointed representative prior to bidding.
1.13 DELIVERY, STORAGE, AND HANDLING

A. All materials shall be delivered with appropriate carton and can labels indicating appropriate warnings, storage conditions, lot numbers, and usage instructions. Materials damaged in shipping or storage shall not be used.

B. Precaution: Some of the indicated materials are extremely flammable and/or toxic. Use precautions indicated on can and carton labels.

C. Deliver products in manufacturer's original containers, dry, undamaged, seals and labels intact and legible including labels indicating appropriate warnings, storage conditions, lot numbers, and usage instructions. Materials damaged in shipping or storage shall not be used.
1. Deliver materials requiring fire resistance classification to the job with labels attached and packaged as required by labeling service.
2. Handle and store material and equipment in such a manner as to avoid damage. Liquid products shall be delivered sealed, in original containers.
3. Handle rolled goods so as to prevent damage to edge or ends.
4. Select and operate material handling equipment so as not to damage existing construction or applied roofing.
5. Moisture-sensitive products shall be maintained in dry storage areas and properly covered. Provide continuous protection of materials against wetting and moisture absorption. Store roofing and flashing materials on clean raised platforms with weather protective covering when stored outdoors.
6. Store rolled goods on end.
7. Protect materials against damage by construction traffic.
8. The proper storage of materials is the sole responsibility of the contractor and any wet or damaged roofing materials shall be discarded, removed from the project site, and replaced prior to application.
9. Comply with fire and safety regulations, especially with materials which are extremely flammable and/or toxic. Use safety precautions indicated on labels.
10. Products liable, such as emulsions, to degrade as a result of being frozen shall be maintained above 40°F in heated storage.
11. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day.

1.14 ENVIRONMENTAL REQUIREMENTS

A. Do not apply roofing membrane during inclement weather or when ambient temperatures may fall below 45 degrees F.

B. Do not apply roofing membrane to damp or frozen deck surface.

C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.15 COORDINATION

A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.

B. Coordinate Work with installing associated metal flashings as work of this section proceeds.

C. Coordinate the work of the contractor with the work to be performed by the Owner's personnel, to ensure proper sequencing of the entire work. The Owner's personnel will be erecting interior protection for equipment, if required. The contractor is to schedule his work so that adequate time is allowed for the Owner's personnel to perform the work. No roof work shall be performed until the Owner's personnel have completed erection of the interior protection in that area.

D. Schedule the work so the building will be left watertight at the end of each day. Do not remove more roofing material than can be reinstalled in any working day.

E. All surfaces to receive new roofing shall be smooth, dry, and free from dirt, debris, and foreign material before any of this work is installed.

F. Competent operators shall be in attendance at all times equipment is in use. Materials shall be stored neatly in areas designated by the Owner. Load placed on the roof at any point shall not exceed the safe load for which the roof is designed.

G. The contractor shall take all necessary precautions to protect the roof mat and deck from damage. The contractor shall be responsible for repairing all new areas of damage caused by
the negligence of the contractor, at the contractor's expense. The Owner's on-site representative shall determine damage caused by contractor negligence.

H. Due caution should be exercised so as not to alter the structural integrity of the deck. When cutting through any deck, care should be taken so as not to damage the deck or any part of the deck, such as post tension cables, etc.

I. All kettles shall have an automatic thermostat control and temperature gauge, all in working order.

J. The contractor is to verify the location of all interior ducts, electrical lines, piping, conduit, and/or similar obstructions. The contractor is to perform all work in such a manner as to avoid contact with the above-mentioned items.

K. Surface and air temperatures should be a minimum 45° F during applications of cleaner and waterproof coating and remain above 45° F for a minimum of four (4) hours following applications. Verify compatibility of cleaner with coatings, paints, primers and joint sealers specified. Advise Owner's representative of any problems in this regard prior to commencing cleaning operations.

L. Measurements: It will be the contractor's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the contractor shall be responsible for the correctness of same. Any drawings supplied are for reference only.

1.16 PROTECTION OF WORK AND PROPERTY

A. Work: The contractor shall maintain adequate protection of all his work from damage and shall protect the Owner's and adjacent property from injury or loss arising from this contract. He shall provide and maintain at all times any OSHA required danger signs, guards, and/or obstructions necessary to protect the public and his workmen from any dangers inherent with or created by the work in progress. All federal, state, and city rules and requirements pertaining to safety and all EPA standards, OSHA standards, NESHAP regulations pertaining to asbestos as required shall be fulfilled by the contractor as part of his proposal.

B. Property: Protect existing planting and landscaping as necessary or required to provide and maintain clearance and access to the work of this contract. Examples of two categories or degrees of protection are generally as follows: a) removal, protection, preservation, or replacement and replanting of plant materials; b) protection of plant materials in place, and replacement of any damage resulting from the contractor's operations.

C. Twenty-four Hour Call: The contractor shall have personnel on call 24 hours per day, seven (7) days per week for emergencies during the course of a job. The Owner's Project Manager is to have the 24 hour numbers for the contact. Contractor must be able to respond to any emergency call and have personnel on-site within two (2) hours after contact. Numbers available to the Owner's Project Manager are to be both home and office numbers for:
   1. Job Foreman
   2. Job Superintendent
   3. Owner or Company Officer

D. Damage to Work of Others: The contractor shall repair, refinish, and make good any damage to the building or landscaping resulting from any of his operation. This shall include, but is not limited to, any damage to plaster, tile work, wall covering, paint, ceilings, floors, or any other finished work. Damage done to the building, equipment, or grounds must be repaired at the successful contractor's expense holding the Owner harmless from any other claims for property damage and/or personal injury.

1.17 CLEANING AND DISPOSAL OF MATERIALS

A. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean and shall allow no roofing materials to remain on the outside walls.

B. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust. A suitable scrap chute or hoist must be used to lower any debris. At completion, all work areas shall be left broom clean and all contractor's equipment and materials removed from the site.

C. All bituminous or roofing related materials shall be removed from ladders, stairs, railings, and similar parts of the building.
D. Debris shall be deposited at an approved disposal site.

1.18 WARRANTY

A. Uniform General Conditions of the Contract, especially paragraph 13.5.
B. Furnish twenty year no dollar limit (NDL) manufacturer material and labor warranty from the date of Substantial Completion for this project. Guarantee responsibilities shall be as follows:
   1. Roofing contractor shall guarantee the entire roofing system for a period of two (2) years from the date of Substantial Completion as stated on the “Certificate of Substantial Completion” issued by the Architect.
   2. The materials manufacturer shall guarantee the roofing system as supplied by system manufacturer for a total period of twenty (20) years from the date of substantial completion.
   3. Membrane manufacturer shall provide the written warranty as specified.
   4. The entire roofing system shall be guaranteed to be water tight and against any failures of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
   5. Warranty repairs shall be performed by a certified installer. The repairs shall be performed in accordance with the manufacturer’s written instructions and recommended procedures so as to not void the warranty.
C. During the proposal period each Contractor shall make arrangements with the materials manufacturer to provide the required warranty. Refer to SUBMITTALS paragraph in this section for requirements concerning submittals of warranty.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS

A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Sustainable Sites Characteristics:
   1. Roof Surface: Minimum solar reflectance index (SRI) of 78, calculated in accordance with ASTM E1980.
      a. Reflectance: Measured in accordance with ASTM E903, ASTM E1918, or ASTM C1549.
      b. Emittance: Measured in accordance with ASTM E408 or ASTM C1371.
C. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.

2.2 MODIFIED BITUMINOUS AND LIQUID ROOFING

A. Manufacturers:
   1. Flex Membrane International, Leesport PA as basis of design.
   2. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.3 SYSTEM DESCRIPTION

A. Roofing Membrane Assembly: A roof membrane assembly consisting of one ply of a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane applied over a prepared substrate, fleece back PVC with Elveloy KEE membrane.
   1. SBS Ply
      a. The reinforcement mats in the SBS ply shall be impregnated/saturated and coated each side with an SBS modified bitumen blend.
      b. The cross sectional area of the SBS sheet material shall contain no oxidized or non-SBS modified bitumen.
B. General:
   1. Compatibility: Provide materials that are recommended by manufacturers to be fully compatible with indicated substrates, or provide separation materials as required to eliminate contact between incompatible materials.
   2. Materials herein specified shall be supplied or approved in writing by Flex Membrane International, 2670 Leiscz’s Bridge Road, Suite 400 Leesport, PA 19533.
3. The white polyester reinforced fleece backed adhered PVC with Elvaloy® roofing system shall only be applied by manufacturer approved and trained roofing contractors.

4. The manufacturer shall have 15 years UL listing for the membrane to be used on the project. Membrane manufacturer shall have a minimum of 15 years FM approval, and 15 years manufacturing experience with the roofing membrane specified for this project.

5. All roofing and roof accessories shall be installed in compliance with manufacturer’s current specifications and details.

6. All materials used on the project shall be asbestos free.

2.4 COMPONENTS

A. Roofing Membrane:

1. Field roof membrane shall be a white polyester reinforced fleece-backed PVC with Elvaloy® membrane, as manufactured by Flex Membrane International.

2. Membrane shall have the following minimum physical property values:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td></td>
<td>White</td>
</tr>
<tr>
<td>Thickness</td>
<td>ASTM D751</td>
<td>0.067”</td>
</tr>
<tr>
<td>Thickness over scrim</td>
<td>ASTM D7635</td>
<td>0.030”</td>
</tr>
<tr>
<td>Breaking Strength (lbf)</td>
<td>ASTM D751</td>
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<td>Tear Strength (lbf)</td>
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</tr>
<tr>
<td>Seam Strength (lbf)</td>
<td>ASTM D751</td>
<td>295</td>
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<tr>
<td>Elongation</td>
<td>ASTM D751</td>
<td>50% x 42%</td>
</tr>
<tr>
<td>Heat Aging</td>
<td>ASTM D3045</td>
<td>&gt; 90%</td>
</tr>
<tr>
<td>Low Temp. Bend</td>
<td>ASTM D2136</td>
<td>Pass (-40°F)</td>
</tr>
<tr>
<td>Static Puncture Resistance</td>
<td>ASTM D5602</td>
<td>Pass</td>
</tr>
<tr>
<td>Dynamic Puncture Resistance</td>
<td>ASTM D5635</td>
<td>Pass</td>
</tr>
<tr>
<td>Permeance</td>
<td>ASTM E96</td>
<td>0.003 Perms</td>
</tr>
<tr>
<td>Dimensional Stability</td>
<td>ASTM D1204</td>
<td>0.3%</td>
</tr>
<tr>
<td>Weight change after Water Immersion</td>
<td>ASTM D570</td>
<td>1.20%</td>
</tr>
<tr>
<td>Accelerated Weathering</td>
<td>ASTM G155</td>
<td>Pass</td>
</tr>
<tr>
<td>Fungi Resistance</td>
<td>ASTM G21</td>
<td>No Growth</td>
</tr>
<tr>
<td>Solar Reflectivity</td>
<td>ASTM C1549</td>
<td>82% (White)</td>
</tr>
<tr>
<td>Emissivity</td>
<td>ASTM C1371</td>
<td>.91 (White)</td>
</tr>
<tr>
<td>SRI</td>
<td>ASTM E1980</td>
<td>109 (White)</td>
</tr>
</tbody>
</table>

B. Flashing Membrane

1. The flashing membrane shall be a white PVC with Elvaloy® polyester reinforced flexible sheet, as manufactured by Flex Membrane International.

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td></td>
<td>White</td>
</tr>
<tr>
<td>Thickness</td>
<td>ASTM D751</td>
<td>60 mil nom.</td>
</tr>
<tr>
<td>Breaking Strength (lbf)</td>
<td>ASTM D751</td>
<td>298 x 278</td>
</tr>
<tr>
<td>Tear Strength (lbf)</td>
<td>ASTM D751</td>
<td>89 x 109</td>
</tr>
<tr>
<td>Seam Strength (lbf)</td>
<td>ASTM D751</td>
<td>286</td>
</tr>
<tr>
<td>Elongation</td>
<td>ASTM D751</td>
<td>35% x 34%</td>
</tr>
<tr>
<td>Heat Aging</td>
<td>ASTM D3045</td>
<td>&gt; 90%</td>
</tr>
<tr>
<td>Low Temp. Bend</td>
<td>ASTM D2136</td>
<td>Pass (-40°F)</td>
</tr>
<tr>
<td>Static Puncture Resistance</td>
<td>ASTM D5602</td>
<td>Pass</td>
</tr>
<tr>
<td>Dynamic Puncture Resistance</td>
<td>ASTM D5635</td>
<td>Pass</td>
</tr>
<tr>
<td>Permeance</td>
<td>ASTM E96</td>
<td>0.003 Perms</td>
</tr>
<tr>
<td>Dimensional Stability</td>
<td>ASTM D1204</td>
<td>0.3%</td>
</tr>
<tr>
<td>Weight change after Water Immersion</td>
<td>ASTM D570</td>
<td>1.20%</td>
</tr>
<tr>
<td>Accelerated Weathering</td>
<td>ASTM G155</td>
<td>Pass</td>
</tr>
<tr>
<td>Fungi Resistance</td>
<td>ASTM G21</td>
<td>No Growth</td>
</tr>
<tr>
<td>Solar Reflectivity</td>
<td>ASTM C1549</td>
<td>82% (White)</td>
</tr>
<tr>
<td>Emissivity</td>
<td>ASTM C1371</td>
<td>.91 (White)</td>
</tr>
<tr>
<td>SRI</td>
<td>ASTM E1980</td>
<td>109 (White)</td>
</tr>
</tbody>
</table>
C. Non-Reinforced Membrane
1. The non-reinforced membrane shall have the following minimum properties, as manufactured by Flex Membrane International.
   a. Description: Non-reinforced thermoplastic white membrane, thickness approximately 45 mils.
   b. Use: Inside/outside corners, multiangled intersections, sealant pockets and other conditions where molding of the membrane is required.

D. Bitumen
1. Shall be ASTM D312 Type IV steep asphalt.

<table>
<thead>
<tr>
<th>Slope</th>
<th>Interply</th>
<th>Cap Ply</th>
<th>Backnail</th>
<th>Strap</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1/2&quot;:12&quot;</td>
<td>Type IV</td>
<td>Type IV</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>1/2&quot;-2&quot;:12&quot;</td>
<td>Type IV</td>
<td>Type IV</td>
<td>Yes</td>
<td>Strap if possible</td>
</tr>
<tr>
<td>2&quot;:3&quot;:12&quot;</td>
<td>Type IV</td>
<td>Type IV</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

E. Bonding Adhesive for Flashing
1. Description: Adhesive is a bonding cement of synthetic rubber for fully adhering membranes to various substrates. Shall be Supplied by the membrane manufacturer.

   Typical Liquid Properties (Room Temperature)
   - Color: Amber/Yellow
   - Base Product: Neoprene
   - Solids: 25%
   - Specific Gravity: .87
   - Pounds/Gallon: 7.25
   - Viscosity (CPS): 2500
   - Solvents: Ketone, Toluene, Aliphatic Hydrocarbon, Zylene
   - Estimated Coverage 2 Sided Application: 55/70 sq. ft. (2/2.5 mils dry)
   - DOT Label Required: Flammable Liquid Code - 584661

2. Handling: Contains ingredients which could be harmful if mishandled. Contact with skin and eyes should be avoided and necessary protective equipment and clothing should be worn.

F. Caulks
1. Sealant for use at reglet joints, etc., shall be a one-component urethane non-sag, gun grade sealant designed for use in active exterior joints, and shall meet or exceed Federal Specification No. 1 TT-S-00230C, Type II, Class A, ASTM C 920. Where joint surfaces are contained or are contaminated with bituminous materials, provide manufacturer’s modified-type sealant, as manufactured by BASF (Sonneborn), or approved equal.

2. To seal the leading edge of the membrane, to bond membrane at terminations with metal, and for open seam repair, sealant shall be a thermosetting, solvent free, non-slump, self-fixturing, multipurpose structural sealant which shall meet the following physical and performance properties, M-1 as manufactured by Chem Link Inc., or approved equal.

   Properties
   - Specific Gravity: 1.62 (13.5 lbs./gallon)
   - Viscosity: 800,000 cps Brookfield RTV, TF spindle, 4 rpm 70° F.
   - Shear Strength (ASTM D-1002): 300 psi+ (7 day ambient cure)
   - Elongation @ break (ASTM D-412): 300% (7 day ambient cure)
   - Hardness Shore A (ASTM C-661): 50 – 55 (14 day ambient cure)
   - Tack free time (ASTM C-679): 35 minutes
   - Low temperature flex: Minus 20° F: PASS
   - Slump (sag) (ASTM C-639): Zero slump
   - Shrinkage (ASTM D-2453): No measurable shrinkage (14 day cure)
   - Service temperature: -40° F to 200° F

G. Polyether Sealant: The joint sealant shall be a 100% solid, one-component, gun grade, non sag, polyether-base material. It shall be applicable for use at Kynar 500 coated metal in vertical and overhead joints. The sealant shall cure under the influence of moisture to form an elastomeric joint material. Materials shall comply to: C920, Type S, Grade NS, Class 50. Use T2, NT, M, A, G, and O:

<table>
<thead>
<tr>
<th>Properties</th>
<th>Results</th>
<th>Test Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile strength, psi</td>
<td>250-300</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>Peal strength, psi</td>
<td>25-30</td>
<td>ASTM C794</td>
</tr>
<tr>
<td>Elongation at break, %</td>
<td>750-800</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>Hardness, Shore A</td>
<td>17-23</td>
<td>ASTM C661</td>
</tr>
<tr>
<td>Lap shear Strength, psi</td>
<td>150-175</td>
<td>ASTM D1002</td>
</tr>
<tr>
<td>Low temp. flexibility</td>
<td>Pass-10°F (-23°C)</td>
<td>1/4 inch mandrel</td>
</tr>
<tr>
<td>Service Temperature</td>
<td>-40°F to 200°F (-40°C to 93°C)</td>
<td>ASTM D816</td>
</tr>
</tbody>
</table>

H. Base Sheet:
1. Shall be Underwriters Laboratory approved and listed in the FM Global Approval Guide.
2. Shall be SBS 80 mil SS base sheet, tested in accordance with ASTM D 5147, as approved by field membrane manufacturer.

I. Insulation:
1. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application, Underwriters Laboratory approved, and be listed in the FM Global Approval Guide. All insulation and cover boards shall be mopped into place utilizing Type IV asphalt.
2. Insulation shall be two layers of rigid polyisocyanurate foam board; total LTTR-value shall be a minimum of 25.0; meeting Federal Specification No. HH-I-1972/1 or 2 with 20 psi minimum compressive strength and nominal 2.0 pcf density. Boards shall be surfaced on two (2) sides with non-asphaltic facer material. No single layer shall be less than 1.5” or greater than 2.7” thick.
3. Shall be tapered polyisocyanurate board per Federal Specification No. HH-I-1972/1 or 2, with a 20 psi minimum compressive strength and 2.0 pcf density minimum. Insulation shall be of thickness required for one-fourth inch (1/4”) slope per foot to roof drains as shown on drawings. Insulation shall be surfaced on two (2) sides with a non-asphaltic facer material.
4. Shall be tapered polyisocyanurate board per Federal Specification No. HH-I-1972/1 or 2, with a 20 psi minimum compressive strength and 2.0 pcf density minimum. Insulation shall be of thickness required for one-half inch (1/2”) slope per foot to roof drains as shown on drawings. Insulation shall be surfaced on two (2) sides with a non-asphaltic facer material.
5. Underlayment and Recover Board: Impact-resistant, nonstructural, specially engineered gypsum and cellulose fiber panels with 95% recycled content; uniform water-resistance throughout core and surface. Board size four feet by eight feet (4' x 8'), thickness 1/2"; conforming to ASTM C 1278, meeting FM 4470 Class 1 criteria, classified by Underwriters Laboratory, and listed in the FM Global Approval Guide. Board will meet the following physical properties, Securock™ Roof Board, as manufactured by USG Corporation, or approved equal.

<table>
<thead>
<tr>
<th>Test</th>
<th>Typical Value</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Resistance</td>
<td>Class A</td>
<td>UL 790</td>
</tr>
<tr>
<td>Permeance</td>
<td>≤ 30</td>
<td>ASTM C473</td>
</tr>
<tr>
<td>Surface water absorption Grams</td>
<td>≤ 1.6 nominal</td>
<td>ASTM C473</td>
</tr>
<tr>
<td>Water resistance</td>
<td>Maximum 10% weight percentage gain</td>
<td></td>
</tr>
<tr>
<td>Mold Resistance</td>
<td>Minimum rating of &quot;10&quot;</td>
<td>ASTM D3273</td>
</tr>
</tbody>
</table>

J. Bonding Adhesive for Flashing:
1. Description: Adhesive is a bonding cement of synthetic rubber for fully adhering membranes to various substrates, produced by Ashland Chemical, or approved equal.

Typical Liquid Properties (Room Temperature)
- Color: Amber/Yellow
- Base Product: Neoprene
- Solids: 25%
- Specific Gravity: .87
- Pounds/Gallon: 7.25
- Viscosity (CPS): 2500
- Solvents: Ketone, Toluene, Aliphatic Hydrocarbon, Zylene
- Estimated Coverage: 55/70 sq. ft. (2/2.5 mils dry) 2 Sided Application
2. Handling: Contains ingredients which could be harmful if mishandled. Contact with skin and eyes should be avoided and necessary protective equipment and clothing should be worn.

K. Asphalt Roof Primer: Quick-dry asphalt-based primer for priming of asphalt roof surfaces, as manufactured by Flex Membrane International or approved equal.

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Procedure</th>
<th>Physical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Gray</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>36&quot; wide x 60' long</td>
<td>.080&quot; nominal</td>
</tr>
<tr>
<td>Thickness</td>
<td>ASTM D 638</td>
<td>1000 Denier Polyester</td>
</tr>
<tr>
<td>Reinforcement</td>
<td>ASTM D 751</td>
<td>210 X 200 lbf</td>
</tr>
<tr>
<td>Tear Strength</td>
<td>ASTM D 1043</td>
<td>-40° C</td>
</tr>
<tr>
<td>Puncture Resistance</td>
<td>96 lbs</td>
<td>85</td>
</tr>
<tr>
<td>Cold Resistance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shore A Durometer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrostatic Resistance</td>
<td>400 psi</td>
<td>12,000 hrs. Excellent</td>
</tr>
<tr>
<td>Dimensional Stability</td>
<td>ASTM D 1240 ≤ 1%</td>
<td></td>
</tr>
<tr>
<td>Ultraviolet Stability</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ninety degrees (90°), for perimeter and curb anchorage, having predrilled holes six inches (6") on center, as manufactured by Olympic Fasteners, or approved equal.

W. T-Joint Covers: Supplied by the membrane manufacturer as a secondary covering to all T – Joints in the installation of thermoplastic roof systems consisting of waterproofing coverings equal to or greater than 60 mils in thickness.

X. Self-Adhering Underlayment for Temporary Waterproofing: A premium heavyweight, minimum 60 mil, self-adhering underlayment, to use as a temporary waterproofing barrier.

Y. Overnight Seal: Hot applied asphalt bitumen shall be provided for the purpose of night sealing the roof system.

Z. Miscellaneous Materials: Other materials shall be as specified or of the best grade for the proposed use as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify surfaces and site conditions are ready to receive work.

B. General: Ensure that substrates are free from gross irregularities, loose, unsound or foreign material such as dirt, ice, snow, water, grease, oil, bituminous products, release agents, laitance, paint, loose particles/friable matter, rust or any other material that would be detrimental to adhesion of the catalyzed primer and/or resin to the substrate. Some surfaces may require scarification, shotblasting, or grinding to achieve a suitable substrate.

C. Moisture Content Evaluation: Evaluate the level of moisture in the substrate to determine that the moisture content is acceptable for application of the specified waterproofing system. Concrete substrates shall have a maximum moisture content of 6% by weight and a maximum internal relative humidity of 75%.

D. Verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains.

E. Verify surfaces are dry and free of snow or ice.

F. Verify roof openings, curbs, pipes, set rails, conduit, sleeves, ducts, and vents through roof are solidly set, and cant strips, wood nailing strips and reglets are in place.

3.2 REFERENCE

A. The manufacturer's Technical Specifications shall be considered a part of this specification and should be referred to for more specific application procedures and recommendations.

B. Application of materials shall be in strict accordance with the manufacturer’s recommendations except where more stringent requirements are shown or specified. In the instance of a conflict between these specifications and those of the manufacturer, the more stringent specifications shall take precedence.

3.3 GENERAL INSTALLATION

A. Protect adjacent areas with tarpaulin or other durable materials.

B. Contractor shall prevent overspray and be responsible for parking lot areas and/or adjoining areas not part of this contract.

C. Contractor shall be responsible for sealing, as required, all openings that may allow bitumen migration or drippage, i.e. pitch dams, envelopes, and filler strips.

D. Prepare surfaces according to manufacturer’s or applicator’s published instructions. All metal that is to receive bitumen, or come in contact with bitumen or adhesive, shall be first primed with appropriate primer. Any prefinished sheet steel that is to receive bitumen, or come in contact with bitumen or adhesive, shall be scored, scuffed or abraded prior to receiving primer.

E. Use cleaning materials or primers necessary to render an acceptable surface/substrate.

F. All surfaces/substrates shall be clean and dry prior to application of materials.

G. Prior to application of felts and membrane, all foreign matter, gravel, etc., shall be removed from the insulation and/or substrate. Gravel or debris between the insulation/substrate and plies is not acceptable.

H. Bitumen kettle shall have a visible thermometer and thermostatic control or some other means to provide positive monitoring of the bitumen temperature when it is heated in accordance with manufacturer’s instructions.
I. Ambient temperature shall be 45° F and rising.
J. The maximum heating temperature of Type III asphalt shall be 500° F.
K. The temperature of Type III asphalt shall be approximately 430° F ± at the point of application or as recommended by the membrane manufacturer.
L. Maintain kettle and/or tanker temperature at least 25° F below the actual flash point of the bituminous materials used.
M. Never heat the bituminous materials at high temperatures for prolonged periods of time.
N. Do not allow bituminous materials to stand in luggers for long periods.
O. Circulate bituminous materials.
P. Insulate hot transport lines if required.
Q. Wrinkles, buckles, kinks, and fishmouths are not acceptable when laying membrane.
R. Where deteriorated base flashing is removed, primed cant strips shall be installed at the intersection of the deck and the vertical surfaces. All flashings shall be mechanically top-fastened with a termination bar a minimum of six inches (6") on center at the top leading edge and be a minimum of eight inches (8") in height from finished membrane.
S. Provide a water test of each roof section prior to substantial completion. Test should simulate rainfall of one inch (1") per hour minimum.
T. On slopes greater than one inch (1") in twelve inches (12"), refer to NRCA and/or manufacturer's guidelines for backnailing procedures and follow the more stringent guidelines for all specified materials.

3.4 INSTALLATION

A. Insulation
   1. Manufacturer’s Instructions: In regard to attachment, the manufacturer’s instructions or specifications shall determine the suitability for an application. Installation must meet ASCE 7 criteria and meet local governing building codes.
   2. Precautions: The surface of the insulation must not be ruptured due to overdriving of fasteners.
   3. Underlayment boards shall be laid on the substrate in parallel rows with end joints staggered and butted as close as possible. All joints shall be tight and at the roof perimeter and roof penetrations, insulation shall be cut neatly and fitted to reduce openings to a minimum.
   4. Thermal insulation boards shall be laid on the underlayment in parallel rows with end joints staggered and butted as close as possible. All joints shall be tight and at the roof perimeter and roof penetrations, insulation shall be cut neatly and fitted to reduce openings to a minimum. All openings one-fourth inch (1/4") or larger shall be filled with insulation.
   5. No more insulation shall be installed than can be covered by the completed roof system by the end of the day or the onset of inclement weather.
   6. Tapered insulation and crickets, when specified, shall be placed in accordance with the drawings and/or as required to minimum of NRCA standards.

B. Adhered Tapered Insulation
   1. Specified underlayment board shall be fully adhered utilizing Type IV asphalt as dictated by wind zone applicable to location of project. Boards shall be staggered and butted as close as possible. Joints shall be taped in accordance with manufacturer’s requirements.
   2. Specified insulation shall be fully adhered utilizing Type IV asphalt as dictated by wind zone applicable to location of project. Boards shall be staggered and butted as close as possible with voids over one-fourth inch (1/4") to be filled.
   3. The base layers of insulation (and tapered insulation where applicable) shall be adhered with hot asphalt laid and bearing on deck surface/flats. All layers shall be applied using offset joints, so that each layer breaks joints to a minimum of six inches (6") both ways with the preceding layer.
   4. The top surface of the base layers of insulation (and tapered insulation where applicable) shall be covered with specified cover board using offset joints, so that each layer breaks joints to a minimum of six inches (6") both ways with the preceding layer, all layers to be fully adhered utilizing hot asphalt in accordance to ASCE 7 criteria.

C. Nailers
   1. Wooden nailers shall be installed at gravel stops and drip edges on outside perimeter of building according to NRCA, Underwriters Laboratory and IBC guidelines.
2. All Construction: Nailers shall be the same height as the top of cover board being installed where required. Nailers shall be anchored to resist a pull-out force of one hundred seventy-five pounds (175#) per foot. Fasteners shall be no less than two (2) per nailer and be spaced at three feet (3') on center maximum. Expansion joint nailers shall extend upward a minimum of eight inches (8") above finish roof height.

D. Wood Cants
1. Toe of cant shall be level with the surface to receive new roof membrane and in all cases anchored according to NRCA, Underwriters Laboratory and IBC guidelines.

E. Application of Modified Base Sheet
1. Cover Board shall be covered with one (1) layer of SBS 80 mil SS base sheet fully adhered as follows.
   a. All layers shall be solid mopped at the nominal rate of thirty pounds (30#) ± 20 percent per one hundred (100) square feet using asphalt Type I-IV as required by slope, properly heated. Specified layers shall be applied in accordance with the manufacturer’s recommendations and in accordance with general practices as set forth by the NRCA Roofing Manual.
      1) Base sheet shall not be left exposed for more than five (5) days.

2. Hot Applied Fleece Backed Membrane
   a. Fully Adhered Application: Fully adhere membrane to acceptable substrate with hot asphalt applied at the rate specified by the manufacturer.
      1) The roof surface must be clean, dry and free of foreign material.
      2) Position sheets as indicated on approved shop drawings.
      3) Fold one end of the PVC with Elvaloy® sheet on top of itself until both ends meet. Apply hot asphalt to the prepared roof surface. The sheet can then be pulled and laid into the bonding material using care not to create any wrinkles.
      4) Carefully push into place from fold line to overlap, avoiding wrinkles and air pockets. Roll or broom membrane flat.
      5) Repeat procedure for other sheet half.
      6) Lap seams shall be done by lapping the two-inch (2") selvedge edge over the non-selvedge edge of the previous roll. The selvedge edge seam shall be made with the heat gun method.
      7) Roll ends are butted together and capped with a six inch (6") wide trim strip. The trim strip is then sealed with the heat gun.
      8) T-Joint covers are required over all t joints on installations of thermoplastic roofing membranes equal to or greater than 60 mils in thickness. Center T-Joint cover over the t-joint and completely hot air weld the cover to the field membrane.
   b. Lap Seaming Procedure: Overlap membrane for attachment method specified and hot-air welded with manufacturer’s approved equipment.
      1) All surfaces to be weld shall be clean, dry and free of foreign material.
      2) All seams must then be checked with a needle probe and any voids repaired with the heat gun.
   c. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize manufacturer’s recommended application techniques, apply the specified materials (i.e. primary and secondary components and accessories, etc.) and exercise care in ensuring that the finished application is undamaged, free of cuts, tears, deformities, etc. and acceptable to the Architect/Engineer/Consultant/Owner.

F. Flashing
1. Flash all penetrations, metal edge systems, walls, curbs, expansion joints, drains as shown on details and approved shop drawings with white reinforced PVC with Elvaloy® flashing membrane.
   a. Use prefabricated flashing accessories or components such as sealant pockets, premolded vent/pipe flashing.
      Mechanically fasten flashing using specified concrete fasteners at terminations according to approved details. Standard Fastener for Structural Concrete / Masonry Applications: Shall be one-fourth inch by two inches (1/4" x 2"), shank shall be zinc coated steel and pin shall be zinc-coated stainless steel, one-piece unit, flat head. The fastener must meet or
exceed GSA Specification No. FFS-325, Group V, Type 2, Class 3 as manufactured by OMG Roofing Products, or approved equal.

b. Fastening membrane flashing through metal counterflashings is not acceptable.

2. Any lumber or shimming required for attachment or to make material flashing flush or level with offsets and/or transitions shall be incorporated in the flashing specifications.

G. Base Flashing (Approximately 8" in Height Minimum)
   1. Base flashings shall be installed using the flashing membrane, with length of run not to exceed twenty linear feet (20').
   2. Wooden nailers or curbs shall be installed at all edges and openings in the roof, mechanically fastened to the deck utilizing concrete pin fasteners.
   3. Cant strips shall be installed at the intersection of the deck and all vertical surfaces.
   4. The roofing field membrane shall extend up over and two inches (2") above the top of cant strips at all vertical intersections or out to the roof's edge.
   5. All existing substrates receiving flashing membrane shall be clean and primed with primer, prior to application as required.
   6. All wooden nailers shall be mechanically fastened at the perimeter utilizing appropriate concrete fasteners and attached securely to the concrete deck system. All wooden nailers shall meet the height of the new wooden nailers and allow for positive drainage.
   7. All vertical flashing lap seams of the flashing membrane shall be hot-air welded.
   8. All flashing membrane shall be adhered with flashing bonding adhesive to the vertical substrate and hot-air welded to the field of roof membrane; hot-air weld vertical laps.
   9. Flashing laps shall be minimum two-inch (2") width, no maximum. Hot-air weld of flashing lap shall be minimum two-inch (2") width, no maximum.

10. Hot-Air Welding of Flashing Laps:
    a. When using a hand-held hot-air welder, the seams should be pressed together using a hand-held roller. The speed and temperature settings of the welding equipment can be affected by the weather conditions at the site of application; therefore, these parameters should be set by trial and error using two (2) pieces of the flashing membrane. Minimum width of hot-air weld two inches (2"), no maximum.
    b. Lay the laps together and apply pressure to the welded seam to ensure full adhesion.
    c. Allow the seams to set fully and probe the entire length for voids. Reseam voids immediately with a hot-air gun and roller.

11. All hot-air welded seams/laps shall be tested daily with a probe for integrity, no variance.

H. Walkway Pads
   1. Fully adhere and heat weld walkway pads where shown on drawings or where required to provide protected pathways from rooftop access points to mechanical or other equipment requiring rooftop maintenance.

3.5 FIELD QUALITY CONTROL
   A. Correct identified defects or irregularities.
   B. Require site attendance of roofing materials manufacturers during installation of the Work.
   C. Arrange for manufacturer’s inspection of completed installation in the presence of the Architect and Owner.

3.6 CLEANING
   A. Uniform General Conditions of the Contract, especially paragraph 3.3.9.
   B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
   C. Clean exposed surfaces of excess cement, adhesive, sealants, mortar and paint associated with the new work.
   D. Clean work area of excess roofing materials and installation debris daily.
   E. Repair or replace defaced or disfigured finishes caused by work of this section.
   F. After all membrane has been installed, it shall be cleaned with a cleaning agent compatible with the membrane to return the membrane to like new appearance.
   G. The contractor shall follow local, state, and federal regulations, safety standards, and codes for the removal, handling, and disposal of asbestos containing materials, if present. When a conflict exists, use the stricter document.
3.7 PROTECTION OF INSTALLED CONSTRUCTION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.
B. Protect building surfaces against damage from roofing work.
C. Where traffic must continue over finished roof membrane, protect surfaces, underlayment, accessories and finishes from damage.
D. Overnight Seal:
   1. Before the end of each working day, or before application is interrupted by precipitation, seal all exposed sheet edges along laps and around drains, projections and upstands.
   2. Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual, SPRI and membrane manufacturer's recommended procedure.
   3. The roofing membrane shall be sealed to the roof deck or existing roof at the end of the day or at the onset of inclement weather to prevent water from flowing into the completed roofing system. Temporary seals shall be removed upon resumption of work.
E. Build cutoffs using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Completely remove cutoffs prior to the resumption of roofing.
F. Where equipment pads, wood sleepers, or walkway slabs are to be installed over the roofing membrane, an additional layer of the roofing membrane shall be installed between the roofing membrane and the pad, sleeper, or slab. Due caution shall be exercised to prevent roofing membrane damage during placement. Where required, membrane shall be welded to field membrane to prevent slippage.
G. The contractor shall take all necessary precautions to protect the roof mat and deck from damage. The contractor shall be responsible for repairing all new areas of damage caused by the negligence of the contractor, at the contractor's expense. The Owner's on-site representative shall determine damage caused by contractor negligence.

3.8 MANUFACTURERS POST INSTALLATION INSPECTION
A. Notify the manufacturer by means of manufacturer's printed Notification of Completion form of job completion in order to schedule a final inspection date.
B. Final Inspection:
   1. Post-Installation Meeting: Hold a meeting at the completion of the project, attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the manufacturer's representative. Complete, sign, and mail the punch list form to the manufacturer's headquarters.
C. Complete all post installation procedures and meet the manufacturer's final endorsement for issuance of the specified guarantee.

3.9 SCHEDULE
A. New roof at Comfort Station.
B. Reference Drawings for locations and additional information.

END OF SECTION 07 5419
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes flashings and counter-flashings and fabricated sheet metal items.
   1. Provide reglets and accessories.
B. Related Sections:
   1. Section 03 3000 - Cast-In-Place Concrete.
   2. Section 04 2000 - Unit Masonry: Through-wall flashings in masonry.
   4. Section 06 1000 - Rough Carpentry: Wood blocking for roofing.
   5. Section 07 3200 - Composite Roof Tile Systems: Flashings associated with roofing tiles.
   6. Section 07 5419 - Fully Adhered Multi-ply Roof System
   7. Section 07 9000 - Joint Protection.
   8. Section 09 9000 - Painting and Coating: Field painting.

1.2 REFERENCES
A. American Architectural Manufacturers Association:
B. ASTM International:
   1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
C. Federal Specification Unit:
   1. FS TT-C-494 - Coating Compound, Bituminous, Solvent Type, Acid Resistant.
D. National Roofing Contractors Association:
   1. NRCA - Roofing and Waterproofing Manual.
E. Sheet Metal and Air Conditioning Contractors:

1.3 DESIGN REQUIREMENTS

1.4 PRE-INSTALLATION MEETINGS
A. Convene minimum one week prior to commencing work of this section.
B. Require attendance of parties directly affecting, or affected by, Work of this Section.
C. Shall be in conjunction with the pre-installation meeting for the roofing as specified in Section 07 5419.
D. Notify Architect/Engineer four days in advance of meeting date.

1.5 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Shop Drawings: Indicate material profile, jointing pat tern, jointing details, fastening methods, flashings, terminations, and installation details.
C. Product Data: Submit data on manufactured components metal types, finishes, and characteristics.
D. Samples:
   1. After initial color selection by Architect, submit two samples, for final approval, 4x6 inch in size, minimum, illustrating metal finish color.
1.6 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.7 QUALIFICATIONS
A. Fabricator and Installer: Company specializing in sheet metal work with minimum six years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
B. Prevent contact with materials causing discoloration or staining.

1.9 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.

2.2 SHEET METAL FLASHING AND TRIM
A. Galvanized Steel: ASTM A653/A653M; structural steel sheet, G90 zinc coating; 0.024, 24 gauge inch thick steel.
B. Pre-Finished Galvalume Steel Sheet: ASTM A792/A792M; structural steel sheet, AZ55 aluminum-zinc coating; 0.024, 24 gauge inch thick core steel shop pre-coated with two coat fluoropolymer top coat; color as selected.

2.3 ACCESSORIES
A. Fasteners: Stainless steel, with soft neoprene washers.
B. Primer: Zinc molybdate or Galvanized iron type.
C. Protective Backing Paint: FSTFC-494, Bituminous.
D. Sealant: Silyl terminated Polyether sealant specified in Section 07 9000.
E. Plastic Cement: ASTM D4586, Type I.
F. Reglets: Surface mounted type, galvanized steel, exposed ends covered with preformed caps, prefabricated corners at transitions; SM manufactured by Fry Reglet as design basis.

2.4 FABRICATION
A. Form sections shape indicated on Drawings, accurate in size, square, and free from distortion or defects.
B. Fabricate cleats of same material as sheet metal, interlocking with sheet.
C. Form pieces in longest possible lengths.
D. Hem exposed edges on underside 1/2 inch; miter and seam corners.
E. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
F. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
H. Fabricate flashings to allow toe to extend 2 inches over roofing or as indicated on Drawings. Return and brake edges.
I. Seal metal joints.

2.5 FACTORY FINISHING
A. Fluoropolymer Coating: Multiple coat as specified for sheet metal system, thermally cured, conforming to AAMA 2605.
B. Washcoat: Finish concealed side of metal sheets with washcoat compatible with finish system, as recommended by finish system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION
A. Install starter and edge strips, and cleats before starting installation.
B. Install surface mounted reglets to lines and levels indicated on Drawings. Seal top of reglets with sealant.
C. Paint concealed metal surfaces with protective backing paint to minimum dry film thickness of 15 mil.

3.3 INSTALLATION
A. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
B. Apply plastic cement compound between metal flashings and felt flashings.
C. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
D. Seal metal joints watertight.

3.4 FIELD QUALITY CONTROL
A. Inspection will involve surveillance of Work during installation to ascertain compliance with specified requirements.

3.5 SCHEDULE
A. Pre-finished flashing: All exposed flashing conditions.
B. Through-Wall Flashing in Masonry.
C. Sill and Ledge Flashings.
D. Flashings Associated with Roofing Tiles, including Valley, Hip, Ridge, Eave, Gutter Edge, Gable Edge, Chimney.
E. Counterflashings at Roofing Terminations (over roofing base flashings).
F. Counterflashings at Curb-Mounted Roof Items.
G. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports.

END OF SECTION 07 6200
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Preparing substrate surfaces.
   2. Sealant and joint backing.

B. Related Sections:
   1. Section 03 3000 – Cast-in-Place Concrete: Sealants in expansion joints.
   2. Section 04 2000 – Unit Masonry.
   3. Section 04 4213 – Masonry-Supported Stone Cladding.
   4. Section 06 1000 – Rough Carpentry.
   5. Section 06 2000 – Finish Carpentry.
   6. Section 06 4100 – Architectural Wood Casework.
   7. Section 06 6119 – Quartz Surfacing Fabrications.
   8. Section 07 2726 – Fluid Applied Weather Barriers: Sealants required in conjunction with weather barriers.
   9. Section 07 3200 – Composite Roof Tile Systems.
   10. Section 07 5419 – Fully Adhered Multi-ply Roof System.
   11. Section 07 6200 – Sheet Metal Flashing and Trim.
   12. Section 08 0152.91 – Wood Window Restoration.
   13. Section 08 1213.13 – Standard Hollow Metal Frames.
   14. Section 08 4113 – Aluminum-Framed Entrances and Storefronts.
   15. Section 08 5619 – Pass-Thru Windows.
   16. Section 08 8000 – Glazing: Glazing sealants and accessories.
   17. Section 09 2116 – Gypsum Board Assemblies: Acoustic sealant.
   18. Section 09 3000 – Tiling.

1.2 REFERENCES

A. ASTM International:
B. FDA Regulation CFR Title 21, Chapter 1, Subchapter B, Section177.2600 – Indirect Food Additives: Polymers - Rubber articles intended for repeated use.
C. NSF/ANSI Standard 61 - Drinking Water System Components.
D. South Coast Air Quality Management District:
   1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.
E. Underwriters Laboratory:

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Products Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
C. Samples: Submit two samples, size illustrating sealant colors for selection.
D. Manufacturer’s Installation Instructions: Submit special procedures, surface preparation, and perimeter conditions requiring special attention.
E. Warranty: Include coverage for installed sealants and accessories failing to achieve airtight seal, watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.

1.4 QUALITY ASSURANCE
A. Perform work in accordance with sealant manufacturer’s requirements for preparation of surfaces and material installation instructions.
B. Perform acoustical sealant application work in accordance with ASTM C919 and ASTM C1193, as appropriate to condition.

1.5 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 ENVIRONMENTAL REQUIREMENTS
A. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.7 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate Work with sections referencing this section.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS
1. Indoor Environmental Quality Characteristics:
   a. Interior Sealants and Sealant Primers: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.

2.2 JOINT SEALERS
A. Sealant Type ES-A
      a. ASTM C920 Grades S & NS
      b. ASTM C920 Class 25
      c. ASTM C920 Exposure NT (non-traffic)
      d. ASTM C920 Uses M, G, and A with O Joint substrates.
      e. Color: black at thresholds, Colors as selected at other locations.
   2. Manufacturers:
      a. Master Builders, a division of BASF – MasterSeal NP150.
      b. Sika – SikaHyflex – 150 LM
      c. STS Coatings – GreatSeal PE-150.
3. Applications: Use for:
   a. Control, expansion, and soft joints in masonry.
   b. Joints between concrete and other materials.
   c. Joints between metal frames, including doors, louvers, etc. and other materials at exterior/perimeter walls. Apply sealant on both exterior and interior sides of wall.
   d. Under thresholds and window/storefront/curtainwall systems at floor slab to prevent air/water infiltration.
   e. At intersections of dissimilar materials where infiltration of water or air is possible.
   f. Perimeter joints of door and window frames or other framed openings in walls where there is no finished edge flange.
   g. Open joints at penetrations through walls, and open joints at penetrations through concrete or gypsum board ceilings, where intended to be tight sealed joints.
   h. Open joints between dissimilar materials where intended to be tight, sealed joints.
   i. Joints where edge trim of gypsum board abuts irregular surfaces or other surfaces and leaves an open joint.
   j. Within masonry system and at perimeter.
   k. Intersection of dissimilar materials which installations not uniform or where workmanship does not meet acceptable construction tolerances, when such workmanship is acceptable by the Architect.
   l. Metal Siding, louvers, fixtures and other penetrations in building enclosures not otherwise sealed weathertight. Unless noted otherwise provide continuous sealing perimeter joints and all other joints at exterior soffits.
   m. As sealant in roofing systems where a urethane sealant is not required by roofing manufacturer.
   n. Other exterior non-traffic joints for which no other sealant is indicated.
   o. Paintable.

B. Sealant Type ES-B
   a. ASTM C920 Grades S & NS
   b. ASTM C920 Class 50
   c. ASTM C920 NT (non traffic)
   d. ASTM C920 Uses M, G, and A with substrates type O
   e. Color: Colors as selected.

2. Manufacturers:
   b. GE/Momentiv – SilPruf NB SC 9000.

3. Applications: Use for:
   a. Exterior Aluminum Window Frames, storefront, and curtainwall to adjacent substrate, exterior and interior joints.
   b. Within Glazing systems.
   c. Do not paint.

C. Sealant Type ES-C
   a. Mildew resistant.
   b. ASTM C920 Grades S & NS
   c. ASTM C920 Class 25
   d. ASTM C920 NT (non traffic)
   e. ASTM C920 Uses G, and A with substrates type O

2. Manufacturers:
   a. Dow Coming Corporation – Dowsil 999A
   b. GE/Momentiv – Sanitary SC 1700.
   d. Tremco – Tremsil 200

3. Applications: Use for:
a. Joints between plumbing fixtures and floor and wall surfaces.
b. Joints between kitchen and toilet room counter tops and wall surfaces.

D. Sealant Type ES-D
   a. ASTM C 920 Grades M & P
   b. ASTM C 920 Class 25
   c. ASTM C 920 Exposure T (traffic) and NT (non-traffic).
   d. ASTM C 920 Uses M, G, and A with type O substrate joints.
   e. Color: Grey.

2. Manufacturers:
   a. Sika Corporation, Inc., – Sikaflex-2c-SL.

3. Applications: Use for:
   a. Expansion joint in concrete construction that is principally horizontal in nature, including paving, sidewalks, curbs, etc. and where water immersion capability is required.

E. Sealant Type ES-E
   a. ASTM C 920 Grades M & P
   b. ASTM C 920 Class 25
   c. ASTM C 920 Exposure T (traffic) and NT (non-traffic).
   d. ASTM C 920 Uses M, G, and A with type O substrate joints.
   e. Color: Grey.

2. Manufacturers:
   a. Pecora Corporation – Dynatrol II-SG.
   b. Sika Corporation, Inc., – Sikaflex-2c-SL.

3. Applications: Use for:
   a. Expansion joint in exterior concrete construction that is principally horizontal in nature, including paving, sidewalks, curbs, etc. where water immersion is likely.
   b. Expansion joints in concrete slabs adjacent to column piers or penetrations in slab.

F. Sealant Type ES-F
1. Multi-component Non-sag Urethane Sealant.
   a. ASTM C 920 Grades NS
   b. ASTM C 920 Class 25
   c. ASTM C 920 T (traffic) and NT (non-traffic).
   d. ASTM C 920 Uses M, G, and A with substrates type O
   e. Color: Black.

2. Manufacturers:

3. Applications: Use for:
   a. Within roofing systems where roofing manufacturer requires a urethane sealant.

G. Sealant Type AS-A
1. Manufacturers:
   a. Pecora Corporation – AC-20 FTR.
   b. USG – Sheetrock Acoustical Sealant.

   a. ASTM E90: Sealant will effectively reduce airborne sound transmission through perimeter joints and opening in building construction as demonstrating by testing of representative assemblies in accordance with ASTM E90.
   b. ASTM C834

3. Applications: Use for:
   a. Sealant bead between top stud runner and structure and between bottom stud track and floor.
b. Applications: Use for interior wall and ceiling control joints, joints between door and window frames and wall surfaces, and other interior joints for which no other type of sealant is indicated. Not for use at exterior walls.

c. Paintable.

H. Sealant Type CSA

1. Pre-compressed foam sealer system.
   a. Open-cell polyurethane expanding foam impregnated with a non-drying, water-based, stabilized, polymer-modified acrylic.
   b. Silicone external weather facing, factory applied.
   c. Silicone Sealant for application as bands.
   e. ASTM D3574: Tensile Strength - 21 psi min.
   f. ASTM C711: Temperature service range - -40ºF to 185ºF.
   g. ASTM D283: Rate of Air leakage - passed.
   h. ASTM E331: Water penetration - up to 20.88 psf.
   i. ASTM E330: Pressure resistance - +62.66 psf, -56.39 psf.
   j. Joint movement capability: ± 25%
   k. Color: Colors as selected.

2. Manufacturers:
   a. Emseal - Colorseal.

3. Applications: Use for:
   a. Control, expansion, and soft joints in masonry and concrete between ½” and 8” in width.
   b. Joints between dissimilar materials such as soffit to wall, siding to masonry, etc. where the joint is between ½” and 8” in width.
   c. As an alternative to sealant type ES-A or ES-B.

I. Sealant Type CS-F

1. Pre-compressed NSF-Compliant foam sealer system.
   a. Open-cell polyurethane expanding foam impregnated with a non-drying, water-based, stabilized, polymer-modified acrylic.
   b. Factory applied Silicone external facing.
   c. Field applied Epoxy Adhesive.
   d. Field applied NSF-compliant silicone sealant as edge beads.
   e. NSF/ANSI Standard 61: compliant.
   f. FDA regulation CFR 177.2600: Compliant for indirect food contact.
   g. ASTM C711: Temperature service range - -40ºF to 185ºF.
   h. Joint movement capability: ± 25%
   i. Color: White.

2. Manufacturers:
   a. Emseal - DSF System.

3. Applications: Use for:
   a. Joints between similar and dissimilar materials in food preparation and storage areas where the joint is between ½” and 8” in width.

J. Sealant Type CS-G

1. Pre-compressed foam sealer system for horizontal applications.
   a. Open-cell polyurethane expanding foam impregnated with water-based, polymer-modified asphalt.
   b. Field applied epoxy adhesive.
   c. Field applied polymer modified rubberized asphalt emulsion top coat.
   d. ASTM D3574: Tensile Strength - 21 psi min.
   e. ASTM C711: Temperature service range - -40ºF to 185ºF.
   f. Joint movement capability: ± 25%
   g. Color: Black.

2. Manufacturers:
   a. Emseal - 20H System.

3. Applications: Use for:
a. Control, expansion, and soft joints in masonry and concrete below grade and between $\frac{1}{2}''$ and 3'' in width.

K. Sealant Type CSH
1. Pre-compressed foam sealer system.
   a. Open-cell polyurethane expanding foam impregnated with a non-drying, water-based, stabilized, polymer-modified acrylic.
   b. Silicone external weather facing, factory applied.
   c. Silicone Sealant for application as bands.
   d. ASTM D3574: Tensile Strength – 21 psi min.
   e. ASTM C711: Temperature service range - -40°F to 185°F.
   f. Joint movement capability: +/- 25%
   g. Color: Colors as selected.
2. Manufacturers:
   a. Emseal – Horizontal Colorseal.
3. Applications: Use for:
   a. Horizontal joints between similar and dissimilar materials in non-traffic areas where the joint is between $\frac{1}{2}''$ and 8'' in width.
   b. As an alternative to sealant type ES-E in non-traffic areas.

L. Sealant Type CS-I
1. Pre-compressed submersible foam sealer system.
   a. Open-cell polyurethane expanding foam impregnated with a non-drying, water-based, stabilized, polymer-modified acrylic.
   b. Silicone external weather facing, factory applied.
   c. Silicone Sealant for application as bands.
   e. FDA regulation CFR 177.2600: Compliant for indirect food contact.
   f. Joint movement capability: +/- 25%
   g. Color: White.
2. Manufacturers:
   a. Emseal – Submerseal.
3. Applications: Use for:
   a. Joints between similar and dissimilar materials in continuous immersion/submersion of potable, chlorinated, or saline water and where the joint is between 1” and 4” in width.

M. Sealant Type CS-J
1. Pre-compressed chemically resistant and submersible foam sealer system.
   a. Open-cell polyurethane expanding foam impregnated with a non-drying, water-based, stabilized, polymer-modified acrylic.
   b. Polysulfide external facing, factory applied.
   c. Polysulfide sealant field applied as bead.
   e. ASTM C1247 compliant.
   f. ASTM C920: (Polysulfide facing and sealant) Type M, Grade NS, Class 25, Use NT, M, G, and A, except ASTM C510 “Stain and color change”.
   g. Joint movement capability: +/- 25%
   h. Color: Grey.
2. Manufacturers:
   a. Emseal – Chemseal+5
3. Applications: Use for:
   a. Joints between similar and dissimilar materials in contact where the joint is between $\frac{1}{2}''$ and 2” in width and exposed to chemicals or solvents. May be used in submersion in conditions up to 5 feet of static head pressure.
   b. Joints between similar and dissimilar materials in continuous immersion/submersion of potable, chlorinated, or saline water and where the joint is between $\frac{1}{2}''$ and 2” in width. May be used in submersion in conditions up to 5 feet of static head pressure.
2.3 ACCESSORIES
   A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
   B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
   C. Joint Backing:
      1. Pre-compressed foam sealer system, compatible with sealant;
         a. Backerseal (Greyflex) manufactured by Emseal.
         b. Open-cell polyurethane foam impregnated with a non-drying, water-based, stabilized, polymer-modified acrylic adhesive.
         c. Sized per manufacturer for proper sealing of joint width.
         d. Non-staining.
      2. Round foam rod compatible with sealant;
         a. ASTM D1056, sponge or expanded rubber.
         b. Oversized 30 to 50 percent larger than joint width.
         c. Non-staining.
      3. Round elastomeric tubing compatible with sealant.
         a. D1056 Neoprene, Butyl, or Silicone tubing;
         b. Oversized 30 to 50 percent larger than joint width.
         c. Non-staining.
         d. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
         e. Non-staining.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify substrate surfaces and joint openings are ready to receive work.
   B. Verify joint backing and release tapes are compatible with sealant.

3.2 PREPARATION
   A. Remove loose materials and foreign matter impairing adhesion of sealant.
   B. Clean and prime joints.
   C. Perform preparation in accordance with ASTM C1193.
   D. Protect elements surrounding Work of this section from damage or disfiguration.

3.3 INSTALLATION
   A. Perform installation in accordance with ASTM C1193.
   B. Perform acoustical sealant application work in accordance with ASTM C919.
   C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
   D. Tool butt joints concave. Tool fillet joints triangularly (straight not concave).
   E. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.
   F. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.

3.4 CLEANING
   A. Uniform General Conditions of the Contract, especially paragraph 3.3.9.
   B. Clean adjacent soiled surfaces.

3.5 PROTECTION OF INSTALLED CONSTRUCTION
   A. Uniform General Conditions of the Contract, especially paragraph 3.3.
   B. Protect sealants until cured.

3.6 SCHEDULE
   A. Reference uses in sealant descriptions this specification and match sealant applied in field to uses listed.
B. Note that there are some conditions where both elastomeric and compressible sealers are indicated. Where both indicate the same use, it is Contractor's option which sealant to use.

C. Vandal/pick resistant sealants shall be used at locations where they may be typically accessible to human contact in the following conditions:
   1. Buildings at locations where accessible to the public visiting or where the public may access the exterior of the building.

END OF SECTION 07 9000
The Agreement, General Conditions Of The Contract For Construction, Supplementary Conditions Of The Contract For Construction, and all Addenda are a part of the Contract. The Contractor shall consult them in detail for instructions pertaining to the Work. The Contractor shall also consult all other divisions and sections of the Project Manual, and all Drawings in the execution of the work of the Contract.

The Contractor shall provide all labor, materials, systems, equipment, items, articles, operations, and/or methods listed, implied, mentioned, or scheduled in the Contract Documents and/or necessary and/or required for the satisfactory completion of the Work.

The listing of work, requirements, and products in this section is not intended to be conclusive. The Contractor shall check all other parts of the Contract Documents and shall provide all miscellaneous items of work and products necessary for the satisfactory completion of the Work described in the Contract Documents.
PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following:
   1. Restoration of Wood windows including:
      a. Paint removal from window sash and frames
      b. Sash and frame component repairs and replacement
      c. Rot remediation and prevention
      d. Glass and glazing of wood windows
      e. Window hardware cleaning, maintenance and installation
      f. Weatherstripping
B. Related Sections include the following:
   1. Section 06 2000 - Finish Carpentry.
   2. Section 07 6200 - Sheet Metal Flashing and Trim.
   3. Section 07 9000 - Joint Protection
   4. Section 08 8000 - Glazing
   5. Section 09 9000 - Painting and Coating
C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 REFERENCES
A. Abbreviations and Acronyms
   1. DH = Double Hung Window
   2. CSMT = Casement window
B. Definitions
   2. Glazing includes glass, glazing points and glazing compounds.
C. Reference Standards
   1. AWI Quality Standard: Comply with applicable requirements in AWI’s “Architectural Woodwork Quality Standards” for construction, finishes, grades of wood windows, and other requirements.

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Action Submittals
   1. Product Data
      a. Submit product data for each type of product indicated.
   2. Shop Drawings
      a. Provide shop drawings for any proposed deviation from methods of joinery observed in the existing conditions on the project.
      b. Provide shop drawings for proposed moldings if recreations must be made identifying their exact match to original profiles.
   3. Samples
      a. Provide owner with samples of replacement materials including:
         1) 12” sample of each type of weatherstripping to be used.
         2) Representative sample of each type of replacement hardware.
C. Informational Submittals
   1. Qualification Statements
a. Submit qualification data for historic treatment specialists including list of projects similar in scope, age, and type including contact information for owner’s representatives sufficient to illustrate 5 years of full time involvement in projects of this type.
b. Submit EPA RRP certification or EPA approved state Lead Based Paint Renovators Certification.

2. Field Quality Control Reports
   a. Provide wood moisture content measurements before painting and at other points as directed by the owner.

3. Special Procedure Submittals
   a. Provide a detailed, written description of the materials, methods, equipment, and sequence of operations to be used in the window restoration process including specific dry and cure time requirements.
   b. Provide a window / openings schedule integrating specific notes or deviations from standard process as described above for any openings.

1.4 CLOSEOUT SUBMITTALS
   A. Refer to the Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
   B. Operation and Maintenance Data
      1. Provide a written maintenance schedule for the owner’s future maintenance requirements.
      2. Perform instruction for owner’s maintenance personnel with regard to rope/chain replacement, hardware operation and finish touch-up if requested.
   C. Warranty Documentation
      1. Provide written warranty as described in section 1.9.
   D. Record Documentation
      1. Provide certification of restoration per applicable standards and regulations.
      2. Provide details of restoration steps undertaken as required by all authorities having jurisdiction and as may be required by the owner for historic record.

1.5 QUALITY ASSURANCE
   A. Regulatory Requirements
      1. Comply with all local, state and federal authorities having jurisdiction with regard to preservation regulations and hazardous materials and disposal regulations.
      2. Contractor must provide evidence of EPA Lead Based Paint Renovators Certification or an equivalent federally recognized state license.
   B. Qualifications
      1. Historic Treatment Specialist Qualifications: A firm or individual experienced in historic treatment of windows similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
      2. Contractor must be engaged full time in restoration of windows (replacement does not qualify) for a period of 5 years prior to the date of this project bid.
      3. Contractor must be able to provide examples of job specific architectural/engineering drawings of profiles, joinery and weatherstrip design that they’ve performed for previous projects.
   C. Preconstruction Testing
      1. Preconstruction testing for hazardous materials has been performed.
         a. Information is available in appendix to this project manual.

1.6 MOCKUP
   A. Section 8.4 of the Uniform General Conditions of the Contract.
   B. Prepare 1 existing window to serve as mockup to demonstrate historic treatment methods and procedures for aesthetic effects and qualities of materials and execution. Use materials and methods proposed for completed Work and prepare mockup under same weather conditions to be expected during remainder of Work.
1.7 DELIVERY, STORAGE, AND HANDLING
   A. Delivery and Acceptance Requirements
      1. Deliver patching and repair compounds to Project site in manufacturer’s original containers,
         labeled with description of contents and name of manufacturer.
   B. Storage and Handling Requirements
      1. Comply with all manufacturers’ instructions with regard to storage and handling requirements.
   C. Packaging Waste Management
      1. This contractor is responsible for legal off site disposal of any hazardous waste.

1.8 ENVIRONMENTAL CONDITIONS
   A. This contractor is responsible to schedule work in a manner necessary to work within optimum
      temperatures and humidity levels and protect partially complete work from inclement weather.
   B. General: Perform work only when temperature of products being used, temperatures of existing
      and new materials, and air temperature and humidity comply with product manufacturer’s
      requirements and requirements of this Section. In case of conflict, the most stringent requirements
      shall govern.
   C. Use of Epoxy Resins: Mix and apply epoxy resins only when temperatures are between 50 deg F
      and 80 deg F.

1.9 WARRANTY
   A. All work is to be warranted against defects in material or workmanship for a period of five years.

PART 2 - PRODUCTS
2.1 EXISTING PRODUCTS
   A. Products being remanufactured, rebuilt and restored are existing elements of the owners building.
      Owner gives no representation as to their condition or that of the substrate. Contractor is to
      provide reasonable assumptions as to the conditions of the substrates based on their observations
      and experience with similar projects. Contractor is to include an assumption of rot and UV
      deterioration in the wood of the sash and visible members of the frame.
   B. Existing materials shall be reused whenever possible in the repair and rehabilitation of historic
      wood windows. This includes all wood elements, hardware and glazing that are determined to be
      of historic significance. Replacement of window elements with new material shall be done only
      when originals are so deteriorated as to prohibit their useful function.

2.2 MANUFACTURERS
   A. Subject to compliance with requirements, provide products by one of the manufacturers
      specified in section 2.3.

2.3 MATERIALS
   A. Adhesives
      1. Exterior grade wood Glue
         a. Acceptable products/manufacturers include:
            1) Titebond III
   B. Paint Removers
      1. Chemical Paint removers are to comply with all local, state, and federal authorities having
         jurisdiction. Dichloromethane / Methylene Chloride may not be used on any component of the
         project on or off site.
      2. The use of infrared stripping on site will be allowed.
      3. Mechanical stripping methods will be allowed if performed in compliance with EPA and OSHA
         regulations.
      4. No heat guns will be used on existing paint.
   C. Replacement wood materials
      1. Any wood replaced shall be done so with the same species as original making every effort to
         match the age, grain direction and growth rate of the piece it is replacing.
   D. Glass
1. Existing intact original glass shall be reused. Any removed lights shall be reused in their original frames and positions.

2. Replacement glass
   a. Per Section 08 8000.
   b. Missing or broken glass shall be replaced with new glass matching the same degree of waviness as the existing or as appropriate for the time period of the original construction.

E. Glazing Compound
   1. Glazing compound for single pane glass shall be linseed oil-based, nonstaining and non-bleeding.
      a. Acceptable manufacturers
         1) Sarco Glaze Putty

F. Glazing Points
   1. Glazing points shall be stainless steel or galvanized steel.

G. Epoxies – liquid consolidants
   1. Liquid wood consolidants shall consist of a two-part, low-viscosity liquid epoxy designed for wood restoration. Design criteria standards and evaluations of acceptable alternates will be based on Abatron LiquidWood.
   2. Acceptable Manufacturers:
      a. Abatron, Inc
      b. Advanced Repair Technology
      c. Gougeon Brothers, Inc
      d. Polymeric Systems, Inc
      e. Wood Care Systems

H. Epoxies – Paste
   1. Epoxy paste shall consist of a two-part, thixotropic paste epoxy designed for wood restoration. Design criteria standards and evaluations of acceptable alternates will be based on Abatron WoodEpox.
   2. Acceptable Manufacturers:
      a. Abatron, Inc
      b. Advanced Repair Technology
      c. Gougeon Brothers, Inc
      d. Polymeric Systems, Inc
      e. Wood Care Systems

I. Wood Preservative
   1. Acceptable manufacturers and products include:
      a. Nisus Corporation; Boracare

J. Hardware
   1. Replacement hardware shall match original in design, material, and finish. Acceptable Manufacturers include:
      a. Ball and Ball
      b. Bronze Craft Corporation, The
      c. Craftsmen Hardware Co., LTD
      d. Phelps Company Architectural Specialties
      e. Sun Valley Bronze - Hailey, ID

K. Weather Stripping
   1. Acceptable manufacturers include:
      a. Accurate Metal Weather Stripping
      b. Pemko Manufacturing CO., Inc
      c. Reese Enterprises, Inc
      d. Schlegel

L. Sash Cord
   1. ¼" or 5/16" sash cord, solid braid 100% cotton.

2.4 FINISHES
   1. Reference Section 09 9000 for primer and paint.
2.5 SOURCE QUALITY CONTROL
   A. Tests
      1. Document testing of all sash and wood materials before finishing confirming moisture content maximums.

PART 3 - EXECUTION

3.1 CONTRACTOR/INSTALLER
   A. The Contractor shall repair wood windows as indicated, and shall return them to proper operation and sound condition.

3.2 REPAIRS
   A. Sash Removal - The interior stops shall be removed first in a method so as not to scar the wood. Connecting hardware and operating mechanisms shall then be detached and the sash shall be removed from the frame. Removed sashes and frames shall be identified as to location to assure reinstallation in their original positions. Windows with counter-weight systems shall have the sash cords detached from the sides of the sash and their ends pinned with a nail or tied in a knot to prevent them from falling into the weight pocket; the lower sash can then be removed. The parting bead shall be removed so as not to scar the wood. Plastic covering or plywood shall be installed to cover the window opening during repairs.

   B. Paint Removal - All paint is to be removed from each sash using non-destructive means such as steam, chemical stripper or heat gun. If chemical strippers are used, wood shall be neutralized after stripping to a litmus pH of 5 to 8.5. Wood shall be allowed to dry to a moisture content of 8 to 12 percent before repainting. If heat methods are used for paint removal, glass shall be protected from sudden temperature change to avoid breakage.

   C. Wood Repair - Badly decayed areas (with more than 30 percent wood decayed) shall be removed from wood sash, sill, frame, and trim assemblies. Moderately decayed areas (less than 30 percent decayed), weathered, or gouged wood shall be patched with approved patching compounds, and shall be sanded smooth. Intact sash rails and stiles that are loose shall be repaired with new dowels to make joints tight.

   D. Epoxy Wood Repair/Consolidation - Epoxy wood repair materials shall be applied in accordance with manufacturer's written instructions. Health and safety instructions shall be followed in accordance with the manufacturer's instructions. The source or cause of wood decay shall be identified and corrected prior to application of patching materials. Wet wood shall be completely dried to a moisture content of 8 to 12 percent to its full depth before patching. Wood that is to be patched shall be clean of dust, grease, and loose paint. Clean mixing equipment shall be used to avoid contamination. Mix and proportions shall be as directed by the manufacturer. Batches shall be only large enough to complete the specific job intended. Patching materials shall be completely cured before painting or reinstallation of patched pieces.

   E. Epoxy Liquid Wood Consolidant - Epoxy liquid wood consolidants shall be used to penetrate and impregnate deteriorated wood sections to reinforce wood fibers that have become softened or absorbent.

   F. Epoxy Paste - Epoxy paste shall be used to fill areas where portions of wood are missing such as holes, cracks, gaps, gouges, and other voids. Areas to receive epoxy paste patching material shall be primed with compatible epoxy liquid wood consolidants or a primer recommended by the manufacturer.

   G. Wood Replacement - Extensively decayed wood shall be replaced with new pieces that match originals in all respects. Joinery shall match that of existing. Muntins shall have coped mortise and tenon joints. Molded members shall have mitered or coped joints.

   H. Hardware - Existing hardware which is in good condition shall be reused unless otherwise noted. Reused existing hardware shall be stripped of paint down to bare metal. New hardware shall be furnished and installed where original is missing, damaged, or unsuitable for new operation, per manufacturer's directions to provide a secure and smoothly operating window assembly.
I. Glazing - Lights to be reused shall be reinstalled in their original frames and positions. Rabbeted integral glazing recesses shall be brushed with boiled linseed oil or primed prior to the application of bed glazing compound. Broken glass shall be replaced as specified in Section 08 8000.

J. Operating System - Windows with counter-weight systems shall be repaired to original operating function. Original sash weights (and sash chains, if applicable) shall be reused wherever possible. Missing weights and sash cords or chains shall be replaced. Missing or deteriorated sash cords shall be replaced with new cotton/polypropylene cord rated for sash weight. When new weights are required, they shall match the originals in weight. Replacement weights shall be cast iron or square milled steel bar stock or weights salvaged from similar projects.

K. Weatherstripping and Moldings - Weatherstripping shall be installed on all operable sash. Weatherstripping shall consist of compression weather strips designed for permanent sealing under bumper or wiper action. Weatherstripping shall be provided at the perimeter of each sash including meeting rails and shall be installed per manufacturer's instructions. Weatherstripping shall be concealed when sash is closed.

3.3 PAINTING PREPARATION
A. Areas where paint was removed or where existing paint shows crazing, wrinkling, and inter-coat peeling shall be scraped, sanded, and shall have edges feathered. Paint shall be removed to bare wood or first sound paint layer. All parts shall be cleaned by brush using bleach and/or tri sodium phosphate (TSP) solution, and let dry. Existing finish shall be de-glossed. Open joints and cracks shall be filled with epoxy repair materials. Perimeter of fixed sash shall be caulked.

3.4 PAINTING
A. Wood elements shall be primed and painted in accordance with Section 09 9000.

3.5 REASSEMBLY
A. After repairs are completed, the window shall be reassembled with all parts tight, true and functioning properly. Wood surfaces shall be free of blemishes.

3.6 ADJUSTMENTS
A. Final adjustment for proper operation of ventilating unit shall be made after reassembly. Adjustments shall be made to operating sash or ventilators to assure smooth operation and weather-tight performance when locked closed.

3.7 CLEANING
A. Windows shall be cleaned on both exterior and interior.

3.8 SCHEDULE
A. Restore seven single hung wood sash windows at the Section House.

END OF SECTION 08 0152.91
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes non-rated, and, acoustically insulated steel frames.
   1. Provide frames for interior and exterior doors.
B. Related Sections:
   1. Section 04 2000 - Unit Masonry: Masonry grout fill of metal frames and placement of anchors into masonry wall construction.
   2. Section 04 4213 – Masonry-Supported Stone Cladding: Adjacent construction.
   3. Section 06 1000 – Rough Carpentry: Placement and anchoring in framed walls and partitions.
   4. Section 07 9000 - Joint Protection
   5. Section 08 1313.13 - Standard Hollow Metal Doors.
   7. Section 08 7100 - Door Hardware: Hardware, silencers, and weatherstripping.
   8. Section 09 2116 – Gypsum Board Assemblies: Placement and anchoring in framed partitions.

1.2 REFERENCES
A. American National Standards Institute:
   1. ANSI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
B. ASTM International:
   1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Shop Drawings: Indicate frame elevations, reinforcement, anchor types and spacing, location of cut-outs for hardware, and finish.
C. Product Data: Submit frame configuration and finishes.
D. Manufacturer's Installation Instructions: Submit special installation instructions.
E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.5 QUALITY ASSURANCE
A. Conform to requirements of ANSI A250.8.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Accept frames on site in manufacturer's packaging. Inspect for damage.
B. Break seal on-site to permit ventilation.
1.8 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate Work with frame opening construction, door, and hardware installation.

PART 2 - PRODUCTS

2.1 STANDARD STEEL FRAMES
A. Manufacturers:
   1. Ceco Door Products.
   2. Curries.
   3. Republic Doors and Frames
   4. Steelcraft.
   5. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
B. Product Description: Standard shop fabricated steel frames, non-rated types.
   1. Frame Profiles:
      a. Frames in masonry walls, existing opening, or other conditions where frame does not wrap drywall;
         1) Ceco - Series SQ.
         2) Curries - Masonry profile M equal rabbets.
         3) Republic - ME Series equal rabbeted.
         4) Steelcraft - F Series double equal rabbet.
      b. Frames wrapping drywall;
         1) Ceco - Series BQ.
         2) Curries - Drywall series C equal rabbets.
         3) Republic - MH Series equal rabbeted.
         4) Steelcraft - K Series double equal rabbet.

2.2 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.

2.3 ACCESSORIES
A. Primer: ANSI A250.10 rust inhibitive type.
B. Silencers: Resilient rubber set in fitted into drilled hole.
   1. Trimco 1229A or approved equal.
   2. Coordinate with Section 08 7100.
C. Weatherstripping: As specified in Section 08 7100.
D. Frame Anchors
   1. Wire Masonry Anchors, equal to Ceco WMA, at all locations where frame installed in new masonry wall.
   2. Existing Opening Anchors, equal to Ceco EO, at all existing masonry openings and existing openings in framed partitions where the gypsum panels are not being replaced.
   3. Wood Stud Anchors, equal to Ceco WSZS or ADJ/STUD, at all locations where installed in wood stud partitions.

2.4 FABRICATION
A. Fabricate frames as follows:
   1. Exterior frames: Full profile welded unit.
   2. Interior frames in gypsum board partitions: Knock down field assembly for gypsum board slip on type.
B. Fabricate frames with hardware reinforcement plates welded in place. Provide mortar guard boxes. Provide hardware reinforcement as follows:
   2. Closers: 14 gage.
C. Prepare frames for silencers. Provide three single silencers for single doors on strike side. Provide two single silencers on frame head at double doors without mullions.
D. Fabricate frames to suit masonry wall coursing with 4 inch and 2 inch head members as indicated on Drawings.

2.5 SHOP FINISHING
   A. Steel Sheet: Galvanealed to ASTM A653/A653M A60 at exterior frames.
   B. Primer: Baked.
   C. Factory Finish: Baked prime paint over phosphatized steel.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify opening sizes and tolerances are acceptable.

3.2 INSTALLATION
   A. Install frames in accordance with ANSI A250.8.
   B. Coordinate with masonry and gypsum board wall construction for anchor placement.
   C. Coordinate installation of frames with installation of hardware specified in Section 08 7100 and doors in Section 08 1313.13 and 08 1416.
   D. Install mineral wool sound batt insulation in door frame to fill all crevices at all framed sound rated partitions and where sound rated doors are scheduled.

3.3 ERECTION TOLERANCES
   A. Maximum Diagonal Distortion: 1/16 inch measured with straight edges, crossed corner to corner.

3.4 SCHEDULE
   A. Exterior Full Profile Welded Frames, A60 Galvanealed:
      1. Level 3: Door 402
   B. Interior Knock Down Frames:
      1. Level 2: Doors 106, 107, and 108
   C. Sound Insulation at Frames
      1. Door 106
   D. Refer to Door and Frame Schedule in Drawings for additional information.

END OF SECTION 08 1213.13
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes non-rated, thermally insulated, steel doors.
B. Related Sections:
   1. Section 08 1213.13 - Standard Hollow Metal Frames.
   2. Section 08 7100 - Door Hardware.
   3. Section 09 9000 - Painting and Coating: Field painting of doors.

1.2 REFERENCES
A. American National Standards Institute:
   1. ANSI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
B. ASTM International:
   1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
C. Hollow Metal Manufacturers Association:
   1. HMMA 800 – 850 Series Documents.
D. Steel Door Institute:

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Shop Drawings: Indicate door elevations, internal reinforcement, closure method.
C. Product Data: Submit door configurations, location of cut-outs for hardware reinforcement.
D. Manufacturer's Installation Instructions: Submit special installation instructions.
E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificate:
      a. Certify recycled material content for recycled content products.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.5 QUALITY ASSURANCE
A. Perform Work in accordance with ANSI A250.8.
B. Meet fabrication methods and product quality standards set by the Hollow Metal Manufacturers Association, HMMA, a division of the National Association of Architectural Metal Manufacturers, NAAMM, as set forth in the contract documents and NAAMM’s HMMA 800 through 850 Series documents.
C. Surface Burning Characteristics:
   1. Foam Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
D. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.
1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.
B. Installer: Company specializing in performing work of this section with minimum three years experience.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Accept doors on site in manufacturer's packaging. Inspect for damage.
B. Break seal on site to permit ventilation.

1.8 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate Work with door opening construction, door frame, and door hardware installation.

PART 2 - PRODUCTS

2.1 STANDARD STEEL DOORS
A. Manufacturers: Rated and non-rated doors, insulated/composite.
B. Ceco Door Products: Imperial
C. Cumex – 707 Series - Composite
D. Republic Doors and Frames: DE Series
E. Steelcraft – L Series
F. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
G. Product Description:
      a. Level 3 - Extra heavy Duty, Model 2, seamless design.

2.2 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.

COMPONENTS
C. Face: Steel sheet in accordance with ANSI A250 and SDI 108.
D. End Closure: Channel, 0.053 inches thick, inverted.
E. Core: polyurethane.
F. Thermal Insulated Door: Total insulation minimum R-Value of 10 measured in accordance with ASTM C1363.
G. Primer: ANSI A250.10 rust inhibitive type.

2.3 FABRICATION
A. Fabricate doors with hardware reinforcement welded in place. Provide mortar/plaster guard boxes. Provide reinforcement as follows:
   1. Hinges: 7 gage minimum
   2. Closers: 14 gage minimum
   3. Exit Devices: 14 gage minimum
   4. Kick plates: 14 gage minimum

2.4 SHOP FINISHING
A. Steel Sheet: Galvanealed to ASTM A653/A653M A60.
B. Primer: Baked.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify opening sizes and tolerances are acceptable.

3.2 INSTALLATION
A. Install doors in accordance with ANSI A250.8.
B. Install door louvers, plumb and level.
C. Coordinate installation of doors with installation of frames specified in Section 08 1213.13 and hardware specified in Section 08 7100.
D. Touch-up damaged shop finishes.

3.3 ERECTION TOLERANCES
A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.4 ADJUSTING
A. Adjust door for smooth and balanced door movement.

3.5 SCHEDULE
A. Exterior Doors
   1. Level 3 – Door 402
B. Refer to Door and Frame Schedule in Drawings for additional information.

END OF SECTION 08 1313.13
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Flush wood doors.
B. Related Requirements:
   1. Section 08 1213.13 - Standard Hollow Metal Frames.
   2. Section 08 7100 - Door Hardware.

1.2 REFERENCE STANDARDS
A. Architectural Woodwork Institute:
   1. AWI AWS - Architectural Woodwork Standards.
B. Forest Stewardship Council:
   1. FSC Guidelines - Forest Stewardship Council Guidelines.
C. Wood Window and Door Manufacturers Association:
   1. WDMA I.S.1A - Architectural Wood Flush Doors.

1.3 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate Work with door opening construction, door frame and door hardware installation.

1.4 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data:
   1. Submit data for door core materials and construction.
   2. Submit data for veneer species, type and characteristics.
   3. Submit data for factory finishes.
C. Shop Drawings:
   1. Indicate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, and factory machining criteria.
D. Samples:
   1. Submit two sample chains of door veneer, 3x5 inch minimum in size illustrating wood grain, stain color, and sheen.
E. Manufacturers' Instructions: Submit special installation instructions.
F. Qualification Statements:
   1. Submit manufacturer experience qualifications.

1.5 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
   2. Indoor Air Quality Certificates:
      a. Certify each composite wood and agrifiber product contains no added urea-formaldehyde resins.
   3. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
      a. Provide cost data for the following products:
         1) Products with recycled material content.

1.6 QUALITY ASSURANCE
A. Perform Work in accordance with AWI AWS Section 9, Custom Grade.
B. Finish doors in accordance with AWI AWS Section 5 Custom Grade.

1.7 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
   B. Installer: Company specializing in performing work of this section with minimum three years experience.

1.8 DELIVERY, STORAGE, AND HANDLING
   A. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer when stored more than one week.
   B. Accept doors on site in manufacturer's packaging. Inspect for damage.
      1. Break seal on site to permit ventilation.

1.9 WARRANTY
   A. Uniform General Conditions of the Contract, especially paragraph 13.5.
   B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.
   C. Interior Doors:
      1. Factory Finished Doors: Furnish manufacturer's life of installation warranty.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS
   A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
   B. Materials and Resources Characteristics:
      1. Recycled Content Materials: Furnish materials with maximum available recycled content.
   C. Indoor Environmental Quality Characteristics:
      1. Interior Composite Wood and Agrifiber Products: Contain no added urea-formaldehyde resins.

2.2 FLUSH WOOD DOORS
   A. Manufacturer List:
      1. VT Industries as basis of design.
      2. AMPCO Products, LLC.
      3. ASSA ABLOY
      5. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
   B. Flush Interior Doors: Solid core non-rated doors.
      1. Thickness: 1-3/4 inches
      2. Core: Urea free, and FSC PC or agrifiber.
         a. Wood-based composite crossbanding.
      4. Performance Duty Level: Heavy duty and Extra heavy duty as scheduled.
      5. Quality Grade: AWI AWS Custom.
   C. Performance / Design Criteria:
      1. Performance Duty Level: WDMA I.S. 1A.

2.3 MATERIALS
   A. Door Cores: AWI AWS Section 9.
      1. Solid Core, Non-Fire Rated:
         a. Type: PC; urea-free FSC particleboard or agrifiber, ANSI A208.1 grade LD-2.
      2. Transparent Finished Faces: Wood veneer.
         a. Species: Select white birch.
         b. Veneer Cut: Plain sliced.
         c. Veneer Matching: Book matched.

B. Interior Door Faces:
   1. Transparent Finished Faces: Wood veneer.
      a. Species: Select white birch.
      b. Veneer Cut: Plain sliced.
      c. Veneer Matching: Book matched.

C. Cross Banding Behind Wood Veneer: One ply; wood fiber based composite.

D. Top and Bottom Rail:
   1. 2 5/8” minimum wide hardwood rail.

E. Stiles:
   1. 1 3/4” wide hardwood stile.

F. Facing Adhesive: Type II - water resistant.

2.4 FABRICATION
A. Fabricate doors in accordance with AWI AWS Section 9 requirements.
B. Furnish lock blocks at lock edge, across face of door for kick plates, top of door for closer, and for reinforcement of hardware specified.
C. Vertical Exposed Edge of Stiles: Hardwood stained and lacquered to match door facing.
D. Fit door edge trim to edge of stiles after applying veneer facing.
E. Bond edge banding to cores.
F. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware. Furnish solid blocking for through bolted hardware.
G. Factory fit doors for frame opening dimensions identified on shop drawings.
H. Provide edge clearances in accordance with AWI AWS Section 9.

2.5 FINISHES
A. Finish work in accordance with AWI AWS Section 5; Custom Grade.
B. Transparent Finish System: Stained, color as selected; sheen as selected.
   1. System 9; UV curable epoxy, polyester, urethane.
C. Seal door top edge with sealer.
D. Color: Wheat WH18 by VT Industries.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify opening sizes and tolerances are acceptable.
B. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION
A. Install doors in accordance with AWI AWS Section 9 and manufacturer's instructions.
B. Field Fitting and Trimming:
   1. Trim non-rated door width by cutting equally on both jamb edges.
   2. Trim door height by cutting bottom edges to maximum of 3/4 inch.
C. Coordinate installation of doors with installation of frames specified in Section 08 1213.13 and hardware specified in Section 08 7100.

3.3 TOLERANCES
A. Conform to AWI AWS Section 9 requirements for the following:
   1. Fit and clearance tolerances.
   2. Gaps.
   3. Flushness.
   4. Flatness.
   5. Squareness.

3.4 ADJUSTING
A. Adjust door for smooth and balanced door movement.
B. Adjust door closer for full closure.

3.5 **SCHEDULE**

B. Refer to Door and Frame Schedule in drawings for more information.

**END OF SECTION 08 1416**
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Aluminum-framed storefronts.
   2. Aluminum and glass doors and frames.
   3. Hardware.
   4. Metal composite infill panels.
B. Related Requirements:
   1. Section 03 3000 - Cast-in-Place Concrete: Substrate.
   2. Section 04 2000 - Unit Masonry: Abutting substrates, flashing membranes.
   4. Section 05 1200 - Structural Steel Framing: Abutting substrates, loose laid steel lintels.
   5. Section 06 1000 - Rough Carpentry: Wood blocking and framing.
   6. Section 07 2726 - Fluid Applied weather Barriers: Perimeter air seal between glazing system and adjacent construction.
   7. Section 07 9000 - Joint Protection: System perimeter sealant and backup materials.
   8. Section 08 7100 - Door Hardware: Hardware items other than specified in this Section.
   9. Section 08 8000 - Glazing: Exterior and interior glazing materials and methods.
   10. Section 09 2116 - Gypsum Board Assemblies: Abutting substrates.

1.2 REFERENCE STANDARDS
A. American Architectural Manufacturers Association/Window & Door Manufacturers Association:
   2. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
   4. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.
   5. AAMA SFM-1 - Aluminum Storefront and Entrance Manual.
B. American Society of Civil Engineers:
C. ASTM International:
   3. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
12. 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.


D. Green Seal:
   1. GC-03 - Green Seal Environmental Criteria for Anti-Corrosive Paints.

E. International Energy Conservation Code:
   1. IECC Climate Zone Map.

F. SSPC: The Society for Protective Coatings:
   1. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic).

1.3 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate Work of this Section with installation of weather barrier components or materials.
C. Verify that field measurements are as indicated on the shop drawings.
D. Coordinate work of this section with installation of glass/glazing specified in Section 08 8000 and door hardware specified in Section 08 7100.

1.4 PREINSTALLATION MEETINGS
A. Convene minimum one week prior to commencing Work of this Section. Schedule to coincide with regular progress meetings.
B. Attendance: General Contractor, sub-contractor placing work of this section, and Architect.
C. Notify Architect/Engineer four days in advance of meeting date.

1.5 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit component dimensions, description of components within assembly, anchorage and fasteners, glass and infill panels, finished brake metal, door hardware, and internal drainage details.
C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, and expansion and contraction joint location and details.
D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
E. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for structural framing member, physical characteristics, and dimensional limitations.
F. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
G. Qualifications Statements:
   1. Submit qualifications for manufacturer, installer, and licensed professional.
   2. Submit manufacturer's approval of installer.

1.6 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate:
   1. Certify that products meet or exceed specified sustainable design requirements.
   2. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
   3. Indoor Air Quality Certificates: Certify VOC content for each interior adhesive, sealant, and related primer.
C. Product Cost Data:
   1. Submit cost of products to verify compliance with Project sustainable design requirements.
   2. Exclude cost of labor and equipment to install products.
   3. Provide cost data for following products:
      a. Products with recycled material content.
1.7 QUALITY ASSURANCE
   A. Perform Work according to AAMA SFM-1.
   B. Surface-Burning Characteristics:
      1. Foam Insulation:
         a. Maximum 75/450 flame-spread/smoke-developed index.
         b. Testing: Comply with ASTM E84.
   C. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.

1.8 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
   B. Installer: Company specializing in performing Work of this Section with minimum three years' experience and approved by manufacturer.
   C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Texas.

1.9 MOCKUP
   A. Section 8.4 of the Uniform General Conditions of the Contract.
   B. Construct storefront assembly mockup, minimum 5 feet long by 9 feet high, including adjacent masonry, mortar and accessories, flashings, weather barrier, parging.
      1. Mock-up shall include all typical joints and transitions, including sill, head or top of wall, and where adjoining dissimilar materials. If the mock-up is to be erected within the project's wall construction, the Contractor shall erect the mock-up to whatever size is required to illustrate all typical joints and transitions, but shall be at minimum the size indicated above.
   C. Mock-up Locations:
      1. Locate at south side, west end of Visitors Center, SF-9 from the masonry wall to the west to the vertical mullion on the west side of door 203, floor to underside of roof.
      2. Locate within mock-up required by Section 04 2000.
   D. The mock-ups will be tested under provisions in Field Quality Control of this Section.
   E. Accepted mockup in the building construction may be incorporated as completed Work.

1.10 DELIVERY, STORAGE, AND HANDLING
   A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
   B. Handling: Comply with AAMA CW-10.
   C. Store products according to manufacturer instructions.
   D. Protection:
      1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
      2. Protect finished aluminum surfaces with strippable coating.
      3. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
      4. Provide additional protection according to manufacturer instructions.

1.11 AMBIENT CONDITIONS
   A. Do not install sealants or glazing materials if ambient temperature is less than 40 deg. F during and 48 hours after installation.

1.12 EXISTING CONDITIONS
   A. Field Measurements:
      1. Verify field measurements prior to fabrication.
      2. Indicate field measurements on Shop Drawings.

1.13 WARRANTY
   A. Uniform General Conditions of the Contract, especially paragraph 13.5.
   B. Furnish two-year manufacturer's warranty for aluminum framing components and assemblies.
   C. Furnish three-year manufacturer's warranty for aluminum finishes.
PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION
A. Aluminum-framed, shop-fabricated, and factory-finished storefront system with tubular aluminum sections, supplementary internal support framing, and aluminum and glass entrances.
B. Furnish systems with glass and glazing, insulated metal-panel infill, related flashings, anchorages, and attachment devices.
C. System Assembly: On Site.

2.2 PERFORMANCE AND DESIGN CRITERIA
A. System Design:
   1. Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall, including building corners.
   2. Testing: Comply with ASTM E330/E330M.
   3. Calculation:
      a. Comply with applicable code.
B. Windborne Debris Loads:
   1. Design and size glass located less than 60 feet above grade to withstand following loads:
      a. Glass within 30 Feet of Grade: Comply with ASTM E1886 and ASTM E1996; large-missile impact test.
      b. Glass Greater Than 30 Feet above Grade: Comply with ASTM E1886 and ASTM E1996; small-missile impact test.
C. Deflection:
   1. Framing Deflection Limit: 1/175 for spans under 13-1/2 feet and 1/240 plus 1/4 inch for spans over 13-1/2 feet.
   2. Ensure full recovery of glazing materials.
D. System Assembly: Without damage to components or deterioration of seals, accommodate movement within system, movement between system and peripheral construction, dynamic loading and release of loads, and deflection of structural support framing.
E. Air Infiltration:
   1. Maximum through Assembly: 0.06 cfm /sq. ft. of wall area.
   2. Reference Differential Pressure across Assembly:
      a. 6.24 psf.
F. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily inline with inside pane of glass, inner sheet of infill panel, and heel bead of glazing compound.
G. Condensation-Resistance Factor: Not less than 60 when measured according to AAMA 1503.
H. Water Leakage:
   1. None.
   2. Measurement:
      a. Comply with ASTM E331.
      b. Test Pressure Difference: 10 psf.
I. Thermal and Solar Heat Transmittance of Assembly (U-Value and Solar Heat Gain Coefficient): Comply with IECC for climate zone in which Project is located.
J. Expansion/Contraction: Ensure that system components can withstand expansion and contraction caused by minimum cycling temperature range of 170 deg. F over a 12-hour period, without causing detrimental effect to system components or anchorage.
K. System Internal Drainage: Furnish weep drainage network to drain water to exterior, including water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system.

2.3 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Material and Resource Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.
C. Indoor Environmental Quality Characteristics:
   1. Interior Anti-corrosive Paints: Maximum VOC content according to GC-03.

2.4 ALUMINUM-FRAMED 2" STOREFRONTS

A. Manufacturers:
   1. Kawneer Company Inc., Trifab VersaGlace 451 as basis of design.
   2. EFCO Corporation, model 402.
   3. Oldcastle Building Envelope, FG-3000.
   4. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

B. Description:
   1. Aluminum Frame:
      b. Glazing Stops: Flush.
      c. Glazing Position: Center.
   2. Mullions:
      a. Profile: Match frame.
      b. Internal Reinforcement: Aluminum or shaped-steel structural section as required.
   3. Framing/mullion size:
      a. Face Dimension: 2".
      b. Depth: 4-1/2".
   4. Aluminum-Framed Glass Doors:
      b. Top Rail Width: 2-1/4 inches.
      c. Stile Width: 2-1/8 inches.
      d. Bottom Rail Width: 10 inches.
      e. Glazing Stops: Square.
      f. Kawneer 190 Narrow Stile Entrance as basis of design.

2.5 ALUMINUM-FRAMED 2" THERMALLY BROKEN STOREFRONTS

A. Manufacturers:
   2. EFCO Corporation, model 403X and 406X
   3. Oldcastle Building Envelope, Series 3000XT and Series 6000XT
   4. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

B. Description:
   1. Aluminum Frame:
      b. Glazing Stops: Flush.
      c. Glazing Position: Center.
   2. Mullions:
      a. Profile: Match frame.
      b. Internal Reinforcement: Aluminum or shaped-steel structural section as required.
   3. Framing/mullion size:
      a. Face Dimension: 2".
      b. Depth: 4-1/2" and 6" or 6-1/2".
   4. Operable Glazing Panels:
      a. Face Dimension: 1 13/16 inches exterior, 2 ¼ inches interior.
      b. Depth: 4-3/8 inches
      c. Thermally broken.
      d. Kawneer GlassVent UT as basis of design.
   5. Aluminum-Framed Glass Doors:
      a. Thickness: 2 to 2-1/4 inches.
      b. Thermally broken.
      c. Top Rail Width: 2-15/16 inches.
d. Stile Width: 2-1/2 inches.
e. Bottom Rail Width: 10 inches.
f. Glazing Stops: Square.
g. Thermally broken.
h. Kawneer InsulPour 250T as basis of design.

2.6 ALUMINUM FRAMED STOREFRONT MATERIALS

A. Extruded Aluminum:
   1. Comply with ASTM B221.
   2. Alloy:
      a. 6063.
      b. Extruded Structural Members: 6061.
   3. Temper:
      a. T5.
B. Sheet Aluminum:
   3. Temper: H15 or H34.
C. Sheet Steel:
   1. Comply with ASTM A653/A653M.
   2. Galvanized to Minimum Coating Class: G90.
D. Steel Sections:
   1. Comply with ASTM A36/A36M.
   2. Shape: To suit mullion sections.
E. Glass: As specified in Section 08 8000 - Glazing.
F. Glazing Materials: As specified in Section 08 8000 - Glazing.
G. Sealant and Backing Materials:
   1. Sealant Used within System and Not Used for Glazing: Manufacturer's standard materials to achieve weather, moisture, and air infiltration requirements.
   2. Perimeter Sealant: As specified in Section 079000 - Joint Protection.
H. Fasteners: Stainless or Hot-dip galvanized steel.

2.7 INFILL PANELS:

A. Infill Panels-Insulated: Composite Infill Panels: Laminated assembly comprised of an insulating core, substrate on either side of the insulating core, and finished face material on both sides.
   1. Face Material & Finish: Aluminum, thickness 0.032 inches minimum, Class 1 clear anodized.
   2. Surface Texture: Smooth.
   3. Substrate: Cement Board, thickness 4mm.
   4. Insulating Core: Isocyanurate insulation.
   5. Total Assembly Thickness: 1 inch.
   6. Color: Class 1 clear anodized.
   7. Warranty:
      a. Warranty against delamination: 25 years.
   8. Mapes Infill-R as basis of design.

2.8 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
B. Joints and Comers:
   1. Accurately fit and secure joints and comers.
   2. Make joints flush, weatherproof, and hairline.
C. Provide for exterior replacement of glazing.
D. Provide means to drain water passing joints, condensation within framing members, and moisture migrating within system to exterior.
E. Provide physical and thermal isolation of glazing from framing members.
F. Arrange fasteners and attachments to conceal from view.
G. Prepare components with internal reinforcement for door hardware.
H. Reinforce framing members for imposed loads.

2.9 FINISHES
A. Clear Anodized Aluminum Surfaces:
   1. AAMA 611, AA-M12C22A41.
   2. Coating: Architectural Class I, 0.7 mils.
B. Concealed Steel Items: Galvanized after fabrication; ASTM A123/A123M.
C. Apply bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar metals.
D. Touchup Primer for Galvanized Surfaces:
   1. SSPC Paint 20, Type II - Organic.
   2. ASTM A780.
E. Application:
   1. Apply factory coating to surfaces exposed at completed assemblies.
   2. Apply finish to surfaces cut during fabrication such that no natural aluminum is visible in completed assemblies, including joint edges.
   3. Apply touchup materials recommended by coating manufacturer for field application to cut ends and minor damage to factory-applied finish.

2.10 ACCESSORIES
A. Hardware:
   1. Furnish manufacturer's standard door hardware for types of doors and for indicated applications.
      a. Top and Bottom set pivots.
      b. Deadlock latch with keyed lock cylinders both sides (no latch).
      c. Closer, Norton 1601 as basis of design.
      d. Saddle threshold.
      e. Push: Kawneer CP-II as basis of design.
      f. Pull: Kawneer CO-12 as basis of design.
   2. Weather Stripping, Sill Sweep Strips, Thresholds, Pivots, Closers, Pushes and Pulls: Manufacturer's standard type to suit application.
   3. Exposed Hardware Finishes: Match door finish.
B. Flashings: Minimum 0.032-inch-thick aluminum. Match mullion sections where exposed.
C. Operable Sash: Hinged “down and out” operation.
D. Air Barriers: As specified in Section 07 2726 – Fluid Applied Weather Barriers.

2.11 SOURCE QUALITY CONTROL
A. Provide shop inspection and testing of completed assembly.
B. Certificate of Compliance:
   1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
   2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify dimensions, tolerances, and method of attachment with other Work.
B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive Work of this Section.

3.2 INSTALLATION
A. Comply with AAMA SFM-1 - Aluminum Storefront and Entrance Manual.
B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
C. Provide alignment attachments and shims to permanently fasten system to building structure.
D. Align assembly plumb and level, free of warp or twist.
E. Maintain assembly dimensional tolerances.
F. Provide thermal isolation where components penetrate or disrupt building insulation.
G. Install continuous thermal pocket fillers.
H. Separate aluminum and other corrodeable surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
I. Sill Flashings:
   1. Turn up ends and edges.
   2. Seal to adjacent Work to form watertight dam.
J. Coordinate attachment and seal of perimeter air and vapor retarder materials.
K. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
L. Install integral flashings and integral joint sealers.
M. Set sills and thresholds in bed of mastic and secure.
N. Hardware:
   1. Use provided templates.
   2. Allow for full range of all operating hardware.
   3. Install weather-resisting accessories to meet air and water infiltration requirements.
   4. Comply with accessibility requirements for door hardware.
O. Infill Panels: Use method as required to achieve performance criteria.
P. Glass:
   1. As specified in Section 08 8000 - Glazing.
   2. Separate glass from metal surfaces.
Q. Perimeter Sealants: As specified in Section 07 9000 - Joint Protection.

3.3 TOLERANCES
A. Maximum Variation from Plumb: 0.06 in./3 ft. noncumulative, or 1/16 in./10 ft., whichever is less.
B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.4 FIELD QUALITY CONTROL
A. Uniform General Conditions of the Contract, especially article 8.2.
B. Field Testing: Comply with AAMA 503 for both air infiltration and water penetration.
   1. Air infiltration ASTM E783:
      a. Test at 6.24 psf.
      b. Maximum leakage: 1.5 times the amount indicated in the performance requirement or 0.09 cfm/sf of area tested, whichever is greater.
      a. Test pressure: Static test pressure of two-thirds the specified water penetration pressure but not less than 6.24 psf.
      b. Maximum leakage: None
   3. Assemblies to be Tested:
      a. Testing shall be performed on the Mock-up described this Section.
      b. Testing shall be performed at a single location of fully installed conditions, exact location to be determined by Architect.
         1) Storefront installed in Visitors Center masonry wall.
C. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 2 days on Site for installation, inspection, and field testing.
   1. Manufacturer's representative shall be required to be present during the Field Quality Control Testing.
D. Equipment Acceptance:
   1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
   2. Make final adjustments under direction of manufacturer's representative.

3.5 ADJUSTING
A. Adjust operating hardware and sash for smooth operation.

3.6 CLEANING
A. Uniform General Conditions of the Contract, especially paragraph 3.3.9.
B. Remove protective material from prefinished aluminum surfaces.
C. Surfaces:
   1. Wash down with solution of mild detergent in warm water.
   2. Apply with soft, clean wiping cloths.
   3. Wipe surfaces clean.
D. Remove excess sealant by method acceptable to sealant manufacturer.

3.7 PROTECTION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.
B. Protect finished Work from damage.

3.8 ATTACHMENTS
A. Exterior storefronts and entrances at the Visitors Center doors 101 and 102: Thermally broken 4-1/2” aluminum storefronts and entrances.
   1. 1” low-E glazing in storefront and entrances as specified in Section 08 8000.
   2. New pivots and weatherstripping as manufacturer’s standards.
   3. New pulls and pushes to be installed in new construction.
   4. Cylinders, cores, threshold, and stop specified in Section 08 7100.
B. Exterior storefronts and entrances at the Visitors Center door 203: Thermally broken 4-1/2” aluminum storefronts and entrances.
   1. 1” low-E glazing in storefront and entrances as specified in Section 08 8000.
   2. New pivots and weatherstripping as manufacturer’s standards.
   3. No pulls or pushes.
   4. Exit device, threshold, and stop specified in Section 08 7100.
C. Interior storefronts and entrances at the Visitors Center: Non-thermally broken 4-1/2” aluminum storefronts and entrances. At Contractor’s option 4-1/2” thermally broken specified may be used in lieu of the non-thermally broken.
   1. 1/4” glazing in storefront and entrances as specified in Section 08 8000.
   2. New pivots and weatherstripping as manufacturer’s standards.
   3. New pulls, pushes to be installed in new construction.
   4. Wall stops specified in Section 08 7100.
D. Exterior storefronts and entrances at the Comfort Station: Thermally broken 6” aluminum storefronts and entrances.
   1. 1” low-E glazing in operable panels specified in Section 08 8000.
   2. 1” composite infill panels in entrances.
   3. New pivots and weatherstripping as manufacturer’s standards.
   4. New pulls and pushes to be installed in new construction.
   5. Cylinders, cores, thresholds, and stops specified in Section 08 7100.
E. Reference Drawings for more information.

END OF SECTION 08 4113
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Self-closing pass, service, and teller window units.
   2. Glazing
B. Related Requirements:
   3. Section 07 2113 – Board Insulation: Abutting insulation in the veneer cavity.
   4. Section 07 2116 – Blanket Insulation: Insulation in window edges.
   5. Section 07 9000 – Joint Protection.

1.2 REFERENCE STANDARDS
A. American Architectural Manufacturers Association (AAMA):
   1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
B. ASTM International:
   7. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   8. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
C. Consumer Products Safety Commission (CPSC):
D. National Association of Architectural Metal Manufacturers (NAAMM):
   1. No. 3 Finish: Ground unidirectional uniform finish obtained with 80 - 100 grit abrasive.
E. SAE International:
   1. AMS5511 - Steel, Corrosion-Resistant, Sheet, Strip, and Plate, 19 Cr, 9.5c Ni (304L), Solution Heat Treated.
   2. AMS5513 - Steel, Corrosion-Resistant, Sheet, Strip, and Plate, 19 Cr, 9.2c Ni (SAE 30304) Solution Heat Treated.
F. Steel Structures Painting Council (SSPC):
   1. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Typical installation methods with requirements to accommodate specific site conditions.
C. Shop Drawings: Verify field measurements prior to fabrication, record on Shop Drawings.
   1. Details of materials, construction and finish including relationship with adjacent construction.
   2. Configuration, sizes, rough-in, mounting, construction and glazing details as well as installation clearances and finishes.

1.4 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify that the products meet or exceed specified sustainable design requirements.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.5 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
B. Installer: Company specializing in performing Work of this Section with minimum three years' experience.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Deliver and store window units and accessories in manufacturer's standard shipping containers and protective packaging. Deliver and store window units in manufacturer's original packaging and unopened containers with identification labels intact.
B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
C. Store products according to manufacturer instructions.
D. Protection:
   1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
   2. Protect finished aluminum surfaces with strippable coating.
   3. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
   4. Provide additional protection according to manufacturer instructions.

1.7 AMBIENT CONDITIONS
A. Do not install sealants or glazing materials if ambient temperature is less than 40 deg. F during and 48 hours after installation.
B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 EXISTING CONDITIONS
A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.9 WARRANTY
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Manufacturer's Warranty:
1. Furnish manufacturer's standard warranty document, executed by a manufacturer authorized officer in which manufacturer agrees to repair or replace windows, drawers and air curtains that fail in materials or workmanship.

2. Warranty Period: One year parts and labor from date of installation.

C. Failures: Including but not limited to the following.
   1. Deterioration of metal, metal finishes, other materials beyond normal weathering, use.
   2. Failure of welds and structural failures including deflections over 1/4 inch (6 mm).
   3. Faulty operation of sliding window hardware, transaction drawers and air curtains.
   4. Excessive air leakage.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE CRITERIA**

**A. Air and Vapor Seals:**
1. Maintain continuous air barrier and vapor retarder throughout assembly.
2. Primarily in line with pane of glass and heel bead of glazing compound.
3. Primarily in line with inside pane of glass and heel bead of glazing compound.
4. Thermal insulation positioned on exterior surface of air barrier and vapor retarder.

**2.2 ALUMINUM PASS-THRU WINDOWS**

**A. Manufacturers:**
1. QuikServ Corp.: Model IFSC as basis of design
2. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

**2.3 SUSTAINABILITY CHARACTERISTICS**

**A.** Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.

**B. Material and Resource Characteristics:**
1. Recycled Content Materials: Furnish materials with maximum available recycled content.

**C. Indoor Environmental Quality Characteristics:**
1. Interior Anti-Corrosive Paints: Maximum volatile organic compound content according to GC-03.

**2.4 MATERIALS**

**A. Aluminum Extrusions:** ASTM B221/B221M.
1. Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish.
2. Ultimate Tensile Strength: Not less than 22,000 psi (151 MPa).
3. Thickness of Main Frame and Sash Members: Not less than 0.125 inch (3.2 mm).

**B. Steel Plates, Shapes, and Bars:** ASTM A36/A36M.

**C. Metallic-Coated Steel Sheet:**
1. ASTM A653/A653M: CS Commercial Steel, Type B; with G 90 (Z275) zinc (galvanized) coating designation.
2. AMS 5511: Steel, corrosion-resistant, sheet, strip, and plate, 19Cr, 9.5 Ni (304L), solution heat treated.
3. AMS 5513: Steel, corrosion-resistant, sheet, strip, and plate, 19 Cr, 9.2 Ni (SAE 30304) solution heat treated.

**D. Stainless Steel:** Sheet, strip, plate, and flat bars.
1. ASTM A666: Austenitic stainless steel, Type 304, stretcher-leveled standard of flatness.

**E. Concealed Bolts:** ASTM A307, Grade A unless otherwise indicated.

**F. Cast-in-Place Anchors in Concrete:** Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing per ASTM E488, conducted by a qualified testing agency.
1. Threaded or Wedge Type: Galvanized ferrous castings.
   a. Cast Steel: ASTM A27/A27M.
2.5 GLAZING MATERIALS - GENERAL

A. Glass and Glazing Materials:
   1. Air Barrier and Vapor Retarder:
      a. Installed continuous to building enclosure vapor retarder and air barrier.
      b. Utilizes the inner pane of multiple pane sealed units for the continuity of the air barrier and vapor retarder seal.
   2. Structural Design: Glass and glazing designed in accordance with applicable code for most critical combination of wind, snow, seismic, and dead loads.

B. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers, and with a proven record of compatibility with surfaces contacted in installation.
   1. Cleaners, Primers, and Sealers: Approved by sealant or gasket manufacturer.
   2. Setting Blocks: Elastomeric material with a Type A Shore durometer hardness of 85, plus or minus 5.
   3. Spacers: Elastomeric blocks or continuous extrusions with a Type A Shore durometer hardness as required by glass manufacturer to maintain glass lites in place.
   4. Edge Blocks: Elastomeric material of hardness required to limit glass lateral movement or side walking.

C. Float Glass Materials:
   1. Tempered Glass: ASTM C1048, Type 1 transparent flat, Quality Q3, Kind FT fully tempered, Condition A uncoated, float glass with horizontal tempering.
      a. Fabricate units that have tempered glass with roller-wave distortion parallel to bottom edge of glass as installed.
      b. Furnish tempered glass conforming to CPSC 16 CFR 1201 Category II.
   2. Clear Glass: Tempered float glass as specified; Class 1 clear.
      1. Minimum Thickness: 1/4 inch (6 mm).
   3. Tinted Glass: Tempered float glass as specified; Class 2 tinted.
      1. Minimum Thickness: 1/4 inch (6 mm).
      2. Tint: Light Green to match Guardian Green as specified in 08 8000.
   4. Low E Glass: Tempered float glass as specified.
      1. Tinted: Class 2.
      2. Minimum Thickness: 1/4 inch (6 mm).
      3. Tint: Light Green to match Guardian Green as specified in 08 8000.
   5. Insulating Glass Units: Double pane insulating vision glass.
         a. Unit Performance: Tested in accordance with ASTM E2188.
         b. Resistance to Foggling: Tested in accordance with ASTM E2189.
         c. Insulating Glass Unit Edge Seal Construction: Aluminum, bent and spot welded comers.
      2. Total Unit Thickness: 5/8 inch (16 mm).
      4. Edge Seals: Glass elastomer edge seals.
      5. Interpane Space: Purged with dry air.
      6. Outer Pane: Glass type, tempered & tinted.
      7. Inner Pane: Glass type, tempered clear.
2.6 SHOP FINISHING
A. Extent of Finishing: General.
   1. Factory coating applied to surfaces exposed in completed assemblies.
   2. Finish applied to surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
   3. Touch-up materials recommended by coating manufacturer are field applied to cut ends and minor damage to factory applied finish.
B. Aluminum:
   1. Mill Finished Surfaces: Manufacturer's standard finish.
   2. Clear Anodized Surfaces: Conforms to AAMA 611.
      a. AA-M10C22A31: Non-specular as fabricated mechanical finish, medium matte chemical finish.
      b. Architectural Class II 0.7 mils (0.018 mm) clear anodized coating.
C. Concealed Steel Items:
   1. Compliance: Galvanized in accordance with ASTM A123.
   2. Thickness: Grade 85, 2.0 oz per sq ft (610 g per sq m).
D. Stainless Steel: Type 304 stainless steel with NAAMM No. 3 finish.
E. Bituminous Paint: Applied to concealed metal surfaces in contact with cementitious or dissimilar materials.

2.7 PASS THRU WINDOWS
A. Service and Teller Windows: Units complete from factory with flashing, anchors, clips, and accessories required for complete installation.
   1. System Design: Components to withstand dead loads and live loads caused by pressure and negative wind loads acting normal to plane of window as calculated in accordance with applicable code.
      a. Re-glazable from secure side without dismantling the nonsecure side of framing.
   2. Fabrication: General.
      a. Fabricate window to dimensions indicated on Drawings.
      b. Windows, drawers, and accessories to provide a complete system for assembly of components and anchorage of window, drawers, and accessories.
      c. Prepare components with reinforcement required for hardware.
      d. Rigidly fit and secure joints and corners with internal reinforcement. Make joints and connections flush, hairline, and weatherproof. Corners fully welded.
      e. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required to comply with ballistics-resistance performance indicated.
      f. Factory glaze window units, as required for applications indicated.
      g. Prepare security windows for glazing unless pre-glazing at factory is indicated.
      h. Fabricate units that have tempered glass with roller-wave distortion parallel to bottom edge of glass as installed.
      i. Weep holes and internal water passages for exterior security windows to conduct infiltrating water to the exterior.
   3. Welding: To greatest extent possible, welded prior to finishing and in concealed locations to minimize distortion or discoloration of finish.
      a. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding prior to finishing.
   4. System Internal Drainage: Weep drainage network drains water entering joints, condensation occurring in glazing channels, and migrating moisture occurring within system to the exterior.
   5. Factory-Cut Openings in Glazing: For speaking apertures, as indicated on Drawings.
   6. Bottom Sills: Stainless steel construction; bottom tracks or pop rivets not acceptable.
   7. Track and Slides for Windows and Drawers: Stainless steel ball bearing slides.
   9. Embedded Plate Anchors: Fabricated from steel shapes and plates; headed studs welded to back of plate.
   10. Metal Protection: Dissimilar metals separated to prevent galvanic action by painting contact surfaces with primer or applying manufacturer approved sealant or tape.

   1. Description: Top-hung unit with no bottom track system; offset in base to prevent intrusion and provide rain protection.
   2. Basis of Design: IFSC-4040 Insulated Single Horizontal Sliding Window Unit as manufactured by Quikserv Corp.
      a. Service Opening (WxH): 23-1/4 x 41 inches.
      c. Glazing: Insulated, tinted, and tempered, 5/8 inch (16 mm) thick.
      d. Finish: Clear.
      e. Hand: As scheduled and indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify field measurements prior to fabrication and recorded on Shop Drawings.
   B. Verify rough openings are correct size and in correct location
   C. Verify that field conditions are acceptable and are ready to receive Work.
   D. Perform additional inspections to determine compliance of replaced or additional work. Prepare anchor inspection reports.
   E. For glazing whose orientation is critical for performance, verify installation orientation.
   F. Do not proceed with installation until substrates have been prepared using the methods recommended by the manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.

3.2 PREPARATION
   A. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.

3.3 INSTALLATION
   A. Install in accordance with manufacturer's instructions, approved submittals and in proper relationship with adjacent construction.
      1. Glaze windows in accordance with manufacturer's instructions.
      2. Align Products plumb, level and square.
      3. Rigidly secure products to adjacent supporting construction.
      4. Seal perimeter joints.
   B. Protection for Dissimilar Materials:
      1. Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose.
      2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.4 TESTING AND ADJUSTING
   A. Uniform General Conditions of the Contract, especially article 8.2.
   B. Adjust horizontal-sliding, transaction security windows to provide a tight fit at contact points for smooth operation and a secure enclosure.

3.5 CLEANING AND PROTECTION
   A. Uniform General Conditions of the Contract, especially paragraph 3.3.9.
   B. Clean and protect products in accordance with the manufacturer's recommendations.
      1. Remove protective material from factory finished surfaces.
      2. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.
      3. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.
      4. Clean metal and glass surfaces to polished condition.
      5. Lubricate sliding security window hardware and transaction drawer hardware.
C. Provide temporary protection to ensure that security windows are without damage at time of Substantial Completion.
D. Touch-up, repair or replace damaged products including security windows that are warped, bowed, or otherwise unacceptable before Substantial Completion.

3.6 **DEMONSTRATION AND TRAINING**
A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems installed.

3.7 **ATTACHMENTS**
A. New pass thru window to replace existing at east wall of Visitors Center.
B. See Drawings for more information.

**END OF SECTION 08 5619**
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes hardware for wood, steel and aluminum doors.
   1. Provide door gaskets, including weatherstripping and seals, and thresholds.
B. Related Sections:
   1. Section 08 1213.13 - Standard Hollow Metal Frames: Silencers integral with steel frames.
   2. Section 08 1313.13 - Standard Hollow Metal Doors.
   3. Section 08 1416 - Flush Wood Doors.
   4. Section 08 4113 - Aluminum-Framed Entrances and Storefronts.

1.2 REFERENCES
A. American National Standards Institute:
   1. ANSI A156.1 - Butts and Hinges.
   2. ANSI A156.2 - Bored and Preassembled Locks and Latches.
   3. ANSI A156.4 - Door Controls - Closures.
   4. ANSI A156.5 - Auxiliary Locks and Associated Products.
   5. ANSI A156.7 - Template Hinge Dimensions.
   6. ANSI A156.16 - Auxiliary Hardware.
   7. ANSI A156.18 - Materials and Finishes
B. Builders Hardware Manufacturers Association:
   1. BHMA Directory of Certified Products.
C. Underwriters Laboratory:
   1. UL 305 – Standard for Panic Hardware.

1.3 PRE-INSTALLATION MEETINGS
A. Keying Meeting:
   1. Convene as soon after approval of product submittals as is feasible to ensure cores and keys are finalized before installation.
   2. Required attendees: Owner, Architect, General Contractor, Hardware Supplier.

1.4 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit manufacturer information.
C. Shop Drawings:
   1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts.
   2. Submit manufacturer’s parts lists, and templates.
D. Manufacturer’s Installation Instructions: Submit special procedures, and perimeter conditions requiring special attention.

1.5 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 – Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer’s Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.
1.6 CLOSEOUT SUBMITTALS
A. Refer to the Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Project Record Documents: Record actual locations of installed cylinders and their master key code.
C. Operation and Maintenance Data: Submit data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
D. Keys: Deliver with identifying tags to Owner by security shipment direct from hardware supplier.

1.7 QUALITY ASSURANCE
A. Perform Work in accordance with the following requirements:
   1. ANSI A156 series.
   2. UL 305.
B. Furnish hardware marked and listed in BHMA Directory of Certified Products.

1.8 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Hardware Supplier: Company specializing in supplying commercial and institutional door hardware with minimum three years documented experience and approved by primary hardware manufacturers.

1.9 DELIVERY, STORAGE, AND HANDLING
A. Package hardware items individually with necessary fasteners, instructions, and installation templates, when necessary; label and identify each package with door opening code to match hardware schedule.

1.10 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate Work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.
   1. Provide templates or actual hardware as required to ensure proper preparation of doors and frames.
C. Coordinate Owner’s keying requirements during course of Work.

1.11 WARRANTY
A. Uniform General Conditions of the Contract, especially paragraph 13.5.
B. Furnish minimum one year manufacturer warranty from the date of substantial completion for all hardware components specified in this section, unless noted otherwise this section. If manufacturer’s standard term of warranty exceeds this, provide manufacturer’s standard term. Coverage will include repair and replacement of all hardware at no charge to the Owner due to manufacturer defect or improper installation.
C. Furnish minimum ten year manufacturer warranty from the date of substantial completion for door closers specified in this section. If manufacturer’s standard term of warranty exceeds this, provide manufacturer’s standard term.
D. Furnish minimum five year manufacturer warranty from the date of substantial completion for panic hardware specified in this section. If manufacturer’s standard term of warranty exceeds this, provide manufacturer’s standard term.

1.12 MAINTENANCE MATERIALS
A. Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Furnish special wrenches and tools applicable for each different and for each special hardware component.
C. Furnish maintenance tools and accessories supplied by hardware component manufacturer.
2.1 SUSTAINABILITY CHARACTERISTICS

A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.

2.2 DOOR HARDWARE

A. Manufacturers:
   1. ABH - [www.abhmfg.com](http://www.abhmfg.com)
   2. Assa - [www.assalock.com](http://www.assalock.com)
   4. Bommer Industries, Inc. - [www.bommer.com](http://www.bommer.com)
   5. Corbin-Russwin - [www.corbinrusswin.com](http://www.corbinrusswin.com)
   6. Falcon - [www.falconlock.com](http://www.falconlock.com)
   7. Hager Companies - [www.hagerco.com](http://www.hagerco.com)
   8. Ives - [professional.iveshardware.com](http://professional.iveshardware.com)
   10. Pemko - [www.pemko.com](http://www.pemko.com)
   11. Precision Hardware - [www.precisionhardware.com](http://www.precisionhardware.com)
   12. Sargent - [www.sargentlock.com](http://www.sargentlock.com)
   13. Schlage Lock Co. - [www.schlage.com](http://www.schlage.com)
   14. Trimco - [www.trimcobbw.com](http://www.trimcobbw.com)
   15. Von Duprin, Inc. - [www.vonduprin.com](http://www.vonduprin.com)
   16. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

B. Hinge Manufacturers:
   1. Hager.
   2. Ives.
   3. ABH.
   4. Bommer.
   5. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

C. Lockset, Latch Set, and Cylinder Manufacturers:
   1. Schlage, ND, Athens lever style, as design basis.
   2. Falcon.
   5. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

D. Exit Device Manufacturers:
   1. Von Duprin, Series 55 as design basis.
   2. Sargent.
   3. Substitutions: Section 01 60 00 - Product Requirements.

E. Cylinder Manufacturers:
   1. Schlage, IC as design basis.
   2. Falcon.
   4. Best.
   5. ASSA.
   7. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

F. Push/Pulls, Manual and Automatic Bolts, Protection Plates, Gaskets, Thresholds, and Trim Manufacturers:
   1. Ives.
2. Hager.
3. National Guard Products
4. Pemko.
5. Trimco/BBW.
6. ABH.
7. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.3 COMPONENTS
A. General Hardware Requirements: Where not specifically indicated, comply with applicable ANSI A156 standard for type of hardware required. Furnish each type of hardware with accessories as required for applications indicated and for complete, finished, operational doors.
   1. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently in advance to avoid delay in Work.
   2. Reinforcing Units: Furnished by door and frame manufacturers; coordinated by hardware supplier or hardware manufacturer.
   3. Fasteners: Furnish as recommended by hardware manufacturer and as required to secure hardware.
      a. Finish: Match hardware item being fastened.
B. Hinges: ANSI A156.1, full mortise type, template type, ANSI A156.7, complying with following general requirements unless otherwise scheduled.
   1. Widths: Sufficient to clear trim projection when door swings 180 degrees.
   2. Number: Furnish minimum three hinges to 90 inches high, four hinges to 120 inches high for each door leaf.
   3. Size and Weight: 4-1/2 inch heavy weight typical for 1-3/4 inch doors.
      a. Doors Over 40 inches Wide: Extra heavy weight ball or oilite bearing hinges.
   4. Pins: Furnish nonferrous hinges with non-removable pins (NRP) at exterior and locked outswinging doors, non-rising pins at interior doors.
   5. Tips: Flat button with Flush tips.
C. Locksets: Furnish locksets compatible with specified cylinders. Typical 2-3/4 inch backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt verify type of cutouts provided in metal frames.
   1. Bored (Cylindrical) Locksets: ANSI A156.2, Series 4000, Grade 1 unless otherwise indicated.
D. Latch Sets: Match locksets. Typical 2-3/4 inch backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt verify type of cutouts provided in metal frames.
   1. Bored (Cylindrical) Latch Sets: ANSI A156.2, Series 4000, Grade 1 unless otherwise indicated.
E. Cylinders: ANSI A156.5, Grade 1, 6 pin type interchangeable core cylinders.
   1. Keying: Keyed as directed by Owner.
   2. Include construction keying.
   4. Supply keys in the following minimum quantities:
      a. 5 master keys.
      b. 3 grand master keys.
      c. 3 control keys.
      d. 2 change keys for each bitting.
F. Manual and Automatic Bolts: ANSI A156.16 Grade 1 top and bottom flush bolts, with dust-proof floor strike, unless otherwise indicated.
G. Kickplates Door Edging: ANSI A156.6, metal; height indicated in Schedule by 2 inches less than door width; minimum 0.050 inch thick stainless steel.
H. Weatherstripping: Furnish continuous weatherstripping at top and sides of exterior doors.
   1. Acoustical Gaskets: Furnish continuous gaskets at top and sides of doors as scheduled.
I. Thresholds: Maximum 1/2 inch height.
J. Wall Stops: ANSI A156.1, Grade 1, 2-1/2 inch wall stop concave pad wall stop with visible screws.
K. Floor Stops: ANSI A156.1 Grade 1 dome type and door holder and strike cast; furnish with accessories as required for applications indicated.
2.4 ACCESSORIES
A. Lock Trim: Furnish levers with rose plate as selected from manufacturer's full range of levers and roses.
   1. Do not permit through bolts on solid wood core doors.
B. Through Bolts: Do not permit through bolts and grommet nuts on door faces in occupied areas unless no alternative is possible.
   1. Do not use through bolts on solid wood core doors.
C. Key Cabinet:
   1. Cabinet Construction: Sheet steel construction, piano hinged door with cylinder type lock master keyed to building system.
   2. Cabinet Size: Size for Project keys plus sufficient room to allow for 10 percent growth.
   3. Horizontal strips for key hook labeling with clear plastic strip cover over labels.
   4. Finish: Baked enamel finish, color as selected.

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*Where indicated 630 finish, core metal shall be stainless steel.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Verify doors and frames are ready to receive door hardware and dimensions are as instructed by manufacturer.

3.2 INSTALLATION
A. Coordinate mounting heights with door and frame manufacturers. Use templates provided by hardware item manufacturer.
B. Mounting Heights From Finished Floor to Center Line of Hardware Item: Comply with manufacturer recommendations and applicable codes where not otherwise indicated.
   1. Locksets: 38 inch.
   2. Push/Pulls: 42 inch.
   3. Dead Locks: 48 inch.
   4. Top Hinge: Jamb manufacturer’s standard, but not greater than 10 inches from head of frame to center line of hinge.
   5. Bottom Hinge: Jamb manufacturer’s standard, but not greater than 12-1/2 inches from floor to center line of hinge.
   6. Intermediate Hinges: Equally spaced between top and bottom hinges and from each other.
   7. Hinge Mortise on Door Leaf: 1/4 inch. to 5/16 inch from stop side of door.

3.3 FIELD QUALITY CONTROL
A. Supplier shall inspect installation and certify hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified. Contractor shall correct all items noted by inspector.
### 3.4 Adjusting

A. Adjust hardware for smooth operation.
B. Make adjustments and corrections as required by Supplier recommendation following inspection.

### 3.5 Protection of Installed Construction

A. Uniform General Conditions of the Contract, especially paragraph 3.3.
B. Do not permit adjacent work to damage hardware or hardware finish.
C. The contractor shall use all means at his disposal to protect all finish hardware items from abuse, corrosion and other damage until the owner accepts the project as complete.

### 3.6 Hardware Schedule

#### HARDWARE GROUP NO. 001
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Balance of hardware specified in Section 08 4113

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<td>FLOOR STOP</td>
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Balance of hardware specified in Section 08 4113

END OF SECTION 08 7100
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Glass glazing for metal frames, doors, windows, and glazed walls.
   2. Glass glazing materials and installation requirements are included in this section for other sections referencing this section.

1.2 RELATED SECTIONS:
A. Section 07 27 26 - Fluid Applied Weather Barriers.
B. Section 07 9000 - Joint Protection: Sealant and back-up material other than glazing sealants.
C. Section 08 0152.91 - Wood Window Restoration.
D. Section 08 4113 - Aluminum-Framed Entrances and Storefronts.

1.3 REFERENCES
A. American Society of Civil Engineers:
B. ASTM International:
C. Consumer Products Safety Commission:
D. Glass Association of North America:
   1. GANA - Sealant Manual.
E. National Fenestration Rating Council Incorporated:
   1. ANSI/NFRC 100 - Procedures for Determining Fenestration Product U-Factors.

1.4 PRE-INSTALLATION MEETING
A. Convene minimum one week before starting Work of this section. Schedule to coincide with regular progress meetings.
B. Required Attendees: General Contractor, Glass installer, Architect.
C. Hold meeting in conjunction with pre-installation meeting for Section 08 4113.
D. Notify Architect/Engineer four days in advance of meeting date.
1.5 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data:
   1. Glass: Provide structural, physical, and thermal and solar optical performance characteristics, size limitations, special handling or installation requirements.
   2. Glazing Sealants, Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors where exposed.
C. Shop Drawings: Signed and sealed by professional engineer.
   1. Indicate sizes, layout, thicknesses, and loading conditions for glass.
D. Samples:
   1. Colored/Textured glass or plastic: If the contractor submits a manufacturer other than the one specified for color, submit set of 4x6 inch glass samples for color selection.
   2. Glass: Submit two samples 6x8 inch minimum in size, illustrating each insulated glass assembly.
   3. Glass: Submit two samples 6x8 inch minimum in size, illustrating each type of specialty glass or plastic units, illustrating textures, coloration and design.
E. Manufacturer's Certificate: Certify sealed insulating glass, meets or exceeds specified requirements.
F. Installer's Certificate: Certify glass furnished without identification label is installed in accordance with Construction Documents and applicable code.
G. Design Data: Signed and sealed by professional engineer.
   1. Submit design calculations for glass thicknesses.

1.6 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resource Certificates:
      a. Certify recycled material content for recycled content products.
   2. Indoor Air Quality Certificates:
      a. Certify volatile organic compound content for each interior adhesive and sealant and related primer.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.7 QUALITY ASSURANCE
A. Perform Work in accordance with GANA Glazing Manual, GANA Sealant Manual, for glazing installation methods.

1.8 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.
B. Installer: Company specializing in performing Work of this section with minimum three years experience and approved by manufacturer.
C. Design glass under direct supervision of Professional Engineer experienced in design of this Work and licensed in the state of Texas.

1.9 MOCKUP
A. Section 8.4 of the Uniform General Conditions of the Contract.
   1. Mock-up in conjunction with mock-up specified for Storefront Systems specified in section 08 4113.
B. Mock-up Locations:
   1. Locate at south side, west end of Visitors Center, SF-9 from the masonry wall to the west to the vertical mullion on the west side of door 203, floor to underside of roof.
2. Locate within mock-up required by Section 04 2000.
C. The mock-ups will be tested under provisions in Field Quality Control of this Section.
D. Accepted mockup in the building construction may be incorporated as completed Work.

1.10 ENVIRONMENTAL REQUIREMENTS
A. Do not install glazing when ambient temperature is less than 50 degrees F.
B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.11 WARRANTY
A. Uniform General Conditions of the Contract, especially paragraph 13.5.
B. Furnish five year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. Provide glass and glazing materials for continuity of building enclosure vapor retarder and air barrier:
   1. In conjunction with materials described in Section 07 27 26, and 07 90 00.
   2. Utilize inner pane of multiple pane sealed units for continuity of air barrier and vapor retarder seal.
   3. Maintain continuous air barrier and vapor retarder throughout glazed assembly from glass pane to heel bead of glazing sealant.
   4. Vertical Glass: 8 lites per 1000 for wind loads with 3 seconds maximum load duration.
B. Structural Design: Design in accordance with applicable code or values indicated in the design criteria in the structural drawings, whichever is greater, for most critical combination of wind, snow, seismic, and dead loads.
C. Wind Loads: Design and size glass to withstand positive and negative wind loads acting normal to plane of wall, including increased loads at building corners.
   1. Design Wind Load: As calculated in accordance with applicable code and ASCE 7 with basic wind speed and exposure as indicated in structural design criteria in the drawings.
D. Wind-Borne Debris Loads: Design and size glass located less than 60 feet above grade to withstand the following loads:
   2. Glass Greater than 30 feet above Grade: ASTM E1886 and ASTM E1996; small missile impact test.
E. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable code.
F. Deflection:
   1. Glass Edge Deflection: Framing shall limit deflection at the edge of glass perpendicular to the glass pane shall not exceed 1/175 of glass edge length or 3/4 inch, which ever is less with full recovery of glazing materials.
   2. Glass Center Relative to Glass Edges at 50 percent of Design Pressures: Maximum 1 inch.
   4. Interior Glass Deflection: Maximum differential deflection for two adjacent unsupported edges when 50 plf force is applied to one panel at any point up to 42 inches above finished floor less than thickness of glass.
G. Thermal and Solar Optical Performance: Measured or calculated in accordance with the following:
   1. Maximum U-Values: Comply with ICC IECC for climate zone in which project is located, or stated for specific glazing in this specification, whichever is lower. Measure in accordance with NFRC 100.
2. Maximum SHGC: Comply with ICC IEEC for climate zone in which project is located, or stated for specific glazing in this specification, whichever is lower. Measure in accordance with NFRC 200.

2.2 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.
C. Indoor Environmental Quality Characteristics:
   1. Interior Adhesives: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
   2. Interior Sealants and Sealant Primers: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.

2.3 FLOAT GLASS MANUFACTURERS
A. Float Glass Manufacturers:
   1. Guardian Industries Corp. as basis of design.
   2. AGC Flat Glass North America
   3. Oldcastle BuildingEnvelope
   4. Pilkington North America, Inc.
   5. Virto
   6. Viraco, Inc.
   7. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.4 FLOAT GLASS MATERIALS
A. Annealed Glass:
   1. Transparent, flat.
   2. Quality Q3.
   3. Type: Float glass.
   4. Comply with ASTM C1036, Type 1.
   5. Furnish annealed glass except where heat strengthened or tempered glass is required to meet specified performance requirements.
B. Heat Strengthened Glass:
   1. Transparent, flat.
   2. Quality Q3.
   3. Type: HS, Heat Strengthened.
   5. Comply with ASTM C1048, Type 1.
   6. Furnish heat strengthened glass where annealed glass cannot meet specified performance requirements.
C. Tempered Glass: ASTM C1048, Type 1 transparent flat, Quality Q3, Kind FT fully tempered, Condition A uncoated, float glass with horizontal tempering.
   1. Transparent, flat.
   2. Quality Q3.
   3. Type: FT, Fully Tempered.
   5. Tempering: Horizontal.
   6. Comply with ASTM C1048, Type 1.
   7. Furnish tempered glass where heat strengthened glass cannot meet specified performance requirements.
   8. Furnish tempered glass where safety glass is required by applicable code and as indicated on Drawings. Tempered glass shall conform to CPSC 16 CFR 1201 Category II, or Category I in accordance with requirements of size, location and use as required by the applicable code.
D. Clear Glass: Annealed, Heat strengthened, and Tempered float glass as specified; Class 1 clear.
1. Clear annealed glass (FG-CA).
2. Clear heat strengthened glass (FG-CH).
3. Clear tempered glass (FG-CT).
5. Visible Light Transmittance: 89 percent minimum.
6. Visible Light Reflectance (maximum): 8% Ext., 9% Int.
7. Solar Heat Gain Coefficient: 0.82 maximum.
8. Light to Solar Gain: 0.84 minimum.

E. Tinted Glass: Annealed, Heat strengthened, and Tempered float glass as specified; Class 2 tinted.
1. Minimum Thickness: 1/4 inch.
2. Green Tinted Glass:
   b. Tinted heat strengthened glass (FG-TH-G).
   c. Tinted tempered glass (FG-TT-G).
   d. Visible Light Transmittance: 52 percent minimum.
   e. Visible Light Reflectance (maximum): 9% Ext., 12% Int.
   f. Solar Heat Gain Coefficient: 0.24 maximum.
   g. Light to Solar Gain: 2.13 minimum.
   h. Guardian; Green as basis of design.
   i. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

F. Low E Glass: Triple Silvered Annealed, Heat strengthened, and Tempered float glass as specified; Class 1 clear and Class 2 tinted.
1. Minimum Thickness: 1/4 inch.
2. Coating: ASTM C1376; vacuum deposited.
   a. SNX 62/27 manufactured by Guardian, or approved equal.
3. Green Tinted Low E Triple Silvered Glass:
   b. Light Green Tinted Low E triple silvered heat strengthened glass (FG-ETH-G-TS).
   c. Light Green Tinted Low E triple silvered tempered glass (FG-ETT-G-TS).
   d. Manufacturer-Product:
      1) Guardian; Green.

G. Acid Etched Glass: Annealed, Heat strengthened, and Tempered float glass as specified; Class 1 clear before etching.
1. Frosted annealed glass (FG-FA).
2. Frosted heat strengthened glass (FG-FH).
3. Frosted tempered glass (FG-FT).
4. Minimum Thickness: 1/4 inch unless otherwise indicated.
5. Visible Light Transmittance: 84 percent minimum.
7. Acid etch heat strengthened and tempered glass prior to heat treating.

2.5 INSULATING GLASS PRODUCTS
A. Insulating Glass Manufacturers:
1. Guardian Industries Corp. as basis of design
2. AGC Flat Glass North America
3. Oldcastle BuildingEnvelope
4. Pilkington North America, Inc.
5. PPG/Vitro (design basis)
6. Viracon, Inc.
7. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

B. Insulating Glass: ASTM E2190 certified by Insulating Glass Certification Council and Insulating Glass Manufacturers Alliance;
1. Purge interpane space with dry hermetic air.
2. Total Unit Thickness: 1 inch.
3. Insulating Glass Unit Edge Seal Construction:
   a. Stainless steel, bent and spot welded corners.
   b. Polyisobutylene sealant primary seal.
   c. Silicone sealant secondary seal.

C. Double Pane Green Tinted Triple Silvered Insulating Vision Glass (IG-DP-T-G-TS):
1. Total Unit Thickness: 1 inch.
2. Outer Pane: Glass Type FG-ETA-G-TS, FG-ETH-G-TS, or FG-ETT-G-TS, Low E coating on #2 surface, as scheduled and/or required by code.
   a. Green tinting.
3. Inner Pane: Glass Type FG-CA, FG-CH, or FG-CT as scheduled and/or required by code.
4. Visible Light Transmittance: 52% minimum.
5. Visible Light Reflectance: 9% Ext., 12% Int. maximum.
6. U-Factor Winter: 0.29 maximum.
7. Solar Heat Gain Coefficient: 0.24 maximum.

D. Double Pane Green Tinted Triple Silvered Insulating Vision Glass with Frosted Inner Pane (IG-DP-T-GF-TS):
1. Total Unit Thickness: 1 inch.
2. Outer Pane: Glass Type FG-ETA-G-TS, FG-ETH-G-TS, or FG-ETT-G-TS, Low E coating on #2 surface, as scheduled and/or required by code.
   a. Green tinting.
3. Inner Pane: Glass Type FG-FA, FG-FH, or FG-FT as scheduled and/or required by code.
4. Visible Light Transmittance: 52% minimum.
5. Visible Light Reflectance: 9% Ext., 12% Int. maximum.
6. U-Factor Winter: 0.29 maximum.
7. Solar Heat Gain Coefficient: 0.24 maximum.

2.6 GLAZING SEALANTS
A. Elastomeric Glazing Sealants: Materials compatible with adjacent materials including glass, insulating glass seals, and glazing channels.
   1. As specified in Section 07 9000.
B. Glazing Putty:
   1. Glazing Putty: Oil and resin base caulking compound, hardening type; knife grade consistency; manufacturer's standard white color.
C. Dense Gaskets: Resilient extruded shape to suit glazing channel retaining slot; black color.
   2. EPDM: ASTM C864.
D. Soft Gaskets: ASTM C509; resilient extruded shape to suit glazing channel retaining slot; black color.
   1. Neoprene.
   2. EPDM.
E. Pre-Formed Glazing Tape: Size to suit application.
   1. Preformed butyl compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; coiled on release paper; black color.
      a. Butyl Corner Sealant: ASTM C920 single component non-skinning butyl compatible with glazing tape; color to match tape.

2.7 GLAZING ACCESSORIES
A. Setting Blocks: Elastomeric material recommended by glass manufacturer, 80 to 90 Shore A durometer hardness, length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
B. Spacer Shims: Elastomeric material recommended by glass manufacturer, 50 to 60 Shore A durometer hardness, minimum 3 inch long x one half the height of glazing stop x thickness to suit application, self adhesive on one face.
C. Glazing Clips: Manufacturer's standard type.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify openings for glazing are correctly sized and within acceptable tolerance.
B. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION
A. Clean contact surfaces with solvent and wipe dry.
B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
C. Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION
A. Perform installation in accordance with GANA Glazing Manual.
B. Exterior Dry Method (Gasket Glazing):
   1. Cut glazing gasket to length; install on glazing pane. Seal corners by butting tape and sealing junctions with compatible butyl sealant.
   2. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
   3. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
   4. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
C. Interior Dry Method (Tape and Tape) Installation:
   1. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
   2. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
   3. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
   4. Place glazing tape on free perimeter of glazing in same manner described above.
   5. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

3.4 CLEANING
A. Uniform General Conditions of the Contract, especially paragraph 3.3.9.
B. Remove glazing materials from finish surfaces.
C. Remove labels after Work is complete.
D. Clean glass and adjacent surfaces.

3.5 PROTECTION OF INSTALLED CONSTRUCTION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.
B. After installation, mark pane with an 'X' by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.

3.6 SCHEDULE
A. Exterior Storefronts and Entrances:
   1. Type IG-DP-TG-TS tinted, exterior dry method at the Visitors Center Building.
   2. Type IG-DP-TG-F-TS tinted with frosted inner pane, exterior dry method at the Visitors Center Building.
B. Interior Storefronts and Entrances:
   1. Type FG-CA, FG-CH, and FG-CT, as indicated or required by code, interior dry method.
C. Exterior Wood Windows at Section House:
1. FG-CA, FG-CH, and FG-CT as required by code to replace broken or damaged panes removed.
2. Install of replacement and reinstalled panes with Glazing Putty and Clips.
D. Reference Drawings for more information.

END OF SECTION 08 8000

THE CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS, SYSTEMS, EQUIPMENT, ITEMS, ARTICLES, OPERATIONS, AND/OR METHODS LISTED, IMPLIED, MENTIONED, OR SCHEDULED IN THE CONTRACT DOCUMENTS AND/OR NECESSARY AND/OR REQUIRED FOR THE SATISFACTORY COMPLETION OF THE WORK.

THE LISTING OF WORK, REQUIREMENTS, AND PRODUCTS IN THIS SECTION IS NOT INTENDED TO BE CONCLUSIVE. THE CONTRACTOR SHALL CHECK ALL OTHER PARTS OF THE CONTRACT DOCUMENTS AND SHALL PROVIDE ALL MISCELLANEOUS ITEMS OF WORK AND PRODUCTS NECESSARY FOR THE SATISFACTORY COMPLETION OF THE WORK DESCRIBED IN THE CONTRACT DOCUMENTS.
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
1. Gypsum board, joint treatment, and finishing.
2. Tile backer board.
B. Related Requirements:
1. Section 06 1000 - Rough Carpentry: Building wood framing system, wood blocking for support.
2. Section 07 2116 - Blanket Insulation: Acoustic and Thermal insulation.
4. Section 08 1213.13 - Standard Hollow Metal Frames.
5. Section 08 4113 - Aluminum-Frame Entrances and Storefronts: Abutting aluminum framing.
6. Section 09 3000 - Tiling: Tile applied to panels of this section.
7. Section 09 9000 - Painting and Coating.
8. Section 10 2219 - Demountable Partitions.
9. Section 10 2800 - Toilet, Bath and Laundry Accessories.
10. Division 23 - Mechanical Penetration.
11. Division 26 - Electrical Penetrations.

1.2 REFERENCE STANDARDS
A. ASTM International:
2. 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.
5. ASTM C1396/C1396M - Standard Specification for Gypsum Board.
B. Gypsum Association:
1. GA 216 - Recommended Levels of Gypsum Board Finish.
2. GA 216 - Application and Finishing of Gypsum Board.
C. South Coast Air Quality Management District:
1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit data on metal framing and trim accessories, gypsum board, backer boards, joint tape, joint and finish compounds.
C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.4 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate:
1. Certify products meet or exceed specified sustainable design requirements.
2. Materials Resources Certificates:
   a. Certify recycled material content for recycled content products.
3. Indoor Air Quality Certificates:
a. Certify volatile organic compound content for each interior adhesive and sealant and related primer.

b. Certify volatile organic compound content for each ceiling and wall system.

C. Product Cost Data:
   1. Submit cost of products to verify compliance with Project sustainable design requirements.
   2. Exclude cost of labor and equipment to install products.
   3. Provide cost data for the following products:
      a. Products with recycled material content.

1.5 QUALITY ASSURANCE
A. Perform Work in accordance with GA-214, GA-216, and GA-600.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.
B. Installer: Company specializing in performing Work of this section with minimum five years experience.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
B. Store materials according to manufacturer instructions.
C. Protection:
   1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
   2. Provide additional protection according to manufacturer instructions.

1.8 AMBIENT CONDITIONS
A. Maintain temperature at not less than 40 degrees F for the mechanical application of gypsum board unless otherwise recommended by manufacturer.
B. Maintain temperature at not less than 50 degrees F for the adhesive application of gypsum board, and for field finishing and texturing, unless otherwise recommended by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Gypsum Board Manufacturer List:
   1. American Gypsum.
   2. CertainTeed.
   5. Pabco Gypsum
   6. United States Gypsum Co.
   7. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.2 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.
C. Indoor Environmental Quality Characteristics:
   1. Interior Adhesives: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
   2. Interior Sealants and Sealant Primers: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
2.3 MATERIALS

A. Gypsum Board Materials: ASTM C1396/C1396M.
   1. Interior Gypsum Board (non-perimeter walls) and Fire Rated Gypsum Board: 1/2 inch thick, maximum available length in place; ends square cut, tapered edges; Type X.
      a. American Gypsum; Firebloc Type X Gypsum Board.
      b. CertainTeed; Type X Drywall.
      c. Georgia-Pacific; ToughRock Fireguard X Gypsum Board, paper facing.
      d. National Gypsum; Gold Bond Fire-Shield X
      e. Pabco Gypsum; Flame Curb Type X.
      g. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

   2. Interior Perimeter Wall Gypsum Board: 1/2 inch thick, glass mat faced, maximum available length in place; ends square cut, tapered edges.
      a. CertainTeed; Diamondback Glasroc Tile Backer Type X.
      b. Georgia-Pacific; DensArmor Plus Fireguard High-Performance Interior Panel, glass fiber mat facing, ASTM C1658
      c. National Gypsum; Gold Bond eXP Interior Extreme Gypsum Panel.
      d. United States Gypsum Co.; Glass-Mat Panels Mold Tough Firecode X.
      e. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

   3. Moisture Resistant Gypsum Board: 1/2 inch thick Type X, maximum available length in place; ends square cut, tapered edges.
      a. CertainTeed; Diamondback Glasroc Tile Backer Type X.
      b. Georgia-Pacific; Dens Shield Tile Backer Board.
      c. National Gypsum; Gold Bond eXP Tile Backer.
      d. United States Gypsum Co.; Fiberock Tilebacker Board.
      e. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

   4. Tile Backer Board: Glass Mat Gypsum.
      a. Comply with ASTM C1178/C1178M.
      b. Thickness: 1/2 inch.
      c. Length: Maximum available in place.
      d. Ends: Square cut.
      e. Edges: Tapered.
      f. Face: Moisture-resistant fiberglass mat, acrylic-coated water barrier.
      g. Mold resistant.
      h. Manufacturers:
         1) CertainTeed; Diamondback Tile Backer.
         2) Georgia-Pacific; DensShield Tile Backer Board.
         3) National Gypsum: Gold Bond eXP Tile Backer.
         4) United States Gypsum Co.; Durock Glass-Mat Tile Backerboard.
         5) United States Gypsum Co.; Fiberock Gypsum Tilebacker Board.

2.4 ACCESSORIES

A. Acoustic Insulation: As specified in Section 07 2116.
B. Acoustic Sealant:
   1. Wall insulation as specified in Section 07 9000.
   2. Under Track Isolation Strip: Kinetics Noise Control Model RWS.
C. Gypsum Board Accessories: ASTM C1047; metal; corner beads, edge trim, and expansion joints.
   1. Metal Accessories: Galvanized steel.
      a. Corner Beads:
         1) External Corners: United States Gypsum Co., Dur-A-Bead Metal Corner Bead or equal.
         2) Internal Corners: United States Gypsum Co., Sheetrock Flex Metal Tape or equal metal reinforced tape.
b. Edge Trim: GA-216; Type 200-A by United States Gypsum Co. or equal.

c. Control Joints: United States Gypsum Co. 093 or equal.

D. Joint Materials: GA-216; reinforcing tape, joint compound, and water.

E. Ensure joint and finish compounds are compatible with and recommended by the manufacturer for the specific product on which they will be applied.

F. Anchorage to Substrate: Type and size to suit application.

G. Seismic Bracing: As required for seismic performance requirements.


I. Gypsum Board Screws: ASTM C954 for screws attaching to studs 0.033 inch thick or greater and ASTM C1002 where attaching to studs less than 0.033 inch thick and wood studs; length to suit application.

1. Screws for Wood Framing: Type W.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify site conditions are ready to receive work and opening dimensions are as instructed by manufacturer.

B. Verify that rough-in utilities are in place.

C. Verify that opening dimensions are as indicated on Shop Drawings and/or instructed by manufacturer.

3.2 DEMOLITION

A. Extend existing gypsum board installations using materials and methods as specified.

B. Repair and remodel existing gypsum board assemblies which remain or are to be altered.

3.3 INSTALLATION

A. Gypsum Board Installation:

1. Install gypsum board in accordance with ASTM C840, GA-216, and GA-600.

2. Erect single layer fire rated gypsum board vertically, with edges and ends occurring over firm bearing.

3. Fasteners:

   a. Use screws when fastening gypsum board to wood furring or framing.

4. Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum soffit board and sheathing with sealant.

5. Control Joints:

   a. Place control joints consistent with lines of building spaces.

   b. Space at maximum of 30 feet both horizontally and vertically, and as shown on drawings.

   c. Place vertical joints above, and below if applicable, at edges of all door frames and windows.

   d. At other locations indicated in the drawings.

6. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

7. Install J moulding at all conditions where drywall meets CMU or Brick.

   a. Leave 1/4 inch gap between end of drywall and CMU or brick. Apply backer rod and sealant in accordance with section 07 9000 to seal the gap.

B. Joint Treatment:

1. Gypsum wall, fur down, and ceiling finishes shall be smooth.

   a. All panels scheduled to be exposed and unpainted shall be finished to a minimum GA-214 Level 1.

      1) All joints and interior angles shall have tape embedded in joint compound. Tool marks and ridges are acceptable.

   b. All panels scheduled as a substrate for tile shall be finished to a minimum GA-214 Level 2.

      1) All joints and interior angles shall have tape embedded in joint compound and wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles.
2) Fastener heads and accessories shall be covered with a coat of joint compound.
3) Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.
4) Joint compound applied over the body of the tape at the time of tape embedment shall be considered a separate coat of joint compound and shall satisfy the conditions of this level.
5) All joints and interior angles shall have tape embedded in joint compound and three separate coats of joint compound applied over all joints, angles, fastener heads and accessories.

c. All panels scheduled for exposed painted surfaces shall be finished to GA-214 Level 5.
   1) All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles.
   2) Two separate coats of joint compound shall be applied over all flat joints and one separate coat of joint compound shall be applied over interior angles.
   3) Fastener heads and accessories shall be covered with three separate coats of joint compound.
   4) A thin skim coat of joint compound trowel applied, or a material manufactured especially for this purpose and applied in accordance with manufacturer's recommendations, applied to the entire surface.
   5) The surface shall be smooth and free of tool marks and ridges.

2. Feather coats on adjoining surfaces such that maximum camber is 1/32 inch

3.4 TOLERANCES
   A. Maximum Variation of Finished Gypsum Board Surface from Flat Surface: 1/8 inch in 10 feet in any direction.

3.5 PROTECTION
   A. Uniform General Conditions of the Contract, especially paragraph 3.3.
   B. Protect gypsum board installations and finish from damage and deterioration until date of Substantial Completion.

END OF SECTION 09 2116
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Porcelain tile for wall applications.
   2. Ceramic accessories.
B. Related Requirements:
   1. Section 07 9000 - Joint Protection: Sealing of joints between tile and other Work.
   2. Section 09 2116 - Gypsum Board Assemblies: Wall substrate.

1.2 REFERENCE STANDARDS
A. American National Standards Institute:
   1. ANSI A108.5 - Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
   2. ANSI A108.10 - Installation of Grout in Tilework.
   3. ANSI A118.1 - Standard Specifications for Dry-Set Cement Mortar.
   4. ANSI A118.4 - Standard Specifications for Modified Dry-Set Cement Mortar.
   5. ANSI A118.6 - Standard Specifications for Standard Cement Grouts for Tile Installation.
B. Scientific Certification Systems:
   1. SCS EC10.2 - Environmental Certification Program: Indoor Air Quality Performance.
C. South Coast Air Quality Management District:
   1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.
D. The Tile Council of North America:

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit manufacturer information regarding tile, mortar, grout.
C. Samples:
   1. Grout: Submit manufacturer's full line of grout colors sample selector.
   2. Tile: If tile other than design basis submitted, submit two mounted samples of tile and grout on plywood panels, 24 by 24 inches in size, illustrating pattern, color variations, and grout joint size variations.
D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
E. Manufacturer Instructions: Submit instructions for using grouts.

1.4 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate:
   1. Certify that products meet or exceed specified sustainable design requirements.
   2. Materials Resource Certificates:
      a. Certify recycled material content for recycled content products.
   3. Indoor Air Quality Certificates:
      a. Certify VOC content for each interior sealant and related primer.
      b. Certify VOC content for each ceiling and wall system.
C. Product Cost Data:
   1. Submit cost of products to verify compliance with Project sustainable design requirements.
   2. Exclude cost of labor and equipment to install products.
   3. Provide cost data for following products:
      a. Products with recycled material content.
1.5 CLOSEOUT SUBMITTALS
   A. Refer to the Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
   B. Operation and Maintenance Data: Submit recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

1.6 MAINTENANCE MATERIAL SUBMITTALS
   A. Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
   B. Extra Stock Materials: Furnish 16 sq. ft. of each size, color, and surface finish of tile specified.

1.7 QUALITY ASSURANCE
   A. Perform Work according to TCA Handbook and ANSI A108 Series/A118 Series.

1.8 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
   B. Installer: Company specializing in performing Work of this Section with minimum three years' experience.

1.9 DELIVERY, STORAGE, AND HANDLING
   A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
   B. Store materials according to manufacturer instructions.
   C. Protection:
      1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
      2. Protect adhesives and grouts from freezing or overheating.
      3. Provide additional protection according to manufacturer instructions.

1.10 AMBIENT CONDITIONS
   A. Do not install adhesives and grouts in unventilated environment.
   B. Maintain ambient and substrate temperature of 50 deg. F during installation of mortar materials.

PART 2 - PRODUCTS

2.1 TILE
   A. Manufacturers:
      1. Dal Tile International as basis of design.
      3. American Tile – Distributor
      5. Florida Tile
      6. Marazzi
      7. Roca/Incepa/United States Ceramic Tile
      8. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
   B. Porcelain Wall Tile:
      1. Comply with ANSI A137.1.
      2. Product:
         a. Manufacturer: Dal Tile.
         b. Style: Severino.
         c. Color: Aria Sand SV97
         d. Size: 12x24.

2.2 SUSTAINABILITY CHARACTERISTICS
   A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
   B. Material and Resource Characteristics:
1. Recycled Content Materials: Furnish materials with maximum available recycled content.

C. Indoor Environmental Quality Characteristics:
   1. Interior Adhesives: Maximum VOC content according to SCAQMD Rule 1168.
   2. Interior Sealants and Sealant Primers: Maximum VOC content according to SCAQMD Rule 1168.
   3. Interior Tile Setting Adhesives and Grout: Maximum VOC content according to SCAQMD Rule 1168.

2.3 MATERIALS
   A. Mortar:
      1. Mortar Bond Coat Materials:
          a. Latex-Portland Cement: Comply with ANSI A118.4.
   B. Grout:
      1. Standard Grout:
          a. Latex-portland cement type according to ANSI A118.6.
          b. Color: As selected.
   C. Tile Edging:
      1. L-shaped profile with anchoring leg.
         a. Satin Nickel Anodized Aluminum
         b. Schluter-Jolly as basis of design.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify that surfaces are ready to receive Work of this Section.

3.2 PREPARATION
   A. Protect adjacent Work from damage.
   B. Vacuum clean surfaces.
   C. Seal substrate surface cracks with filler.
   D. Level existing substrate surfaces to acceptable flatness tolerances.

3.3 INSTALLATION
   A. Install tile and grout according to ANSI A108.5, A108.10 and TCNA Handbook recommendations.
   B. Pattern:
      1. Lay tile to indicated pattern.
      2. Do not interrupt tile pattern through openings.
   C. Alignment:
      1. Cut and fit tile to penetrations through tile, leaving sealant joint space.
      2. Form corners and bases neatly.
   D. Joints:
      1. Place tile with joints uniform in width, subject to variance in tolerance allowed in tile size.
      2. Make joints watertight, without voids, cracks, or excess mortar or grout.
      3. Width:
         a. Porcelain Tile: 1/16 inch.
      4. Expansion and Control Joints:
         a. Keep free of adhesive or grout.
         b. Apply sealant to joints according to TCNA Handbook Method EJ171.
   E. Angles:
      1. Internal: Square.
      2. External: Square.
   F. Install ceramic accessories rigidly in prepared openings.
      1. Install aluminum edging at vertical edges abutting dis-similar materials.
   G. Sounding:
      1. Sound tile after setting.
      2. Replace hollow sounding units.
   H. Allow tile to set for a minimum of 48 hours prior to grouting.
   I. Grouting:
1. Grout tile joints.
2. Use standard grout unless otherwise indicated.
J. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.
K. Wall Tile:
   1. Over Coated Glass Mat Water-Resistant Gypsum Backer Board:

3.4 CLEANING
   A. Uniform General Conditions of the Contract, especially paragraph 3.3.9.
   B. Clean tile and grout surfaces.

3.5 ATTACHMENTS
   A. Restroom 103, Wall:
      1. Tile: Porcelain.
         a. Size: 12 by 24 inch.
         b. Color: Chestnut Brown IP08
         a. Color: As selected
      4. Tile Edging: At vertical edges where tile abuts dissimilar material.

END OF SECTION 09 3000
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Acoustical Ceiling Panels and securement.

1.2 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Provide data on acoustical panels and fabric surface covering, trim and accessories.
C. Shop Drawings: Indicate on shop drawings reflected ceiling plans, dimensions, joint locations, frame profiles, and special anchor details.
D. Samples: Submit two samples 12x12 inches in size illustrating fabric material and finish, color, texture, edge detail and attachment hardware of acoustical panels.
E. Submit manufacturer's installation instructions under provisions of Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.

1.3 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
   2. Indoor Air Quality Certificates:
      a. Certify volatile organic compound content for each interior adhesive and sealant and related primer.
      b. Certify volatile organic compound content for each panel system.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.4 DELIVERY, STORAGE, AND PROTECTION
A. Protect acoustical panels with resilient packaging. Break seal on site to permit ventilation after ambient temperature and humidity levels are continuously maintained for Owner occupancy; do not remove packaging.

1.5 CLOSE-OUT SUBMITTALS
A. Refer to the Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Include maintenance information on regular cleaning, stain and removal.

1.6 WARRANTY
A. Provide one-year warranty under provisions of Uniform General Conditions of the Contract, especially paragraph 13.5.
B. Warranty: Include coverage of acoustical panel surface from discoloration due to cleaning, staining, fading, fabric delamination, and failure of fastening system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - ACOUSTICAL WALL SYSTEMS
A. ATS Acoustics
   1. Product: Acoustic Panels in Guilford Fabric as basis of design.
2. Substrate: Mineral Wool with 1/4" thick wood back panel.
3. Panel Size: 2-inch thick; half-bevel edge all four sides; width and heights as indicated in the drawings.
4. Surface Type: Polyester by Guilford of Maine.
5. Color: Pale Green
6. NRC Rating: Minimum, 1.0 with a Type A mounting.

B. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.2 ACCESSORIES
A. Adhesive: Construction adhesive.
B. Acoustical Cloud Installation Hardware
   1. Manufacturer's cloud installation kit with angled steel runners, anchors, cable, and fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify that ceiling surfaces are ready to receive work.
B. Beginning of installation means acceptance of existing surfaces and substrate construction.
C. Panels shall not be installed until final painting is complete on room surfaces.
D. Verify that all dust generating activities are complete prior to proceeding with sound panel installation.

3.2 INSTALLATION
A. Seal any damage to the back of the panel facing prior to installation.
B. At locations where indicated in the Drawings to adhere to underside of surface, apply construction adhesive to the back side of panels and set in place on the underside of the concrete channels as indicated in the Drawings.
   1. Support panels until adhesive is adequately set to fully support panels.
C. At all other locations, suspend panels with acoustical cloud installation hardware. Suspend with cables and anchors per manufacturer's instructions.
   1. Underside of panel should be level with the lower edge of the concrete channel legs.

3.3 CLEANING
A. Clean acoustical panels in accordance with manufacturer's recommendations.
B. Vacuum clean all sound panels immediately prior to Owner final acceptance.

3.4 SCHEDULE
A. Acoustical ceiling panels as indicated at Rooms 101, 102, 103, 104, 105, 201, 202, 203, 301, 302, 303, and 304.
B. Reference Drawings for more information.

END OF SECTION 09 5446
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes
   1. Resilient base.
B. Related Sections:
   1. Section 09 2116 – Gypsum Board Assemblies: Substrate for wall base.

1.2 REFERENCES
A. ASTM International:
B. National Fire Protection Association:
C. Scientific Certification Systems:
   1. SCS EC10.2 - Environmental Certification Program Indoor Air Quality Performance.
D. South Coast Air Quality Management District:
   1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit data describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
C. Samples: If submitting alternate product to basis for design, submit manufacturer's complete set of color samples for initial selection.
D. Installation Instructions: Submit manufacturer’s installation instructions.

1.4 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
   2. Indoor Air Quality Certificates:
      a. Certify volatile organic compound content for each interior adhesive and sealant and related primer.
      b. Certify volatile organic compound content for each base and transition system.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.5 CLOSEOUT SUBMITTALS
A. Refer to the Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.6 QUALITY ASSURANCE
A. Surface Burning Characteristics:
   1. Base Material: Class I, minimum 0.45 watts/sq cm when tested in accordance with NFPA 253.
1.7 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 ENVIRONMENTAL REQUIREMENTS
A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
B. Store materials for not less than 48 hours prior to installation in area of installation at temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.9 EXTRA MATERIALS
A. Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Furnish 25 linear feet of base or 5 percent of amount installed, whichever is greater, of each type and color specified.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.
C. Indoor Environmental Quality Characteristics:
   1. Interior Adhesives: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
   2. Interior Hard Surface Flooring: FloorScore Certified for VOC content in accordance with SCS EC 10.2.

2.2 RESILIENT BASE
A. Manufacturers:
   1. Roppe; Pinnacle as basis of design.
   2. Burke; Burke Base
   3. Flexco; Wallflowers
   4. Johnsonite; Baseworks Thermoset Rubber Wallbase.
   5. Mannington; Optimum Edge
   6. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
B. Base: ASTM F1861 Type TS - Vulcanized, Group 1 - Solid, Style B cove:
   1. Height: 4 inch.
   2. Thickness: 0.125 inch thick.
   4. Length: 4 foot sections or Roll.
   5. Accessories: Pre-molded external corners and end stops. Same material, size, and color of base.

2.3 ACCESSORIES
A. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify that surfaces are smooth and flat with a maximum variation of 1/8 inch in 10 ft. and are ready to receive work.
B. Verify lower wall surfaces are free of substances capable of impairing adhesion of new adhesive and finish materials.

3.2 PREPARATION
A. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
B. Prohibit traffic until filler is cured.
C. Vacuum clean substrate.
D. Apply primer as recommended by manufacturer or required to prevent "bleed-thru" or interference with adhesion by substances cannot be removed.

3.3 INSTALLATION - BASE
A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
B. Miter internal corners. At external corners, use pre-molded units. At exposed ends, use pre-molded units.
C. Install base on solid backing. Bond tightly to wall and floor surfaces.
D. Scribe and fit to door frames and other interruptions.

3.4 CLEANING
A. Uniform General Conditions of the Contract, especially paragraph 3.3.9.
B. Remove excess adhesive from floor, base, and wall surfaces without damage.
C. Clean, seal, and maintain resilient flooring products.

3.5 PROTECTION OF INSTALLED CONSTRUCTION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.
B. Prohibit traffic on resilient flooring for 48 hours after installation.

3.6 SCHEDULE
A. Refer to Contract Drawings and to Room Finish Schedule for locations of specified materials.

END OF SECTION 09 6513
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Epoxy terrazzo with divider strips at interior floors.
B. Related Requirements:
   1. Section 03 3000 – Cast-In-Place Concrete: Substrates.
   2. Section 04 2000 – Unit Masonry: Adjacent and abutting construction.
   3. Section 22 4200 – Plumbing Fixtures: Floor mounted fixtures over terrazzo.

1.2 REFERENCE STANDARDS
A. ASTM International:
B. National Terrazzo and Mosaic Association, Inc. (NTMA)
C. Scientific Certification Systems:
   1. SCS EC10.2 - Environmental Certification Program Indoor Air Quality Performance.
D. South Coast Air Quality Management District:
   1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit data on resins, aggregates, color selector, strip materials, and sealers.
C. Shop Drawings:
   1. Include plans, elevations, sections, component details and attachments to other work. Include terrazzo installation requirements. Show layout of the following:
      a. Divider strips.
      b. Expansion joint strips.
      c. Accessory strips.
      d. Abrasive strips.
D. Samples for Verification: Terrazzo Contractor shall prepare and submit samples for each color and pattern of terrazzo required showing the full range of color, texture and pattern variations expected.
   1. Terrazzo: Minimum 6 by 6 inch samples

1.4 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
   2. Indoor Air Quality Certificates:
      a. Certify volatile organic compound content for each:
1) Adhesive.
2) Primer.
3) Epoxy resin.
4) Sealer.

b. Certify volatile organic compound content for each flooring system.

C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
1. Provide cost data for the following products:
   a. Products with recycled material content.

1.5 CLOSEOUT SUBMITTALS
A. Refer to the Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning and sealing.

1.6 QUALITY ASSURANCE
A. Perform Work in accordance with NTMA guidelines.
B. Epoxy Resin shall meet the following performance requirements.
1. Cured test specimens shall meet or exceed the following requirements:
   a. Hardness: 60 to 85 per ASTM D 2240, Shore D.
   b. Minimum Tensile Strength: 3000 psi per ASTM D 638 for a 2-inch specimen made using a “C” die per ASTM D 412.
   c. Minimum Compressive Strength: 10,000 psi per ASTM D 695, Specimen B cylinder.
   d. Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.
      1) Distilled Water.
      2) Mineral Water.
      3) Isopropanol.
      4) Ethanol.
      5) Soap solution at 1 percent.
      6) Sodium hydroxide at 10 percent solution.
      7) Hydrochloric acid at 10 percent solution.
      8) Hydrochloric acid at 30 percent solution.
      9) Detergent Solution at 0.025.
      10) Acetic Acid at 5 percent solution.
2. Test Specimens: Mix resin materials according to manufacturer's recommendation without aggregate added and cure for 7 days at 75 degrees plus or minus 2 deg. F and 50 percent plus / minus 2 percent relative humidity.
C. Epoxy Resin with Aggregate shall meet the following performance requirements.
1. Flammability: Self-extinguishing, extent of burning 1/4 inch maximum according to ASTM D 635.
2. Coefficient of Linear Thermal Expansion: 0.0025 inch/inch per deg F for temperature range of minus 12 to plus 140 deg F per ASTM D 696.
3. Bond Strength of Epoxy Terrazzo: 300 lb. failure according to field test method for surface soundness and adhesion as described in ACI Committee No. 403 Bulletin.
4. Test Specimens:
   a. Mix epoxy resin according to manufacturer's recommendations and blend one volume of epoxy resin with 3 volumes of marble aggregate, consisting of:
      1) 60 percent No. 1 chip.
      2) 40 percent No. 0 chip.
   b. Grind and grout with epoxy resin finished to a nominal 1/4 inch thickness.
   c. Cure specimens 7 days at 75 deg. F plus/ minus 2 deg. and 50 percent plus/ minus 2 percent relative humidity.
1.7 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience and an associate member of the NTMA.
B. Installer: Company specializing in performing Work of this section with minimum five years experience and a contractor member of NTMA.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Materials shall be delivered to Project site in supplier's original wrappings and containers, labeled with source or manufacturer's name, material or product brand name, and lot number if any.
B. Materials shall be stored in their original, undamaged packages and containers, in a location where they will not be exposed to direct sunlight.
   1. Epoxy components shall be stored in a space where the ambient temperature can be maintained 60 and 90 deg. F before use.

1.9 ENVIRONMENTAL REQUIREMENTS
A. Maintain ambient and substrate temperature of 60 degrees F during installation of mortar materials.

1.10 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate terrazzo work with installation of concrete substrates and stair components.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.
C. Indoor Environmental Quality Characteristics:
   1. Interior Adhesives: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
   2. Interior Hard Surface Flooring: FloorScore Certified for VOC content in accordance with SCS EC10.2.

2.2 COMPONENTS
A. Epoxy Resin Matrix:
   1. Two-component, high solids product complying with specified performance requirements.
   2. Color: As required for mix selected.
   3. Cured test specimens shall meet or exceed the following requirements:
      a. Hardness: 60 to 85 per ASTM D 2240, Shore D.
      b. Minimum Tensile Strength: 3000 psi per ASTM D 638 for a 2-inch specimen made using a “C” die per ASTM D 412.
      c. Minimum Compressive Strength: 10,000 psi per ASTM D 695, Specimen B cylinder.
      d. Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.
         1) Distilled Water.
         2) Mineral Water.
         3) Isopropanol.
         4) Ethanol.
         5) Soap solution at 1 percent.
         6) Sodium hydroxide at 10 percent solution.
         7) Hydrochloric acid at 10 percent solution.
         8) Hydrochloric acid at 30 percent solution.
         9) Detergent Solution at 0.025.
         10) Acetic Acid at 5 percent solution.
   B. Primer: As recommended, manufactured and supplied by epoxy resin manufacturer.
   C. Aggregates: Marble.
1. Comply with NTMA gradation standards.
2. Abrasion and Impact Resistance: Loss of 40 percent or less when tested according to ASTM C 131 (LA Abrasion).
3. Aggregates shall contain no deleterious or foreign matter.

D. Divider Strips:
2. Strip Thickness: 16 gauge.
3. Type: “L” strip: 3/8 inch by 1/2 inch.
4. Heavy Top Thickness: 1/8 inch.

2.3 ACCESSORIES
A. Sealer:
1. Non-ambering, clear sealer that is chemically neutral; does not impair terrazzo aesthetics or physical properties; is recommended by terrazzo matrix manufacturer. Sealers shall comply with the following:
   a. Comply with requirements of authorities having jurisdiction.
   b. Comply with ASTM D 2047.
   c. Water Based Sealer Properties: With pH factor between 7 and 10 at interior installations.
   d. Solvent Based Sealer Properties: Flashpoint at 80 deg. F or above according to ASTM D 56 at exterior installations.
B. Moisture Mitigation: Two-component, high solids, moisture tolerant, high density, low odor, epoxy-based product produced by epoxy terrazzo resin manufacturer specifically recommended to reduce alkalinity levels and moisture emission to acceptable levels.
C. Crack Suppression/Isolation Membrane: As recommended, produced and supplied by approved terrazzo resin formulator, having minimum 120 percent elongation potential per ASTM D 412.

2.4 COLOR MIXES AND PATTERNS
A. Terrazzo Selection: Terrazzo Contractor shall provide standard terrazzo mix according to the following:
   1. NTMA Plate No. EP3-72.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Verify site conditions are ready to receive work.
   1. Slab Flatness Tolerance: Subfloor is not to vary more than 1/4 inch from true plane in a 10 foot span.
   3. Verify concrete floors are dry to maximum moisture content as recommended by manufacturer, and exhibit negative alkalinity, carbonization, and dusting.
   4. Verify floors are free of substances capable of impairing adhesion of new adhesive and finish materials.
      a. If required to prevent moisture vapor transmission in concrete substrates, the Terrazzo Contractor shall make a written recommendation to install moisture mitigation materials and include specific recommendations on type and location.

3.2 PREPARATION
A. Protect surrounding work from damage.
B. Broom clean area to receive terrazzo to remove loose chips and all foreign matter.
C. Mechanically abrade concrete surface.
D. Provide/install moisture mitigation materials according to instructions and recommendations of moisture mitigation materials manufacturer.
E. Provide/install flexible epoxy crack isolation/suppression membrane: Cost for materials and installation for not more than five percent of the floor area receiving epoxy terrazzo shall be included in the Base Bid.
3.3 INSTALLATION
   A. Strip Materials: Terrazzo Contractor shall install strip materials as follows:
      1. Divider and Control Joint Strips:
         a. Locate divider strips in locations indicated.
         b. Install control joint strips back to back in locations indicated.
         c. Install strips in epoxy adhesive without voids below strips.
         d. Accessory Strips: Install as required to provide a complete installation.
      2. Placing Terrazzo:
         a. Prime subfloor in accordance with manufacturer's recommendations.
         b. Proportion and thoroughly blend the materials.
         c. Place mixture to achieve specified thickness.
   B. Finishing: Terrazzo Contractor shall finish the terrazzo topping as follows:
      1. Rough Grinding:
         a. Grind with 24 or finer grit stones or with comparable diamond abrasives.
         b. Follow initial grind with 60/80 grit stones or with comparable diamond abrasives.
      2. Grouting:
         a. Clean terrazzo with clean water and rinse. Allow to dry.
         b. Apply epoxy grout per manufacturer's instructions.
         c. Allow grout to cure.
      3. Fine Grinding/Polishing: Grind with 120 grit or with comparable diamond abrasives until all
grount is removed from surface.
   C. Terrazzo Cleaning: Terrazzo Contractor shall clean finished terrazzo as follows:
      1. Remove grinding residue from terrazzo surface.
      2. Wash terrazzo surfaces immediately after final grinding of terrazzo flooring with water and allow
         surfaces to dry thoroughly.
   D. Sealing: Terrazzo Contractor shall seal terrazzo according to sealer manufacturer's written
      instructions.

3.4 REPAIR
   A. Terrazzo Contractor shall repair terrazzo areas that evidence lack of bond between topping and
      underbed according to NTMA's written recommendations.

3.5 PROTECTION OF INSTALLED CONSTRUCTION
   A. Uniform General Conditions of the Contract, especially paragraph 3.3.
   B. Protect the finished floor after final grinding and applied sealer to terrazzo surfaces.

3.6 Schedule
   A. Interior Floors
      1. Rooms 401 and 403.
      2. Single color mix.
      3. Reference drawings for more information.

END OF SECTION 09 6623.16
PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes surface preparation and field application of paints, stains, varnishes, and other coatings.
   B. Related Sections:
      1. Section 05 1200 – Structural Steel Framing.
      2. Section 05 5000 - Metal Fabrications: Shop primed items.
      3. Section 05 5200 - Metal Railings.
      5. Section 08 1213.13 – Standard Hollow Metal Frames.
      7. Section 09 2116 - Gypsum Board Assemblies.

1.2 REFERENCE STANDARDS
   A. ASTM International:
   B. Green Seal:
      1. GC-03 - Anti-Corrosive Paints.
      2. GS-11 - Product Specific Environmental Requirements.
   C. South Coast Air Quality Management District:
      1. SCAQMD Rule 1113 - Architectural Coatings.

1.3 DEFINITIONS
   A. Conform to ASTM D16 for interpretation of terms used in this section.

1.4 SUBMITTALS
   A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
   B. Product Data: Submit data on all finishing products and special coatings.
   C. Manufacturer's Installation Instructions: Submit special surface preparation procedures and substrate conditions requiring special attention.

1.5 SUSTAINABLE DESIGN SUBMITTALS
   A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
   B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
      1. Materials Resources Certificates:
         a. Certify recycled material content for recycled content products.
      2. Indoor Air Quality Certificates:
         a. Certify volatile organic compound content for each interior paint and coating.
   C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
      1. Provide cost data for the following products:
         a. Products with recycled material content.

1.6 CLOSEOUT SUBMITTALS
   A. Refer to the Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
   B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.
1.7 QUALITY ASSURANCE
A. Surface Burning Characteristics:
   1. Fire Retardant Finishes: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
B. Conform to the International Building Code for flame and smoke rating requirements for products and finishes.

1.8 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Applicator: Company specializing in performing work of this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING
A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.10 ENVIRONMENTAL REQUIREMENTS
A. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
B. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
D. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior; unless required otherwise by manufacturer's instructions.
E. Provide lighting level of 80 ft candle measured mid-height at substrate surface.

1.11 SEQUENCING
A. Sequence application to the following:
   1. Do not apply finish coats until paintable sealant is applied.
   2. Back prime wood trim before installation of trim.

1.12 EXTRA MATERIALS
A. Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Supply 1 gallons of each color, type, and surface texture; store where directed.
C. Label each container with color, type, texture, room locations, and date in addition to manufacturer's label.

PART 2 - PRODUCTS

2.1 PAINTS AND COATINGS
A. Manufacturers: Paint, Transparent Finishes, Stain, Primer Sealers.
   1. Sherwin Williams as basis of design.
   4. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.2 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.
C. Indoor Environmental Quality Characteristics:
   1. Interior Flat and Non-Flat Paints: Maximum volatile organic compound content in accordance with GS-11.
   2. Interior Anti-Corrosive Paints: Maximum volatile organic compound content in accordance with GC-03.

2.3 COMPONENTS
   A. Coatings: Ready mixed, except field catalyzed coatings. Prepare coatings:
      1. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
      2. For good flow and brushing properties.
      3. Capable of drying or curing free of streaks or sags.
   B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve finishes specified; commercial quality.
   C. Patching Materials: Latex filler.
   D. Fastener Head Cover Materials: Latex filler.

2.4 FINISHES
   A. Refer to schedule at end of section for surface finishes.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify surfaces and substrate conditions are ready to receive Work as instructed by product manufacturer.
   B. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.
   C. Test shop applied primer for compatibility with subsequent cover materials.
   D. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
      1. Gypsum Wallboard: 12 percent.
      2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
      3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
      4. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION
   A. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
   B. Surfaces: Correct defects and clean surfaces capable of affecting work of this section. Remove or repair existing coatings exhibiting surface defects.
   C. Marks: Seal with shellac those which may bleed through surface finishes.
   D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
   E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
   F. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply compatible sealer or primer.
   H. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
   I. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
J. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand, power tool, wire brushing or sandblasting; clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.


L. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.

M. Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.

N. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior paintable caulking compound after prime coat has been applied.

O. Metal Doors Scheduled for Painting: Prime metal door top and bottom edge surfaces.

3.3 EXISTING WORK
A. Extend existing paint and coatings installations using materials and methods compatible with existing installations and as specified.

3.4 APPLICATION
A. Apply products in accordance with manufacturer's instructions.
B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
C. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.
D. Sand wood and metal surfaces lightly between coats to achieve required finish.
E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
F. Where clear finishes are required, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.
G. Prime concealed surfaces of interior and exterior woodwork with primer paint.
H. Prime concealed surfaces of interior wood surfaces scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with thinner.
I. Finishing Mechanical And Electrical Equipment:
   1. Refer to Section 22 0553, Section 23 0601, Section 26 05 3, and Section 27 0533 for schedule of color coding and identification banding of equipment, duct work, piping, and conduit.
   2. Paint shop primed equipment.
   3. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
   4. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are shop finished.
   5. Paint interior surfaces of air ducts visible through grilles and louvers with one coat of flat black paint to visible surfaces. Paint dampers exposed behind louvers, grilles, to match face panels.
   6. Paint exposed conduit and electrical equipment occurring in finished areas.
   7. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
   8. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
   9. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.5 FIELD QUALITY CONTROL
A. Inspect and test questionable coated areas.
3.6 CLEANING
   A. Uniform General Conditions of the Contract, especially paragraph 3.39.
   B. Collect waste material which may constitute fire hazard, place in closed metal containers, and
      remove daily from site.

3.7 SCHEDULE - EXTERIOR SURFACES
   A. Steel - Shop Primed:
      1. One coat Acrylic Primer
         a. SW Pro Industrial Pro-Cryl Universal Acrylic Primer (B66-310)
            1) Min dft per coat: 2.0-4.0 mils.
            2) VOC: 96 g/L
            3) GreenGuard Gold certified.
      2. Two coats of high performance acrylic, semi-gloss.
         a. SW Sher-Cryl High Performance Acrylic Semi-Gloss (B66-350).
            1) Min dft per coat: 2.5-4.0 mils.
            2) VOC: < 200 g/L
   B. Steel – Shop Primed – Doors and Frames:
      1. Touch-up with zinc rich primer.
         a. SW Zinc Clad XI Water Based Inorganic Zinc Silicate Coating (B69V11/B69D11)
            1) Min dft per coat: 3.0-4.0 mils.
            2) VOC: 0 lb/gal
      2. Two coats of acrylic, semi-gloss.
         a. SW Pro Industrial Multi-surface Acrylic Semi-Gloss (B66-1550).
            1) Min dft per coat: 1.4 mils.
            2) VOC: 1.41 lb/gal.
   C. Steel - Galvanized:
      1. One coat galvanized metal primer.
         a. SW DTM Wash Primer (B66W1)
            1) Min Dft per coat: 2.5-5.0 mils
      2. Two coats of high performance acrylic, semi-gloss.
         a. SW Sher-Cryl High Performance Acrylic Semi-Gloss (B66-350).
            1) Min dft per coat: 2.5-4.0 mils.
            2) VOC: < 200 g/L
   D. Concrete - Painted (Opaque): Underside of Concrete Roof Channels at Visitors Center, previously
      painted.
      1. Two coats of latex enamel, satin.
         a. SW Exterior Latex Satin (A82)
            1) Min dft per coat: 1.4 mils.
            2) VOC: 0.42 lb/gal.
   E. Wood - Painted (Opaque): Siding, battens, posts, and railings at Section House.
      1. One coat of latex primer sealer.
         a. SW Latex Primer (B42)
            1) Min dft per coat: 2.5-4.0 mils.
            2) VOC: 0.64 lb/gal.
      2. Two coats of latex enamel, satin.
         a. SW Exterior Latex Satin (A82)
            1) Min dft per coat: 1.4 mils.
            2) VOC: 0.42 lb/gal.
   F. Wood - Painted (Opaque): Trim, windows, and doors at Section House.
      1. One coat of latex primer sealer.
         a. SW Latex Primer (B42)
            1) Min dft per coat: 2.5-4.0 mils.
            2) VOC: 0.64 lb/gal.
      2. Two coats of latex enamel, gloss.
         a. SW Exterior Latex Gloss (A08)
            1) Min dft per coat: 1.5 mils.
G. Wood - Painted (Opaque): Wood Deck at Section House.
   1. Two coats of acrylic enamel, slip resistant low gloss.
      a. SW ArmorSeal Tread-Plex (B90)
         1) Min dft per coat: 1.5 - 2.0 mils.
         2) VOC: 0.83 lb/gal.

3.8 SCHEDULE - INTERIOR SURFACES

A. Wood - Transparent:
   1. Filler coat (for open grained wood only).
      a. One coat of stain.
         1) SW Wood Classics Oil Stain (A49-200)
         2) Min wft per coat: 3.0 - 3.5 mils.
         3) VOC: 525 g/L
   2. One coat sanding sealer.
      a. SW Wood Classics Fast Dry Sanding Sealer (B25v43)
         1) Min dft per coat: 1.0 - 1.2 mils.
         2) VOC: 542 g/L
   3. One coat of varnish, satin.
      a. SW Wood Classics Fast Dry Oil Satin Varnish (A66-300)
         1) Min dft per coat: 1.3 mils.
         2) VOC: 496 g/L

B. Steel - Shop Primed - Doors and Frames:
   1. Touch-up with zinc rich primer.
      a. SW Zinc Clad XI Water Based Inorganic Zinc Silicate Coating (B69V11/B69D11)
         1) Min dft per coat: 3.0-4.0 mils.
         2) VOC: 0 lb/gal
   2. Two coats of acrylic, semi-gloss.
      a. SW Pro Industrial Multi-surface Acrylic Semi-Gloss (B66-1550).
         1) Min dft per coat: 2.5-4.0 mils.
         2) VOC: 1.41 lb/gal.

C. Steel - Galvanized:
   1. One coat galvanized metal primer.
      a. SW DTM Wash Primer (B66W1)
         1) Min Dft per coat: 2.5-5.0 mils
   2. Two coats of acrylic, semi-gloss.
      a. SW Pro Industrial Multi-surface Acrylic Semi-Gloss (B66-1550).
         1) Min dft per coat: 2.5-4.0 mils.
         2) VOC: 1.41 lb/gal.

D. Gypsum Board (Walls and Fur downs):
   1. One coat latex primer
      a. SW ProMar 200 Zero VOC Interior Latex Primer (B28W02600)
         1) Min dft per coat: 1.0 mils
         2) VOC: 0 g/L
         3) GreenGuard Gold Certified
   2. Two coats latex, Eg-Shel.
      a. SW ProMar 200 Zero VOC Eg-Shel Interior Latex (B20W12651)
         1) Min dft per coat: 1.7 mils.
         2) VOC: 0 g/L
         3) GreenGuard Gold Certified

3.9 COLOR SCHEDULE - EXTERIOR

A. Wood:
   1. Wood siding, battens, posts, and railings at Section House:
      a. Previously painted and/or lead abated wood:
      b. SW 7001 Marshmallow
   2. Wood trim, single hung windows, and doors at Section House:
a. Previously painted and/or lead abated wood:
  b. SW 7757 High Reflective White

3. Wood planking at entry porch of Section House:
   a. Previously painted and lead abated wood:
      b. Haze Gray

B. Concrete:
1. Roof channels at Visitors Center and pedestrian bridge:
   a. Existing Painted Concrete.
   b. SW 6434 Spinach White.
2. Cast in place concrete columns and beam, Visitors Center and roof, floor, and pedestrian bridge:
   a. Existing Painted Concrete.
   b. SW 7005 Pure White.

C. Steel structural members:
1. MC channels at Visitors Center at Head and Sill fascias of structure, and support beams of pedestrian bridge.
   a. Existing Painted Steel.
   b. SW 6444 Lounge Green.
2. MC Channels at Comfort Station at Head fascia of structure:
   a. Prime Painted Steel.
   b. SW 6444 Lounge Green.
3. HSS columns at Comfort Station:
   a. Prime Painted Steel.
   b. SW 6444 Lounge Green.

D. Hollow Metal Door Frames:
1. At Comfort Station.
   a. Primed Steel
   b. SW 6445 Garden Grove.

E. Hollow Metal Doors:
1. At Comfort Station:
   a. Primed Steel
   b. SW 6444 Lounge Green

F. Steel handrails, guardrails, and privacy entry screens:
1. Prime Painted Steel:
   a. SW colorant formula for 5 gallons pure white base.
      1) B1-Black:
         a) 2 oz, 46/32
      2) R3-Magenta:
         a) 2 oz, 63/32
      3) Y3-Deep Gold:
         a) 16 oz, 16/32, 1/64, 1/128
   2. Unprimed Steel:
      a. SW colorant formula for 5 gallons pure white base.
         1) B1-Black:
            a) 2 oz, 46/32
         2) R3-Magenta:
            a) 2 oz, 63/32
         3) Y3-Deep Gold:
            a) 16 oz, 16/32, 1/64, 1/128
   3. Previously Painted Steel:
      a. SW colorant formula for 5 gallons pure white base.
         1) B1-Black:
            a) 2 oz, 46/32
         2) R3-Magenta:
            a) 2 oz, 63/32
         3) Y3-Deep Gold:
3.10 COLOR SCHEDULE - INTERIOR

A. Wood box beams (top of partitions transition to concrete channels):
   1. Hardwood Plywood and trim.
   2. Match color and finish of casework specified in Section 06 4100.

B. Wood Cabinetry (accent panel as indicated)
   1. SW 6444 Lounge Green.

C. Hollow Metal Door Frames:
   1. Primed Steel
      a. SW 6444 Lounge Green.
   2. Previously Painted Steel
      a. SW 6444 Lounge Green.

D. Concrete:
   1. Roof channels at Visitors Center:
      a. Existing Painted Concrete.
      b. SW 6434 Spinach White.
   2. Cast in place concrete columns and beam, Visitors Center and roof:
      a. Existing Painted Concrete.
      b. SW 7005 Pure White.

E. Ceiling and Fur downs
   1. Gypsum Board.
   2. SW 6434 Spinach White.

F. Walls and Partitions Field Color
   1. Gypsum Board and unglazed masonry.
   2. SW 6434 Spinach White

G. Wall and Partitions Accent Color
   1. Gypsum Board.
   2. SW 6443 Relish
      a. Room 102: West wall.
      b. Room 103: All walls including wing wall at drinking fountain
      c. Room 104: North, South, and West walls
      d. Room 105: North and East walls.
      e. Room 302: West wall and south end of East Wall.
      f. Room 303: East wall and south end of West wall.
      g. Room 304: West and South Walls, not including fur down above demountable partition.

H. Reference Drawings for more information regarding color placement.

END OF SECTION 09 9000

THE CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS, SYSTEMS, EQUIPMENT, ITEMS, ARTICLES, OPERATIONS, AND/OR METHODS LISTED, IMPLIED, MENTIONED, OR SCHEDULED IN THE CONTRACT DOCUMENTS AND/OR NECESSARY AND/OR REQUIRED FOR THE SATISFACTORY COMPLETION OF THE WORK.

THE LISTING OF WORK, REQUIREMENTS, AND PRODUCTS IN THIS SECTION IS NOT INTENDED TO BE CONCLUSIVE. THE CONTRACTOR SHALL CHECK ALL OTHER PARTS OF THE CONTRACT DOCUMENTS AND SHALL PROVIDE ALL MISCELLANEOUS ITEMS OF WORK AND PRODUCTS NECESSARY FOR THE SATISFACTORY COMPLETION OF THE WORK DESCRIBED IN THE CONTRACT DOCUMENTS.
PART 1 GENERAL

1.1 SUMMARY
A. Section includes cast metal building plaque and signage.
B. Related Sections:
   1. Section 04 2000 – Unit Masonry: Anchorage into CMU veneer.
   2. Section 04 4213 – Masonry Supported Stone Cladding: Anchorage into stone veneer.
   3. Section 06 1000 – Rough Carpentry: Framing and blocking within mounting substrate.
   4. Section 09 2116 – Gypsum Board Assemblies: Mounting substrate.

1.2 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Owner will provide a scaled detailed layout of the Dedicatory Plaque and signage logos in manufacturer’s acceptable electronic format.
C. Shop Drawings: Indicate sign styles, lettering font, foreground and background colors, locations, overall dimensions of each sign.
D. Manufacturer’s Installation Instructions: Submit installation template and attachment devices.

1.3 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Furnish products for each sign form and graphic image process indicated from single manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING
A. Package items to avoid damage in transit and storage.
B. Inspect plaques, signs and letters upon delivery for damage and correctness.
C. Store items inside building prior to installation. Building shall be enclosed and dry.

1.5 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.

PART 2 PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers:
   2. Gemini Sign Products, USA.
   3. The Southwell Company.
   4. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.2 CAST METAL COMPONENTS
A. Dedicatory Plaques:
   1. Metal: Cast from aluminum alloy.
   2. Finish: 504, border and faces of raised letters shall be satin finish.
   3. Plaque shall be chemically cleaned and etched and treated with Alodine and sprayed with two coats of Clear Acrylic Lacquer.
   4. Size: 22" H x 16" W.
   5. Border Design: Standard Border 504, raised, single edge band, satin finish.
   7. Background: Dark oxidized background with leatherette texture.
   8. Mounting: No. 4, flush with concealed anchor for masonry walls.
   9. Text/Layout: Layout and text to be provided by Owner through the Architect at a later date.

B. Restroom and Exit Plaques:
   1. Metal: Cast from aluminum alloy.
   2. Finish: 504, border and faces of raised letters shall be satin finish.
   3. Plaque shall be chemically cleaned and etched and treated with Alodine and sprayed with two coats of Clear Acrylic Lacquer.
6. Background: Painted background with leatherette texture, color to match SW 6444 Lounge Green specified in Section 09 9000.
7. Mounting:
   a. No. 4, flush with concealed anchor for masonry walls.
   b. No. 5, oval head wood screws at gypsum partitions with wood blocking in wall.
   c. No. 3 Rosettes/Toggle bolts at existing gypsum board column.
8. Exit Sign:
   a. Size: 3" H x 6" W.
9. Exit Sign with Arrow:
   a. Size: 4\(\frac{1}{4}\)" H x 6" W
10. Restroom Signs:
    a. Size: 9" H x 6" W.
11. See Drawings for more detail on Restroom and Exit sign plaque layout and sizes.
   C. Casting of all plaques shall be free of pits and gas holes.
   D. All letters on plaques shall be sharp and hand tooled.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify substrate is acceptable and ready for acceptance of the mounting where plaques, signs, and letters are to be installed.
B. Verify that proposed installation method is compatible with substrate, and that surface is plumb, even, and within required tolerances.
C. Notify Architect of unsatisfactory mounting conditions. Do not proceed with installation until unsatisfactory mounting conditions are corrected.

**3.2 INSTALLATION**

A. Install plaques and letters in accordance with Manufacturer’s instructions.
B. Ensure plaques, signs, and letters are installed plumb, level, and square, in proper planes with related surfaces. Ensure letters are level and spaced evenly according to manufacturer’s supplied guide.
C. Clean surfaces in accordance with manufacturer’s instructions.

**3.3 SCHEDULES**

A. Dedicatory Plaques: Qty 1:
   1. Install at Room 102 on north wall.
      a. Concealed mounting.
B. Exit Signs: Qty: 2
   1. Install at Room 103 on West Wall, 18” from storefront at door 103.
      a. Wood screw mounting.
   2. Install at Room 105 on stone veneer at end of wall east of door 105.
      a. Concealed mounting.
C. Exit Signs with Arrow: Qty: 1
   1. Install at Room 203 on gypsum board column, east face.
      a. Toggle screw mounting.
D. Restroom Signs: Qty: 3
   1. Install Staff Restroom sign at Room 105 on gypsum board partition 18” west of door frame door 106.
      a. Wood screw mounting.
   2. Install Men Restroom sign at Room 404 on east wall 9” south of end of wall.
      a. Concealed mounting.
   3. Install Women Restroom at Room 405 on west wall 9” south of end of wall.
      a. Concealed mounting.
E. Reference drawings for location, layout, and other information.

END OF SECTION 10 1416
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes stainless steel toilet compartments.
B. Related Sections:
   1. Section 03 3000 - Cast-In-Place Concrete: Floor substrate.
   2. Section 04 2000 - Unit Masonry: Wall substrate.
   3. Section 09 6623.16 - Epoxy Terrazzo: Floor substrate finish.
   4. Section 10 2800 - Toilet, Bath, and Laundry Accessories.

1.2 REFERENCES
A. ASTM International:
   1. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall and floor supports, door swings.
C. Product Data: Submit data on panel construction, hardware, and accessories.
D. Samples: Submit two 4x4 inch in size illustrating panel finish, color, and sheen.
E. Manufacturer's Installation Instructions: Submit special procedures, perimeter conditions requiring special attention.

1.4 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificate:
      a. Certify recycled material content for recycled content products.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.5 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate Work with placement of support framing and anchors in wall.

PART 2 - PRODUCTS

2.1 METAL TOILET COMPARTMENTS
A. Manufacturers:
   1. Metpar, Model Corinthian as basis of design.
   2. Bradley Mills
   3. Flush Metal Partitions, LLC
   4. Hadrian
   5. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
B. Product Description: Overhead braced partitions.

2.2 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Materials and Resources Characteristics:
1. Recycled Content Materials: Furnish materials with maximum available recycled content.

### 2.3 COMPONENTS

A. Toilet Compartments: Stainless-steel panels, doors, and pilasters, ceiling-hung partitions.

B. Doors, Panels, and Pilasters: ASTM A666, Type 304; sheet steel faces, pressure bonded to sound-deadening core, formed and closed edges, mitered and welded corners ground smooth.

2. Door Faces: Minimum 22 gauge.
4. Reinforcement: Minimum 14 gauge.

5. Internal Reinforcement: Furnish in areas of attached hardware and fittings. Mark locations of reinforcement for partition-mounted washroom accessories.

C. Door and Panel Dimensions:

2. Door Width: 24-inches.
3. Accessible Door Width: 36-inches, out-swinging.
5. Thickness of Pilasters: 1-1/4 inch-thick, of sizes required to suit compartment width and spacing.

D. Finish: AISI No. 4, with diamond texture.

### 2.4 ACCESSORIES

A. Pilaster Shoe: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Head Rails: Hollow anodized aluminum tube, 1 x 1-5/8 inch size, with anti-grip profiles and cast socket wall brackets.

C. Brackets: Satin stainless steel or anodized aluminum continuous brackets.

D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.

1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.

E. Hardware: Satin Stainless steel:

1. Continuous pin hinge.
2. Thumb slide door latch with receptor mounted to pilaster.
3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
4. Coat hook with rubber bumper; one for each compartment, mounted on door.
5. Furnish door pull for out-swinging doors.

### PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify field measurements are as indicated on shop drawings.
B. Verify correct spacing of and between plumbing fixtures.
C. Verify correct location of built-in framing, anchorage, and bracing.

### 3.2 INSTALLATION

A. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.
B. Attach panel brackets securely to walls using anchor devices.
C. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
D. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

### 3.3 ERECTION TOLERANCES

A. Maximum Variation From Indicated Position: 1/4 inch.
B. Maximum Variation From Plumb: 1/8 inch.

### 3.4 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
B. Adjust hinges to position doors in full closed position when unlatched. Return out-swinging doors to closed position.
C. Adjust adjacent components for consistency of line or plane.

3.5 SCHEDULES
A. Room 401: Two standard and one accessible Toilet Partitions.
B. Room 403: One standard and one accessible toilet partitions.
C. Reference Drawings for more information.

END OF SECTION 10 2113.13
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Non-progressive, moveable and reconfigurable system of unitized panels, from a single manufacturer.
   2. Related Requirements:
      4. Section 09 2116 – Gypsum Board Assemblies: Adjacent partition and fur down substrates.

1.2 REFERENCE STANDARDS
A. Aluminum Association:
   1. AA DAF45-R03, Designation System for Aluminum Finishes, 9th Edition
B. American National Standards Institute
C. ASTM International:
   1. ASTM B221-06, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profile and Tubes
   2. ASTM C1036, Standard Specification for Flat Glass
D. The Business and Institutional Furniture Manufacturers Association (BIFMA)
   1. BIFMA M7.1 Standard Test Method for Determining VOC Emissions
   2. BIFMA X5.6 – Panel Systems
E. Consumer Product Safety Commission
F. International Code Congress
G. International Organization for Standardization
   1. ISO 9001 – Quality Management Systems

1.3 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions.
   4. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of demountable partition.
   5. Care and Maintenance Standards: For demountable partitions to include in maintenance manuals.
C. Shop Drawings:
   1. For demountable partitions. Include plans, elevations, sections, details, and attachments to other work.
      a. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
      b. Indicate partition layout, including doors and hardware, elevations, opening locations, special panels and conditions at adjacent construction.
1.4 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify that the products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
   2. Indoor Air Quality Certificates:
      a. Certify volatile organic compound content for each interior adhesive and sealant and related primer.
      b. Certify volatile organic compound content for each interior paint and coating.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.5 QUALIFICATIONS
A. Manufacturer Qualifications:
   1. All primary products specified within this section will be supplied by a single manufacturer with a minimum of ten (10) years' experience. The manufacturer of the wall system shall operate under an ISO 9001 certified quality management system.
B. Installer Qualifications:
   1. All products listed within this section shall be installed by a manufacturer-certified installation company.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Deliver demountable partition system components cartoned or crated to provide protection during direct transit to site or intermediary location. Components shipped from intermediary location to site shall be protected as required to provide protection during transit.
B. Inspect demountable partition system components for damage upon delivery to site and to intermediary location.
C. Minor damages may be repaired, provided finish items are equal to new work and acceptable to Architect. Remove and replace damaged items as directed.
D. Store demountable partition system components on raised platforms with blocking between units to allow air circulation. Keep stored material covered and protected from damage.

1.7 WARRANTY
A. Uniform General Conditions of the Contract, especially paragraph 13.5.
B. Warranty period: Ten (10) years from date of substantial completion.

1.8 EXISTING CONDITIONS
A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.
B. Finished Spaces: Do not deliver or install demountable partition components until building is enclosed and finishing operations, including installation of light fixtures, and HVAC equipment are complete.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. Structural Performance
   1. Design and size the demountable partitions and components to withstand dead and live loads as calculated in accordance with the International Building Code, 2015 Edition.
   3. Load Bearing Capacity: Tested to not less than the requirements for panel systems as defined by ANSI/BIFMA X5.6, latest edition. Specifically, a load of 300 lbs. on either side of each panel
at both overhead and desktop elevations with a Center of Gravity (CG) of no greater than 8" from the panel face.

4. Transverse-Load Capacity of Glass Partitions: Lateral deflection of glass framing members not to exceed the lesser of L/175 of length or 3/4-inch (19 mm), when subject to a uniformly distributed load of 5lbs/sf (240 Pa) in accordance with ASTM E72.

5. At a minimum, glass thickness shall conform to the requirements of ASTM E1300.


B. Surface-Burning Classification: Provide demountable partitions complying with the following requirements:

1. Surface-Burning Classification: Provide demountable partitions per ASTM E 84:
   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

2. Combustibility: Provide demountable partitions constructed in a manner and of materials suitable for installation in non-combustible (Type I or Type II) building.

C. Indoor Air Quality Performance

1. Product shall be GREENGUARD certified to be low-emitting and it shall comply with ANSI/BIFMA Standard Method M7.1-2011.

D. Sustainability Performance

1. Solid and combination panels shall be third-party certified in conformance with the requirements of The Business and Institutional Furniture Manufacturers Association (BIFMA) level 1 sustainability standard.

2.2 DESIGN REQUIREMENTS

A. The demountable partition system (the system) shall be rectilinear in design and expression with crisp corners and well defined horizontal and vertical elements.

B. The system shall be 4" (101.6mm) thick minimum and designed and sized in horizontal and vertical modules to accommodate the partition layout indicated.

1. Panel heights shall be available in 1/8" (3.2mm) increments from a minimum of 8" (203.2mm) to maximum of 144" (3657.6mm) as required. Actual floor to ceiling heights shall be verified in field.

2. Solid panel widths shall be available in 1/16" (1.6mm) increments from a minimum of 8" (203.2mm) to maximum of 48" (1219.2mm) and 60" (1524mm).

C. Glass and steel panels shall be constructed of materials acceptable for use in non-combustible construction.

D. The system shall be non-progressive, allowing for removal and re-installation of panels, including door frames, at any position, without disturbing adjacent panels.

E. Each unitized panel shall be able to be removed, relocated and re-installed in different layouts, with all parts reusable. Scribing and fitting of panels on site to individual locations is not acceptable.

F. The panel/floor interface shall have a reveal, recessed 3/4" (19mm) from the face of the panel on both sides and adjustable in height from 1 1/4" (31.7mm) to 2 1/2" (63.5mm), and 1 1/4" (31.7mm) down to 1/2" (12.7mm). Surface mounted base trim not permitted.

G. The panel/ceiling interface shall have a 1" (25.4mm) nominal height reveal, recessed 3/4" (195mm) from the face of the panel on both sides. Surface mounted top trim not permitted.

H. The system shall provide a vertical adjustment of not less than 2" (50.8mm) in overall height to accommodate floor and ceiling irregularities.

I. The system shall include a freestanding option that does not require a connection or attachment to the ceiling.

J. The system must be erected and removed in a manner to prevent damage to adjacent building surfaces and elements, including floors, walls, ceilings, columns and window mullions. All system connectors to fixed-in-place building components shall be non-marking, removable and reusable.

K. The system shall be capable of extending in multiple directions using 2-way, 3-way, 4-way and variable angle corner posts.

L. Doors: Single, Sliding doors utilizing adjustable metal frames. All door panels shall utilize standard panel connection methods.
M. Provide cuttable panels in order to address irregularities in the interface between the panel system and fixed-in-place construction (i.e. sills, columns, bulkheads).
N. Components shall be free of distortion and uniform in dimension, construction and appearance.

2.3 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Material and Resource Characteristics
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.
C. Indoor Environmental Quality Characteristics
   1. Interior Anti-Corrosive Paints: Maximum volatile organic compound content according to GC-03.

2.4 DEMOUNTABLE PARTITIONS
A. General: Site-erected demountable partition assembly and components that are the standard products of manufacturer.
B. Manufacturer:
   1. Haworth, Inc.; Enclose, as basis of design.
   2. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.5 MATERIALS
A. Core Framing Components: Manufacturer's standard, extruded aluminum ASTM B221, within manufacturer's tolerance and free from defects impairing strength and/or durability.
B. Glass and Glazing Materials:
   1. Glazing: Glass type as indicated by Architect complying with Division 08 Section “Glazing”.
      a. Minimum thickness: 1/4” (6mm)
      b. Maximum thickness: 3/8” (10mm)
   c. Glazing sections: Resilient ABS, extruded glazing section to suit glazing channel retaining slot placed into demountable partition system for setting glass.

2.6 UNITIZED PANEL TYPES
A. Solid Panels:
   1. Core Framing Components: Extruded aluminum minimum 0.05” (1.3mm) thick, stile and frame with corner brackets, installed for full frame rigidity.
   2. Panel Types:
      a. Monolithic: 3/8” (10mm) thick glass pane, Tempered, ceiling height, fit to frame with ABS glazing gaskets.

2.7 DOORS, DOOR FRAMES AND HARDWARE:
A. Sliding Doors: Manufacturer’s standard 3/8” (10mm) thick Glass slab.
   1. Door Finishes: Fully tempered clear float glass
   2. Door Glass Thickness:
      a. Glass Slab – Manufacturer’s standard, 3/8” (10mm)
   3. Texture and Pattern:
      a. Frosted glass, velour finish.
B. Accessory Hardware:
   1. Sliding Doors:
      a. Glass Slab Doors – Adjustable bottom plinth C-Channel track
C. Door Glazing: Fully tempered frosted float glass.
   1. Maximum thickness 3/8-inch (10 mm)
   2. Minimum and maximum values do not apply to doors.

2.8 FABRICATION
A. Fabricate demountable partition system off-site in a controlled factory environment and deliver panels fully finished to site for installation with no additional assembly, construction or finishing required.
B. Fabricate demountable walls for installation with concealed fastening devices and pressure-fit members. Fabricate systems to accept installation of PVC-free continuous light and sound seals at floor, ceiling, and other locations where partitions abut fixed construction.

2.9 CONNECTION METHODS
   A. Demountable Partition System to Fixed-in-Place Construction: Extruded aluminum wall starter with PVC-free light and sound seal at all abutments between demountable partition system and fixed-in-place construction.
   B. Panel to Panel, Door Frame or Post Connector: Continuous, extruded ABS connector applied to aluminum frame providing a 5/16” (8mm) reveal, recessed 3/16” (5mm) from panel face and ensuring integrity of light and sound seal.
   C. Panel Face to Frame: Continuous, extruded ABS retention clip affixed to back of panel face secured to aluminum frame.
   D. Exposed Ends and Corners: Supply and install one-piece aluminum extrusion to match panel finish, attached to end panel with standard panel-to-panel connector.

2.10 FINISHES, GENERAL
   A. Aluminum Surfaces: Finish exposed surfaces of aluminum components Class 1 clear anodized. Non-repairable, anodized aluminum finishes are unacceptable.
   B. ABS Extrusions: Selected from manufacturer’s samples.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify that field conditions are acceptable and are ready to receive Work.
   B. Verify that concealed blocking and reinforcement is installed and correctly located to receive wall-mounted handrails.

3.2 PREPARATION
   A. Prior to installation of demountable partition system, clean floor to remove dust, debris, and loose particles.
   B. Illuminate areas of installation to provide an ambient light level of at least 100 foot candles measured in the area where partitions are to be installed.
   C. Maintain temperature in the area of installation at a constant minimum of 65 degrees F with relative humidity less than 70 percent for a period of 48 hours prior to installation and during the installation process.
   D. General Contractor will deliver all construction interfacing with the demountable partition system in true and plumb condition.
   E. For manufacturer to accept responsibility of dimensional compatibility between demountable partition wall system and construction, manufacturer shall have access to the completed site for accurate field measuring six (6) weeks prior to requiring product on site to commence installation. If time line does not permit the six (6) weeks lead time, demountable manufacturer shall provide “hold-to” dimensions for the General Contractor. General Contractor then assumes responsibility that construction delivers on “hold to” dimensions.

3.3 INSTALLATION
   A. Install the demountable partition system under manufacturer’s approved, direct supervision to ensure performance and compatibility with design and specification intent.
   B. Install demountable partition systems rigid, level, plumb, and aligned. Install seals to prevent light and sound transmission at connections to floors, ceilings, fixed walls, and abutting surfaces.
      1. Installation Tolerance: Install each demountable partition so surfaces vary not more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent partitions.
   C. Install door-and-frame and glazing-and-glazing-frame assemblies securely anchored to partitions and with doors aligned and fitted. Install and adjust door hardware for proper operation.

3.4 DEMONSTRATION
   A. Engage a factory-authorized service representative to demonstrate and train Owner’s maintenance personnel to adjust, operate, and maintain demountable partitions.
3.5 PROTECTION
   A. Uniform General Conditions of the Contract, especially paragraph 3.3.
   B. Protect installed demountable partition system components until completion of project.
   C. Touch-up, repair or replace damaged moveable wall system components before Substantial Completion.

3.6 ATTACHMENTS
   A. Demountable partitions at Rooms 302, 303 and 304.
   B. Reference Drawings from more information.

END OF SECTION 10 2219
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes toilet accessories and utility room accessories.
B. Related Sections:
   1. Section 04 2000 – Unit Masonry.
   2. Section 09 2116 - Gypsum Board Assemblies.
   3. Section 09 3000 - Tiling.
   4. Section 10 2113.13 – Metal Toilet Compartments.

1.2 REFERENCES
A. ASTM International:
B. Green Seal:
   1. GS-03 - Anti-Corrosive Paints.
   2. GS-11 - Product Specific Environmental Requirements.
C. South Coast Air Quality Management District:
   1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.3 DESIGN REQUIREMENTS
A. Design grab bars, and attachments to resist minimum 250 lb concentrated load applied at any point in any direction and as required by applicable code.

1.4 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit data on accessories describing size, finish, details of function, attachment methods.
C. Manufacturer's Installation Instructions: Submit special procedures and conditions requiring special attention.

1.5 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
   2. Indoor Air Quality Certificates:
      a. Certify volatile organic compound content for each interior adhesive and sealant and related primer.
      b. Certify volatile organic compound content for each interior paint and coating.
C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.

1.6 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate the Work with placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS

A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.

C. Indoor Environmental Quality Characteristics:
   1. Interior Adhesives: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
   2. Interior Flat and Non-Flat Paints: Maximum volatile organic compound content in accordance with GS-11.
   3. Interior Anti-Corrosive Paints: Maximum volatile organic compound content in accordance with GC-03.

2.2 TOILET AND BATH ACCESSORIES

A. Manufacturers:
   1. American Specialties, Inc.
   2. Bobrick.
   3. Bradley Corp.
   4. World Dryer

   5. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.

2.3 COMPONENTS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.

2.4 TOILETROOM ACCESSORIES

A. Toilet Paper Dispenser: Single roll Roll-in-reserve type, designed to allow automatic activation of reserve roll when needed, or manual activation by pressing release bar, surface-mounted, satin finish stainless steel unit with pivot hinge, tumbler lock.
   1. Product: B-4288 manufactured by Bobrick.

B. Electric Hand Dryer
   2. Motor: 5/8 hp/13,000 rpm to provide 70 cfm at air velocity of 12,300 lfm.
   5. Operating Voltage: 110/120, 208, or 220/240 universal voltage.

   1. Capacity: 600 C-fold or 800 multifold minimum.
   2. Product: B-318 manufactured by Bobrick.

D. Waste Receptacle: Recessed, satin finish stainless steel, seamless door for access to container, with tumbler lock, reinforced panel full height of door, continuously welded bottom pan and seamless exposed flanges.
   a. Liner: Removable, heavy-duty vinyl liner, with stainless steel U shaped support strap: 3944-134 manufactured by Bobrick.
E. Soap Dispenser: Liquid soap dispenser, wall-mounted, with satin stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gage refill indicator.
   1. Minimum Capacity: 40 ounces.
   2. Product: B-4112 manufactured by Bobrick.

F. Mirrors: Stainless steel framed, 6 mm thick tempered glass mirror.
   1. Size: As scheduled.
   2. Frame: 0.05 inch channel shapes, 1/2 x 1/2 x 3/8 inches with 1/4" return at rear, with mitered corners, and tamperproof hanging system; bright polished finish.
   3. Backing: Full-mirror sized, minimum 20 gauge thick galvanized steel sheet and shock absorbing, water-resistant nonabrasive, 3/16" thick polyethylene padding/filler material. Horizontal hanging brackets, top and bottom, shall be integral with galvanized back. Brackets shall mount on concealed rectangular wall hanger to prevent pulling away for wall.
   4. Mirror: 1/4" select tempered glass, No. 1 quality, selected for silvering, electrolytically copper plated by the galvanic process. Protect comers by friction absorbing filler strips. Protect back by full size, shock absorbing, water-resistant nonabrasive, 3/16" thick polyethylene padding.
   5. Product: B-1658 manufactured by Bobrick.

G. Grab Bars: Stainless steel satin finished, 1-1/2 inches outside diameter, minimum 18 gauge wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
   1. Length and configuration: As indicated on schedule.
   2. Lengths and configurations:
      a. 42 inches long.
      b. 36 inches long.
   3. Products: B-6806.99x42, B-6806.99x36, manufactured by Bobrick.

H. Sanitary Napkin Disposal Unit: Stainless steel satin finish, surface-mounted with full-length stainless steel piano-type hinge on top cover.
   1. Product: B-270 manufactured by Bobrick.

I. Baby Changing Station: Recess mounted, Stainless steel, 18 gauge type 304 with FDA approved blow molded high-density grey polyethylene with Microban antimicrobial interior. Reinforced full-length steel on steel hinge with 11 gauge steel mounting plates. Concealed pneumatic cylinder to provide slow and controlled opening and closing of the bed.
   1. Product: KB110-SSRE manufactured by Koala Kare Child Care Products.

2.5 Utility Room Accessories

A. Combination Utility Shelf/Mop and Broom Holder with hooks: 18 gauge thick stainless steel, Type 304, with bent to profile to produce a mounting strip and shelf, 16 gauge stainless steel satin finish wall brackets welded to support shelf.
   1. Hooks: Four 12 gauge stainless steel rag hooks at attached by rivets to mounting strip.
   2. Mop/broom holders: 3 spring-loaded rubber cam holders with anti-slip coating affixed to mounting strip.
   3. Length: 34 inches.

2.6 Factory Finishing

A. Stainless Steel: No. 4 satin brushed finish, unless otherwise noted.
B. Chrome/Nickel Plating: ASTM B456, Type SC 2, satin finish, unless otherwise noted.
C. Galvanizing: ASTM A123/A123M; hot dip galvanize after fabrication.
D. Galvanizing for Nuts, Bolts and Washers: ASTM A153/A153M.

PART 3 - EXECUTION

3.1 Examination

A. Verify exact location of accessories for installation.
B. Verify field measurements are as indicated on product data.
C. See Section 06 10 00 Rough Carpentry for installation of blocking in walls.
3.2 PREPARATION
A. Deliver inserts and rough-in frames to site for timely installation.
B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION
A. Install plumb and level, securely and rigidly anchored to substrate.
B. Mounting Heights and Locations: As required by accessibility regulations and as indicated on Drawings.

3.4 SCHEDULES
A. Room #106 – Staff Toilet
      a. Qty: 1
      a. Qty: 1
      a. Qty: 1
   4. Soap Dispenser – Bobrick Model B-4112.
      a. Qty: 1
   5. Mirror – Bobrick Model B-1658.
      a. Size: 24x36
      b. Qty: 1
   6. Grab Bars
      a. Bobrick Model B-6806.99-42
         1) Qty: 1
      b. Bobrick Model B-6806.99-36
         1) Qty: 1
   7. Sanitary Napkin Disposal Unit
      a. Bobrick Model B-270.
         1) Qty: 1
B. Room #108 – Custodial/Elect.
   1. Utility Shelf/Mop & Broom Holder – Bobrick Model B-239.
      a. Qty: 1
C. Room #401 – Women’s Comfort Station
      a. Qty: 3
   2. Electric Hand Dryer – World Dryer Model SlimDri
      a. Qty: 1
      a. Qty: 1
   4. Soap Dispenser – Bobrick Model B-4112.
      a. Qty: 1
   5. Mirror – Bobrick Model B-1658.
      a. Size: 24x36
      b. Qty: 2
   6. Grab Bars
      a. Bobrick Model B-6806.99-42
         1) Qty: 1
      b. Bobrick Model B-6806.99-36
         1) Qty: 1
   7. Sanitary Napkin Disposal Unit
      a. Bobrick Model B-270.
         1) Qty: 3
   8. Baby Changing Station - Koala Kare model KB110-SSRE.
      a. Qty: 1
D. Room #402 – Chase
   1. Utility Shelf/Mop & Broom Holder – Bobrick Model B-239.
a. Qty: 1

E. Room #403 – Men’s Comfort Station
   a. Qty: 2
2. Electric Hand Dryer- World Dryer Model SlimDri
   a. Qty: 1
   a. Qty: 1
4. Soap Dispenser - Bobrick Model B-4112
   a. Qty: 1
5. Mirror – Bobrick Model B-1658.
   a. Size: 24x36
   b. Qty: 2
6. Grab Bars
   a. Bobrick Model B-6806.99-42
      1) Qty: 1
   b. Bobrick Model B-6806.99-36
      1) Qty: 1
7. Baby Changing Station - Koala Kare model KB110-SSRE.
   a. Qty: 1

END OF SECTION 10 2800
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes fire extinguishers; fire extinguisher cabinets; and brackets for wall mounting.
B. Related Sections:
   1. Section 04 2000 - Unit Masonry: Wall construction to accept cabinets.
   2. Section 04 4213 - Masonry Supported Stone Cladding: Wall construction to accept cabinets.
   3. Section 06 1000 - Rough Carpentry: Framing, blocking, and shims for support and alignment of cabinets.
   4. Section 09 2116 - Gypsum Board Assemblies: Wall construction to accept cabinets.

1.2 REFERENCES
A. National Fire Protection Association:
   1. NFPA 10 - Standard for Portable Fire Extinguishers.
B. Underwriters Laboratories Inc.:
   1. UL - Fire Protection Equipment Directory.

1.3 PERFORMANCE REQUIREMENTS
A. Conform to NFPA 10 and applicable building/fire code.
B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for purpose specified and indicated.

1.4 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, wall bracket mounted measurements, location, fire ratings, and anchorage details.
C. Product Data: Submit extinguisher operational features, color and finish, and anchorage details.
D. Manufacturer's Installation Instructions: Submit special criteria and wall opening coordination requirements.
E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
   2. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
      a. Provide cost data for the following products:
         1) Products with recycled material content.

1.6 CLOSEOUT SUBMITTALS
A. Refer to the Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Operation and Maintenance Data: Submit test, refill or recharge schedules and re-certification requirements.

1.7 ENVIRONMENTAL REQUIREMENTS
A. Do not install extinguishers when ambient temperature is capable of freezing extinguisher ingredients.
PART 2 - PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS
   A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
   B. Materials and Resources Characteristics:
   C. Recycled Content Materials: Furnish materials with maximum available recycled content.

2.2 FIRE EXTINGUISHERS
   A. Manufacturers:
      1. Amerex Model B500.
      2. JL Industries Model Cosmic 5E.
      5. Potter Roemer Model 3005.
      6. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
   B. Dry Chemical Type: Steel tank, with pressure gage; Class 2A-10B:C.
   C. Extinguisher Finish: Red painted finish.

2.3 FIRE EXTINGUISHER CABINETS
   A. Manufacturers:
      1. JL Industries Model 1827; with Saf-T-Lok.
      2. Larsen’s Manufacturing Co. Model AL2409-R3; with Larsen-Loc.
      3. Substitutions: Section 01 6000 - Product Requirements.
   B. Enclosure Metal: Formed sheet steel, 0.036 inch thick base metal, finish with baked enamel.
   C. Door & Trim Metal: Formed aluminum.
   D. Configuration: Semi-recessed type, inside box nominal dimensions of 9.5 inch wide x 24 inch high x 5 inch deep.
   E. Trim Type: Flat and Returned to wall surface, with 2.5-3 inch projection.
   F. Door: 0.016 inch thick minimum, reinforced for flatness and rigidity; breakaway lock access.
   G. Door Glazing: Full Panel Plastic, clear, 1/8 inch thick acrylic.
   H. Cabinet Mounting Hardware: Appropriate to cabinet.
   I. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim and door stiles.
   J. Pre-drill for anchors.
   K. Hinge doors for 180 degree opening with continuous piano hinge. Furnish roller type catch.
   L. Weld, fill, and grind components smooth.
   M. Glaze doors with resilient channel gasket glazing.
   N. Finishing Cabinet Exterior: White baked enamel.
   O. Finishing Trim and Door: Anodized clear.
   P. Finishing Cabinet Interior: White baked enamel.

2.4 ACCESSORIES
   A. Extinguisher Brackets: Formed steel, red enamel finish.
   B. Cabinet Signage: Die-cut lettering in vertical format identifying “Fire Extinguisher”.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION
   A. Install cabinets plumb and level in wall openings, maximum 48 inches from finished floor to top of extinguisher handle.
   B. Install wall brackets, maximum 48 inches from finished floor to top of extinguisher handle.
   C. Secure rigidly in place.
   D. Place extinguishers and accessories in cabinets and on wall brackets as scheduled.
E. Position cabinet signage as required by authorities having jurisdiction.

3.3 SCHEDULES
A. Class 2A-10B:C extinguishers in cabinets:
   1. Rooms 202, 405
B. Reinstall existing bracket and fire extinguisher, Room 104.

END OF SECTION 10 4400
DIVISION 11
EQUIPMENT

The Agreement, General Conditions of the Contract for Construction, Supplementary Conditions of the Contract for Construction, and all Addenda are a part of the Contract. The Contractor shall consult them in detail for instructions pertaining to the Work. The Contractor shall also consult all other divisions and sections of the Project Manual, and all drawings in the execution of the work of the Contract.

The Contractor shall provide all labor, materials, systems, equipment, items, articles, operations, and/or methods listed, implied, mentioned, or scheduled in the Contract Documents and/or necessary and/or required for the satisfactory completion of the Work.

The listing of work, requirements, and products in this section is not intended to be conclusive. The Contractor shall check all other parts of the Contract Documents and shall provide all miscellaneous items of work and products necessary for the satisfactory completion of the Work described in the Contract Documents.
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Refrigerator.
   2. Microwave oven.
B. Related Requirements:
   1. Section 06 4100 – Architectural Wood Casework: Openings and trim for Work of this Section.
   2. Section 06 6119 – Quartz Surfacing Fabrications.
   3. Section 22 4200 - Plumbing Fixtures: Plumbing fixtures and trim as required by this Section.
   4. Section 26 0120 – Basic Electrical Requirements: Electrical characteristics and wiring connections.

1.2 REFERENCE STANDARDS
A. Underwriters Laboratories Inc.:
   1. UL - Electrical Appliance and Utilization Equipment Directory.
B. NSF International
   1. NSF 7 – Commercial Refrigerators and Freezers

1.3 COORDINATION
A. Uniform General Conditions of the Contract, especially paragraph 3.3.1 and article 9.
B. Coordinate Work of this Section with Section 06 4100 – Architectural Wood Casework and Section 06 6119 – Quartz Surfacing Fabrications.

1.4 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Product Data: Submit data on equipment, accessories.
C. Manufacturer's Instructions: Submit manufacturer's installation instructions.

1.5 CLOSEOUT SUBMITTALS
A. Refer to the Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Project Record Documents: Record actual locations of appliances.
C. Operation and Maintenance Data: Submit relevant instructions.

1.6 QUALITY ASSURANCE
A. Electrical Wiring and Components and Self-Contained Refrigeration Systems: Conform to UL standards.
B. Conform to NSF 7 for refrigerators.
C. Conform to applicable code for UL approval.

1.7 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Deliver materials in manufacturer's packaging; include installation instructions.
B. Inspection: Accept appliances on-Site. Inspect for damage.
C. Store appliances according to manufacturer's instructions.

1.9 EXISTING CONDITIONS
A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.
1.10 WARRANTY
   A. Uniform General Conditions of the Contract, especially paragraph 13.5.
   B. Furnish five year parts and labor manufacturer warranty for refrigerant compressor.
   C. Furnish one year parts and labor manufacturer warranty for other components.

PART 2 - PRODUCTS

2.1 RESIDENTIAL EQUIPMENT
   A. Refrigerator:
      1. Manufacturer: Summit as basis of design.
      2. Model AL55.
      3. 4.2 cu. ft. capacity, undercounter type, self-defrosting, single door, stainless steel finish.
      4. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
   B. Microwave Oven:
      1. Manufacturer: Panasonic as basis of design.
      3. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
   C. Electrical Characteristics: As specified in Section 26 0120.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify that openings and utility services are ready to receive Work.
   B. Verify that opening dimensions are as indicated on Shop Drawings.

3.2 INSTALLATION
   A. Set and adjust units such that they are level and plumb.
   B. Connect to utilities and make units operational.
   C. Activate units to confirm correct operation.
   D. Turn refrigerators on to moderate temperature setting.

3.3 PROTECTION
   A. Uniform General Conditions of the Contract, especially paragraph 3.3.
   B. Do not permit operation of appliances, other than for testing, prior to Substantial Completion.

3.4 ATTACHMENTS
   A. Room 304:
      1. One undercounter refrigerator.
      2. One countertop microwave.
   B. Reference Drawings for more information.

END OF SECTION 11 3113
DIVISION 12
FURNISHINGS

The Agreement, General Conditions Of The Contract For Construction, Supplementary Conditions Of The Contract For Construction, and all Addenda are a part of the Contract. The Contractor shall consult them in detail for instructions pertaining to the Work. The Contractor shall also consult all other divisions and sections of the Project Manual, and all Drawings in the execution of the work of the Contract.

The Contractor shall provide all labor, materials, systems, equipment, items, articles, operations, and/or methods listed, implied, mentioned, or scheduled in the Contract Documents and/or necessary and/or required for the satisfactory completion of the Work.

The listing of work, requirements, and products in this section is not intended to be conclusive. The Contractor shall check all other parts of the Contract Documents and shall provide all miscellaneous items of work and products necessary for the satisfactory completion of the Work described in the Contract Documents.
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes site benches.

1.2 SUBMITTALS
A. Section 8.3 of the Uniform General Conditions of the Contract and Section 1.05 of the Special Conditions of the Contract.
B. Shop Drawings: Indicate detailed materials, dimensions, and attachment details.
C. Product Data: Materials and coatings.
D. Manufacturer’s installation instructions.

1.3 SUSTAINABLE DESIGN SUBMITTALS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
B. Manufacturer’s Certificate: Certify that products meet or exceed specified sustainable design requirements.
   1. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
C. Product Cost Data:
   1. Submit cost of products to verify compliance with Project sustainable design requirements.
   2. Exclude cost of labor and equipment to install products.
   3. Provide cost data for following products:
      a. Products with recycled material content.

1.4 CLOSEOUT SUBMITTALS
A. Refer to the Uniform General Conditions of the Contract, especially definitions 1.8 and 1.11, and paragraph 8.3 and article 12.
B. Maintenance Instructions: Submit Maintenance Data.

1.5 QUALIFICATIONS
A. Manufacturer specializing in site furnishings with minimum 5 years experience.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Store products in manufacturer’s packaging until ready for installation.
B. Protect products and accessories from damage or moisture.

PART 2 - PRODUCTS

2.1 SITE BENCH
A. Manufacturers:
   1. Forms+Surfaces, Model: Balance Bench SBBAL-72NPC.
   2. Substitutions: Uniform General Conditions of the Contract, especially paragraphs 8.3.5 and 8.3.6.
B. Product Description: Slotted and coated steel bench with cast aluminum legs, secured to concrete foundation, footings, and flatwork.

2.2 SUSTAINABILITY CHARACTERISTICS
A. Section 01 8113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
B. Material and Resource Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.

2.3 FACTORY FINISHING
A. Factory applied powdercoat finish.
B. Aluminum Texture.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify area is ready to receive work and dimensions are as indicated on shop drawings and as instructed by manufacturer.

3.2 INSTALLATION
A. Install in accordance with manufacturer’s installation instructions.

3.3 SCHEDULES
A. Alternate #1, Site Benches at Pavilion:
   1. Qty: 2
B. Reference drawings for locations.

END OF SECTION 12 9343
The Agreement, General Conditions Of The Contract For Construction, Supplementary Conditions Of The Contract For Construction, and all Addenda are a part of the Contract. The Contractor shall consult them in detail for instructions pertaining to the Work. The Contractor shall also consult all other divisions and sections of the Project Manual, and all drawings in the execution of the work of the Contract.

The Contractor shall provide all labor, materials, systems, equipment, items, articles, operations, and/or methods listed, implied, mentioned, or scheduled in the Contract Documents and/or necessary and/or required for the satisfactory completion of the Work.

The listing of work, requirements, and products in this section is not intended to be conclusive. The Contractor shall check all other parts of the Contract Documents and shall provide all miscellaneous items of work and products necessary for the satisfactory completion of the Work described in the Contract Documents.
PART 1 - GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS
A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.
B. Plumbing Contract Documents were prepared for the Project by:
   Trinity MEP Engineering, LLC
   3533 Moreland Dr. Ste. A
   Weslaco, Texas 78596
   Phone Number: (956) 973-0500
   Contact Person: Leonardo Munoz, P.E.
C. General Scope of Work:
   1. Install systems and equipment as shown on the contract documents. Refer to drawings for schedule of equipment that will be installed. After installing equipment, connect all water, sewer, and/or power to fixtures.
   2. Provide all materials and labor associated with a complete operational installation of new systems including, but not limited to:
      • Fixtures for facility
      • Piping for Sanitary Sewer and Vent Systems
      • Piping for Domestic water and Hot Water Systems.

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

1.3 UTILITIES
1. Coordinate with power, water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
2. Obtain any approvals required from utilities to relocate utilities.
3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

1.4 CONTRACTOR USE OF PREMISES
A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
   1. Owner Occupancy: Allow for Owner occupancy and use by the public.
   2. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner’s employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
1. Temporary fencing around construction areas.
2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
3. Temporary fencing around equipment while site work is in progress.

1.5 SUBMITTALS
1. All equipment and fixtures shall be provided with a submittal.
2. To expedite the submittal process more efficiently, DO NOT piece-meal the submittals. Submit entire plumbing or in a bound enclosure. This will eliminate delays in the submittal process.

END OF SECTION
1. Temporary fencing around construction areas.
2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
3. Temporary fencing around equipment while site work is in progress.

1.5 SUBMITTALS
1. All equipment and fixtures shall be provided with a submittal.
2. To extradite the submittal process more efficiently, DO NOT piece-meal the submittals. Submit entire plumbing or in a bound enclosure. This will eliminate delays in the submittal process.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common requirements and procedures for plumbing systems.
   2. Responsibility for proper operation of electrically powered equipment furnished under this Division.
   3. Furnish and install sealants relating to installation of systems installed under this Division.
   4. Furnish and install Firestop Penetration Systems for plumbing systems penetrations as described in Contract Documents.

B. Products Furnished But Not Installed Under This Section:
   1. Sleeves, inserts, supports, piping and equipment for plumbing systems installed under other Sections.

1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer’s catalog data for each manufactured item.
      1) Provide section in submittal for each type of item of equipment. Include Manufacturer’s catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data (Modify and add to requirements of Section 01 7800):
         1) At beginning of PLUMBING section of Operations and Maintenance Manual, provide master index showing items included:
            a) Provide name, address, and phone number of Architect, Architect’s Mechanical Engineer, General Contractor, and Plumbing subcontractor.
            b) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:
               i) List of plumbing equipment used indicating name, model, serial number, and nameplate data of each item together with number and name associated with each system item.
               ii) Manufacturer’s maintenance instructions for each piece of plumbing equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance instructions.
            c) Provide operating instructions to include:
               i) General description of fire protection system.
               ii) Step by step procedure to follow for shutting down system or putting system into operation.
      b. Warranty Documentation:
         1) Include copies of warranties required in individual Sections of Division 22.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Perform work in accordance with applicable provisions of Plumbing Codes applicable to Project. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.

3. Identification:
   a. Motor and equipment name plates as well as applicable UL / ULC and AGA / CGA labels shall be in place when Project is turned over to Owner.

B. Qualifications.
   1. Plumbing Subcontractor:
      a. Company specializing in performing work of this section.
         1) Minimum five (5) years experience in plumbing installations.
         2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
      b. Upon request, submit documentation.
   2. Installer:
      a. Licensed for area of Project.
      b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
      c. Upon request, submit documentation.

1.4 DELIVERY, STORAGE, AND HANDLING
   A. Delivery And Acceptance Requirements:
      1. Accept valves on site in shipping containers with labeling in place.
      2. Provide temporary protective coating on cast iron and steel valves.
      3. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
   B. Storage And Handling Requirements:
      1. In addition to requirements specified within, stored material shall be readily accessible for inspection by Architect/engineer until installed.
      2. Store items subject to moisture damage in dry, heated spaces.

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

PART 2 - PRODUCTS

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

D. Valves:
   1. Valves of same type shall be of same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLERS
A. Acceptable Installers:

3.2 Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

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

B. Verification Of Conditions:
   1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which plumbing work is dependent for efficiency and report work that requires correction.
   2. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.
   3. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.

3.4 No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

3.5 PREPARATION
A. Demolition Requirements:
B. Changes Due To Equipment Selection:
   1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings showing proposed installations.
   2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
   3. Provide additional motors, valves, controllers, fittings, and other equipment required for proper operation of systems resulting from selection of equipment.
   4. Be responsible for proper location of rough-in and connections provided under other Divisions.

3.6 INSTALLATION
A. Interface With Other Work:
1. Furnish exact location of electrical connections and complete information on motor controls to installer of electrical system.
2. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and confirm that they are properly installed.
3. Furnish inserts for attaching hangers that are to be cast in concrete floor construction at time floors are poured.

B. Cut carefully to minimize necessity for repairs to previously installed or existing work. Do not cut beams, columns, or trusses.

C. Locating Equipment:
   1. Arrange pipes and equipment to permit ready access to valves, cocks, unions, traps, and to clear openings of doors and access panels.
   2. Adjust locations of pipes, equipment, and fixtures to accommodate work to interferences anticipated and encountered.
   3. Install plumbing work to permit removal of equipment and parts of equipment requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.
   4. Determine exact route and location of each pipe before fabrication.

   a. Right-Of-Way:
      1) Lines that pitch shall have right-of-way over those that do not pitch. For example, plumbing drains shall normally have right-of-way.
      2) Lines whose elevations cannot be changed shall have right-of-way over lines whose elevations can be changed.

   b. Offsets, Transitions, and Changes in Direction:
      1) Make offsets, transitions, and changes in direction in pipes as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
      2) Furnish and install all traps, air vents, sanitary vents, and devices as required to effect these offsets, transitions, and changes in direction.

D. Penetration Firestops:
   1. Install Penetration Firestop System appropriate for penetration at plumbing systems penetrations through walls, ceilings, roofs, and top plates of walls.

E. Sealants:
   1. Seal openings through building exterior caused by penetrations of elements of plumbing systems.
   2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.

F. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus:
   1. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper installation of plumbing systems.
   2. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings:
      a. Arrange so as to facilitate removal of tube bundles.
      b. Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
         1) Make connections of dissimilar metals with di-electric unions.
         2) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
      c. Do not use reducing bushings, bull head tees, close nipples, or running couplings. Street elbows are allowed only on potable water pipe 3/4 inch (19 mm) in diameter and smaller.
      d. Install piping systems so they may be easily drained
      e. Install piping to insure noiseless circulation.
      f. Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.
   3. Do not install piping in shear walls.
4. Cut piping accurately to measurements established at site. Remove burr and cutting slag from pipes.
5. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
6. Make changes in direction with proper fittings.
7. Expansion of Thermoplastic Pipe:
   a. Provide for expansion in every 30 feet of straight run.
   b. Provide 12 inch offset below roof line in each vent line penetrating roof.
8. Expansion of PEX Pipe: Allow for expansion and contraction of PEX pipe as recommended by Pipe Manufacturer.

G. Sleeves:
1. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete slabs on grade (unless noted on plans).
2. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Seal sleeves with specified sealants. Follow Pipe Manufacturer’s recommendations for PEX pipe (if used) penetrations through studs and floor slabs.
3. Sleeves through floors shall extend 1/4 inch above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
4. Sleeves through floors and foundation walls shall be watertight.

H. Escutcheons:
1. Provide spring clamp plates where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.

3.7 REPAIR / RESTORATION
A. Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it:
   1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.
   2. Surface finishes shall exactly match existing finishes of same materials.

3.8 FIELD QUALITY CONTROL
A. Field Tests:
   1. Perform tests on plumbing piping systems. Furnish devices required for testing purposes.
B. Non-Conforming Work:
   1. Replace material or workmanship proven defective with sound material at no additional cost to Owner.
   2. Repeat tests on new material, if requested.

3.9 CLEANING
A. Remove dirt, grease, and other foreign matter from each length of piping before installation:
   1. After each section of piping used for movement of water or steam is installed, flush with clean water, except where specified otherwise.
   2. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
   3. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.
B. Clean exposed piping, equipment, and fixtures. Remove stickers from fixtures and adjust flush valves.

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

3.11 PROTECTION

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

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions

1.2 SUMMARY
A. This Section includes the following general-duty valves:
1. Copper-alloy ball valves.
2. Bronze check valves.
4. Cast-iron gate valves.

1.3 DEFINITIONS
A. The following are standard abbreviations for valves:
1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. PTFE: Polytetrafluoroethylene plastic.
5. SWP: Steam working pressure.
6. TFE: Tetrafluoroethylene plastic.
7. PEX: Cross-linked Polyethylene
8. NPSM: National Pipe Straight Mechanical

1.4 SUBMITTALS
A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE
A. ASME Compliance: ASME B31.9 for building services piping valves.
1. Exceptions: Sanitary waste, and storm drainage piping valves unless referenced.
B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.
B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Grinnell Corporation.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Red-White Valve Corp.
   g. Watts Industries, Inc.; Water Products Div.

2.2 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.
B. Bronze Valves: NPS 2 (DN 50) and smaller with threaded ends, unless otherwise indicated.
C. Ferrous Valves: NPS 2-1/2 (DN 65) and larger with flanged ends, unless otherwise indicated.
D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
F. Valve Actuators:
   1. Handwheel: For valves other than quarter-turn types.
   2. Lever Handle: For quarter-turn valves NPS 6 (DN 150) and smaller, except plug valves.
G. Extended Valve Stems: On insulated valves.
I. Valve Grooved Ends: AWWA C606.
   1. Solder Joint: With sockets according to ASME B16.18.
      a. Caution: Use solder with melting point below 840 deg F (454 deg C) for angle, check, gate, and globe valves; below 421 deg F (216 deg C) for ball valves.
   2. Threaded: With threads according to ASME B1.20.1.
J. Valve Bypass and Drain Connections: MSS SP-45.

2.3 COPPER-ALLOY BALL VALVES

A. Copper-Alloy Ball Valves, General: MSS SP-110.
B. One-Piece, Copper-Alloy Ball Valves: Brass or bronze body with chrome-plated bronze ball, PTFE or TFE seats, and 400-psig (2760-kPa) minimum [600-psig (4140-kPa)] CWP rating.
C. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.
2.4 BRONZE CHECK VALVES
   A. Bronze Check Valves, General: MSS SP-80.
   B. Type 1, Class 150, Bronze, Horizontal Lift Check Valves: Bronze body with bronze disc and seat.
   C. Type 1, Class 150, Bronze, Vertical Lift Check Valves: Bronze body with bronze disc and seat.

2.5 BRONZE GATE VALVES
   A. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.
   B. Type 1, Class 125, Bronze Gate Valves: Bronze body with nonrising stem and bronze solid wedge and union-ring bonnet.

2.6 CAST-IRON GATE VALVES
   A. Cast-Iron Gate Valves, General: MSS SP-70, Type I.
   B. Class 125, NRS, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, non-rising stem, and solid-wedge disc.
   C. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.

2.7 CAST-IRON PLUG VALVES
   A. Cast-Iron Plug Valves, General: MSS SP-78.
   B. Class 125 or 150, lubricated-type, cast-iron plug valves.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
      1. Proceed with installation only after unsatisfactory conditions have been corrected.
   B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
   C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
   D. Examine threads on valve and mating pipe for form and cleanliness.
   E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
   F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS
   A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
      1. Shutoff Service: Ball, butterfly, gate, or plug valves.
      2. Throttling Service: Ball, butterfly, or globe valves.
      3. Pump Discharge: Swing check, lift-disc check valves.
   B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
   C. Domestic Water Piping: Use the following types of valves:
      1. PEX-to-PEX, lead-free (LF) brass ball valves (1/2 inch (13 mm) through 2 inch (50 mm) nominal pipe size)
         a. Manufacturers: Provide ball valve(s) from the same manufacturer as the piping system.

c. LF brass valve with a positive stop shoulder.


e. Provide stem extension kits for insulated piping.

2. PEX-to-NPSM, lead-free (LF) full-port brass water meter service valve

a. 3/4 inch PEX x 1 inch NPSM straight and elbow

b. 1 inch PEX x 1-1/4 inch NPSM straight and elbow

c. Metal and polypropylene NPSM union nut

d. In compliance with 250 CWP, ANSI/NSF 359, ANSI/NSF 14/61, cNSF-us-pw_G lead free 0.25% lead maximum, ASTM F1960, ASTM F877 (CAN/CSA B137.5).

3. Ball Valves, NPS 2 (DN 50) and Smaller: Two-piece, [400-psig (2760-kPa)] CWP rating, copper alloy.

4. Ball Valves, NPS 2-1/2 (DN 65) and Larger: Class 150, ferrous alloy.

5. Swing Check Valves, NPS 2 (DN 50) and Smaller: Type 4, Class [125] [150], bronze.

6. Swing Check Valves, NPS 2-1/2 (DN 65) and Larger: Type II, Class 125, gray iron.

7. Gate Valves, NPS 2 (DN 50) and Smaller: Type [1] [2], Class 150, bronze-mounted cast iron.

8. Gate Valves, NPS 2-1/2 (DN 65) and Larger: Type I, Class 125, bronze-mounted cast iron.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

3.4 JOINT CONSTRUCTION

A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

END OF SECTION
SECTION 22 0529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY
B. Includes But Not Limited To:
   1. Common hanger and support requirements and procedures for plumbing systems.
C. Products Installed But Not Furnished Under This Section:
   1. Paint identification for gas piping used in HVAC equipment.

1.2 SUBMITTALS
B. Action Submittals:
   1. Product Data:
      b. Manufacturer’s catalog data for each manufactured item.

PART 2 - PRODUCTS

2.1 ASSEMBLIES
B. Manufacturers:
   1. Manufacturer Contact List:
      a. Anvil International,
      b. Cooper B-Line,
      c. Unistrut, Wayne,
C. Materials:
   1. Hangers, Rods, And Inserts
      a. Galvanized and UL approved for service intended.
      b. Support horizontal piping from hangers or on roller assemblies with channel supports, except where trapeze type hangers are explicitly shown on Drawings. Hangers shall have double nuts.
      1) Support insulated pipes 2 inches in diameter and smaller with adjustable swivel ring hanger with insulation protection shield. Gauge and length of shield shall be in accordance with Anvil design data.
         a) Type Two Acceptable Products:
            (1) Swivel Ring Hanger: Anvil Fig. 69.
            (2) Insulation Protection Shield: Anvil Fig. 167.
            (3) Equals by Cooper B-Line.
        2) Support insulated pipes 2-1/2 inches in diameter and larger with clevis hanger or roller assembly with an insulation protection shield. Gauge and length of shield shall be according to Anvil design data.
           a) Type Two Acceptable Products:
              (1) Clevis Hanger: Anvil Fig. 260.
              (2) Roller Assembly: Anvil Fig. 171.
              (3) Insulation Protection Shield: Anvil Fig. 167.
              (4) Equals by Cooper B-Line.
        3) Support uninsulated copper pipe 2 inches in diameter and smaller from swivel ring hanger, copper plated and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from swivel ring hanger.
           a) Type Two Acceptable Products:
              (1) Swivel Ring Hanger For Copper Pipe: Anvil Fig. CT-69.
              (2) Swivel Ring Hanger For Other Pipe: Anvil Fig. 69.
              (3) Equals by Cooper B-Line.
4) Support uninsulated copper pipe 2-1/2 inches in diameter and larger from clevis hanger, copper plated hangers and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from clevis hanger.
   a) Type Two Acceptable Products:
      (1) Clevis Hanger For Copper Pipe: Anvil Fig. CT-65.
      (2) Clevis Hanger For Other Pipe: Anvil Fig. 260.
      (3) Equals by Cooper B-Line.
   c. Support rods for single pipe shall be in accordance with following table:
   b. Support rods for multiple pipe supported on steel angle trapeze hangers shall be in accordance with following table:

<table>
<thead>
<tr>
<th>Rods Number</th>
<th>Diameter</th>
<th>Number of Pipes per Hanger for Each Pipe Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2 Inch</td>
</tr>
<tr>
<td>2</td>
<td>3/8 Inch</td>
<td>Two</td>
</tr>
<tr>
<td>2</td>
<td>1/2 Inch</td>
<td>Three</td>
</tr>
<tr>
<td>2</td>
<td>5/8 Inch</td>
<td>Six</td>
</tr>
<tr>
<td>2</td>
<td>5/8 Inch</td>
<td>Nine</td>
</tr>
<tr>
<td>2</td>
<td>5/8 Inch</td>
<td>Twelve</td>
</tr>
</tbody>
</table>

(Size trapeze angles so bending stress is less than 10,000 psi)

2. Riser Clamps For Vertical Piping:
   a. Type Two Acceptable Products:
      1) Anvil Fig. 261.
      2) Equals by Cooper B-Line.
      3) Concrete Inserts:
   b. Suitable for special nuts size 3/8 inch through 7/8 inch with yoke to receive concrete reinforcing rods, and with malleable iron lugs for attaching to forms.
   b. Type Two Acceptable Products:
      1) Fig. 282.
      2) Equals by Cooper B-Line.
   c. Concrete Inserts:
      1) Class Two Quality Standard: Equal to Unistrut P-3200 series.
      5. Steel Deck Bracket:
         a. Class Two Quality Standard: Equal to Unistrut P1000 with clamp nut, minimum 6 inch length.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work: If project contains concrete structural system.
   1. Furnish inserts for attaching hangers that are to be cast in concrete floor construction at time floors are poured.

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

2. Gas piping identification:
b. Apply paint identification for gas piping used with HVAC equipment as specified in Section 22 0529.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install identification of plumbing piping and equipment as described in Contract Documents.

PART 2 - PRODUCTS

2.1 SYSTEM

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

PART 3 - EXECUTION

3.1 APPLICATION

A. Labels:
   1. Identify following items with specified labels fastened to equipment with screws (unless noted otherwise):
   2. Water Heaters.
   3. Engrave following data from Equipment Schedules on Drawings onto labels:
      a. Equipment mark.
      b. Room(s) served.
      c. Panel and breaker from which unit is powered.

B. Painting:
   1. Only painted legends, directional arrows, and color bands are acceptable.
   2. Locate identifying legends, directional arrows, and color bands at following points on exposed piping of each piping system:
      a. Adjacent to each item of equipment.
      b. At point of entry and exit where piping goes through wall.
      c. On each riser and junction.
      d. Every 25 feet on long continuous lines.
      e. Stenciled symbols shall be one inch high and black.
3.2 ATTACHMENTS
A. Schedules:
   1. Pipe Identification Schedule:
      a. Apply stenciled symbols as follows:

      | Pipe Use           | Abbreviation |
      |--------------------|--------------|
      | Domestic Cold Water| CW           |
      | Domestic Hot Water | HW           |

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Includes But Not Limited To:
   1. Furnish and install insulation on HOT and COLD water lines, fittings, valves, and accessories as described in Contract Documents.
   2. Furnish and install insulation on roof drain piping as described in Contract Documents.
B. Related Requirements:
   1. Section 22 1116: ‘Domestic Water Piping’.

1.2 SUBMITTALS
A. Informational Submittals:
   1. Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.3 QUALITY ASSURANCE
A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
   1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING
A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

<table>
<thead>
<tr>
<th>Service Water Temperature</th>
<th>Pipe Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1-1/4 In</td>
<td>1-1/2 to 2 In</td>
</tr>
<tr>
<td>170 - 180 Deg F</td>
<td>One In</td>
</tr>
<tr>
<td>140 - 160 Deg F</td>
<td>1/2 In</td>
</tr>
<tr>
<td>45 - 130 Deg F</td>
<td>1/2 In</td>
</tr>
</tbody>
</table>

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

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

PART 2 - PRODUCTS

2.1 COMPONENTS
A. Manufacturers:
   1. Manufacturer Contact List:
B. Materials:

1. Above Grade Metal Piping:
   a. Insulation For Piping:
      1) Snap-on glass fiber or heavy density pipe insulation with factory vapor jacket.
      2) Insulation Thickness:
      3) Performance Standards: Fiberglas ASJ by Owens-Corning.
      4) Type One Acceptable Manufacturers:
         a) Childers Products.
         b) Knauf.
         c) Manson.
         d) Owens-Corning.
         e) Johns-Manville.
         f) Equal as approved by Architect before bidding. See Section 01 6200.
   b. Fitting, Valve, And Accessory Covers:
      1) PVC.
      3) Type One Acceptable Manufacturers:
         a) Knauf.
         b) Speedline.
         c) Johns-Manville.
         d) Equal as approved by Architect before bidding. See Section 01 6200.

2. Below Grade Metal Piping:
   a. Insulation:
      1) 1/2 inch (13 mm) thick.
      2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
         a) SS Tubolit by Armacell.
         b) ImcoLock by Imcoa.
         c) Nomalock or Therma-Cel by Nomaco.
   b. Joint Sealant:
      1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
         a) Armacell 520.
         b) Nomaco K-Flex R-373.

3. Pex Piping, Above And Below Grade:
   a. Insulation:
      1) 1/2 inch (13 mm) thick.
      2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
         a) SS Tubolit
         b) by Armacell.
         c) ImcoLock by Imcoa.
         d) Nomalock or Therma-Cel by Nomaco.
   b. Joint Sealant:
      1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
         a) Armacell 520.
         b) Nomaco K-Flex R-373.

4. PP-R Piping, Above And Below Grade:
   a. Insulation:
      1) 1/2 inch (13 mm) thick.
      2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
a) SS Tubolit by Armacell.
b) ImcoLock by Imcoa.
c) Nomalock or Therma-Cel by Nomaco.

b. Joint Sealant:
   1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
      a) Armacell 520.
      b) Nomaco K-Flex R-373.

5. PVC or ABS Piping, Above And Below Grade - Facility Storm Drain:
a. Insulation:
   1) 1/2 inch (13 mm) thick.
   2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
      a) SS Tubolit by Armacell.
      b) ImcoLock by Imcoa.
      c) Nomalock or Therma-Cel by Nomaco.

b. Joint Sealant:
   1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
      a) Armacell 520.
      b) Nomaco K-Flex R-373.

PART 3 - EXECUTION
3.1 APPLICATION
A. Above Grade Piping:
   1. Apply insulation to clean, dry piping with joints tightly butted.
   2. Install insulation in manner to facilitate removal for repairs. Place sections or blocks so least possible
damage to insulation will result from inspection or repairs of piping or equipment.
   3. Piping up to 1-1/4 inch Diameter:
      a. Adhere ‘factory applied vapor barrier jacket lap’ smoothly and securely at longitudinal laps with white
         vapor barrier adhesive.
      b. Adhere 3 inch wide self-sealing butt joint strips over end joints.
   4. Piping 1-1/2 inches Diameter And Larger:
      a. Use broken-joint construction in application of two-layer covering.
      b. Fill cracks and depressions with insulating cement mixed to thick plastic paste.
         1) Apply by hand in several layers to make up total specified thickness.
         2) Final layer shall have smooth uniform finish before application of covering.
   5. Fittings, Valves, And Accessories:
      a. Do not apply insulation over flanged joints or victaulic couplings until piping has been brought up to
         operating temperature and flange bolts have been fully tightened. Insulate valves so wheel, stem, and
         packing nut are exposed.
      b. Insulate with same type and thickness of insulation as pipe, with ends of insulation tucked snugly into
         throat of fitting and edges adjacent to pipe insulation tufted and tucked in.
      c. Piping Up To 1-1/4 Inch Diameter:
         1) Cover insulation with one piece fitting cover secured by stapling or taping ends to adjacent pipe
            covering.
         2) Alternate Method:
            a) Insulate fittings, valves, and accessories with one inch of insulating cement and vapor
               seal with two 1/8 inch wet coats of vapor barrier mastic reinforced with glass fabric
               extending 2 inches onto adjacent insulation.
      d. Piping 1-1/2 inches To 2 Inches :
         1) Insulate with hydraulic setting insulating cement or equal, to thickness equal to adjoining pipe
            insulation.
         2) Apply final coat of fitting mastic over insulating cement.
      e. Piping 2-1/2 inch And Larger:
         1) Insulate with segments of molded insulation securely wired in place and coated with skim
            coat of insulating cement.
         2) Apply fitting mastic, fitting tape and finish with final coat of fitting mastic.
   6. Pipe Hangers:
      a. Do not allow pipes to come in contact with hangers.
      b. Pipe Shield:
         1) Provide schedule 40 PVC by 6 inch oong at each clevis and/or unistrut type hanger.
2) Provide 16 ga by 6 inch long galvanized shields at each pipe hanger to protect pipe insulation from crushing by clevis hanger.
3) Provide 22 ga by 6 inch long galvanized shield at each pipe hanger to protect insulation from crushing by Unistrut type hanger.

c. At Pipe Hangers:
   1) Provide rigid calcium silicate insulation (100 psi compressive strength) at least 2 inches beyond shield.

7. Protect insulation wherever leak from valve stem or other source might drip on insulated surface, with aluminum cover or shield rolled up at edges and sufficiently large in area and of shape that dripping will not splash on surrounding insulation.

B. Below Grade Piping:
   1. Slip underground pipe insulation onto pipe and seal butt joints.
   2. Where slip-on technique is not possible, slit insulation, apply to pipe, and seal seams and joints.

3.2 EXAMINATION
A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION
A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.4 GENERAL APPLICATION REQUIREMENTS
A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
G. Keep insulation materials dry during application and finishing.
H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
I. Apply insulation with the least number of joints practical.
J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
K. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
   1. Apply insulation continuously through hangers and around anchor attachments. Insulation around hanger or pipe clamp will not be acceptable.
   2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
   3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
L. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
M. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
N. Apply insulation with integral jackets as follows:
   1. Pull jacket tight and smooth.
   2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.
3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
   a. Exception: Do not staple longitudinal laps on insulation having a vapor retainer.
4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
   1. Seal penetrations with vapor-retarder mastic.
   2. Apply insulation for exterior applications tightly joined to interior insulation ends.
   3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
   4. Seal metal jacket to roof flashing with vapor-retarder mastic.

P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
   1. Firestopping and fire-resistive joint sealers are specified in Section “Firestopping.”

3.5 MINERAL-FIBER INSULATION APPLICATION
A. Apply insulation to straight pipes and tubes as follows:
   1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
   2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
   3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
   4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

3.6 INSULATION TO FLANGES APPLICATION:
A. Apply insulation to flanges as follows:
   1. Apply preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Apply canvas jacket material with manufacturer’s recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

B. Apply insulation to fittings as follows:
   1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
   3. Cover fittings with standard PVC fitting covers.
C. Apply insulation to valves and specialties as follows:
   1. Apply premolded segments of cellular-glass insulation or glass-fiber blanket insulation to valve body.
   2. Apply insulation to flanges as specified for flange insulation application.
   3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer’s attachments and accessories. Seal seams with tape and vapor-retarder mastic.
   4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.
3.7 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
   1. Apply jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of jacket manufacturer's recommended adhesive.
   3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.
   1. Draw jacket material smooth and tight.
   2. Apply lap or joint strips with the same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Apply jackets with 1-1/2-inch (40-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

C. Apply metal jacket where indicated, with 2-inch (50-mm) overlap at longitudinal seams and end joints.
   Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.8 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

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

3.9 INTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Domestic water piping.
   1. Operating Temperature: 60 to 80 deg F
   2. Insulation Material: Mineral Fiber
   3. Insulation Thickness: 1" thick.
   5. Vapor Retarder Required: Yes.
   6. Finish: None.

B. Service: Domestic hot and recirculated hot water.
   1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).
   2. Insulation Material: Mineral fiber
   3. Insulation Thickness: 1" thick
   5. Vapor Retarder Required: No.
   6. Finish: None.

C. Service: Condensate and equipment drain piping.
   1. Operating Temperature: 40 to 60 deg F
   2. Insulation Material: Flexible elastomeric, only on first ten feet of pipe from trap.
   3. Insulation Thickness: 3/4"
   5. Vapor Retarder Required: No.
   6. Finish: Two coats of the insulation manufacturer's recommended protective coating.

D. Service: Refrigerant suction and hot-gas piping.
   1. Operating Temperature: 35 to 50 deg F
   2. Insulation Material: Flexible elastomeric.
   3. Insulation Thickness: 1" thick.
   5. Vapor Retarder Required: Yes.
   6. Finish: None.

E. Service: For obtaining fire/smoke rating in return air plenum (calbes, PE, PB, PP, ABS, PVC, CPVC, etc).
1. Operating Temperature: 35 to 90 deg F
2. Insulation Material: 3M Fire Barrier Plenum Wrap 5 A or equal.
3. Insulation Thickness: larger of 1" or mfr’s recommendations.
4. Field-Applied Jacket: scrim reinforced foil
5. Vapor Retarder Required: None.
6. Finish: None.

3.10 EXTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Domestic water.
   1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).
   2. Insulation Material: Mineral fiber.
   3. Insulation Thickness: Apply the following insulation thicknesses: 1"
   5. Vapor Retarder Required: Yes.
   6. Finish: None.

B. Service: Refrigerant suction.
   1. Operating Temperature: 35 to 50 deg F (2 to 10 deg C).
   2. Insulation Material: Flexible elastomeric.
   3. Insulation Thickness: Apply the following insulation thicknesses: ½"
   4. Field-Applied Jacket: Aluminum
   5. Vapor Retarder Required: Yes.
   6. Finish: None.
PART 1 GENERAL

1.1 SECTION INCLUDES
A. Domestic water piping and fittings for the following applications:
   1. Domestic cold water piping
   2. Domestic hot water piping
   3. Domestic hot water recirculation piping

1.2 RELATED SECTIONS
A. Section 22 1113 — Facility Water Distribution Piping
B. Section 22 0719 — Plumbing Piping Insulation
C. Section 22 0529 — Hangers and Supports for Plumbing Piping and Equipment

1.3 REFERENCES
A. ASTM International (ASTM)
   1. ASTM D 2765 Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics.
  12. ASTM F2657 Standard Test Method for Outdoor Weathering Exposure of Crosslinked Polyethylene (PEX) Tubing

B. American Water Works Association
   1. AWWA C904 Standard for Crosslinked Polyethylene (PEX) Pressure Pipe, 1/2 in. Through 3 in., for Water Service.

C. American National Standards Institute (ANSI)/National Sanitation Foundation (NSF)
   1. ANSI/NSF Standard 14 Plastics Piping System Components and Related Materials
   2. ANSI/NSF Standard 61 Drinking Water System Components - Health Effects
   4. ANSI/NSF Standard 372 Drinking Water System Components - Lead Content

D. American National Standards Institute (ANSI)/Underwriters Laboratories, Inc. (UL)

E. American Society of Mechanical Engineers (ASME)
2. ASME B16.51 Copper and Copper Alloy Press-Connect Pressure Fittings.

F. Canadian Standards Association (CSA)
1. CAN/CSA B137.11 Polypropylene Pipe and Fittings for Pressure Applications
2. CAN/CSA B137.5 Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
3. CSA B242-05 Groove-and Shoulder-Type Mechanical Pipe Couplings.

G. City of Los Angeles, California
1. Research Report RR-5482

H. German Welding Society (DVS)

I. Department of Housing and Urban Development
1. Materials Release no. 1269f

J. International Code Council (ICC)
1. International Plumbing Code (IPC)
2. Evaluation Service Report PMG-1006 and PMG-1412
3. ICC-ES PMG — 1106
4. International Association of Plumbing Officials (IAPMO)
5. Uniform Plumbing Code (UPC)
6. Evaluation Report 253

K. State of Massachusetts Division of Professional Licensure

L. National Association of Plumbing, Heating and Cooling Contractors (NAPHCC)
1. National Standard Plumbing Code (NSPC)

M. Plastics Pipe Institute (PPI)
1. PPI Technical Report TR-4

N. QAI Laboratories
1. P321-1 Water Pipe Systems - Plumbing Product-Pipe and Accessories
2. P321-2 Water Pipe Systems - Plumbing Product-Plastic Piping and Accessories

O. Underwriters Laboratories (UL)

P. Uponor Inc.

1.4 SUBMITTALS
A. Submit under provisions of Section 01 30 00 — Administrative Requirements.
B. Product data: Provide manufacturer's product submittal data.
C. Shop drawings: Provide installation drawings indicating piping layout, size dimension by installation segment, vault locations, support fixtures and schedules with all details required for installation of the system.
D. Samples: Submit selection and verification samples of piping.
E. Quality assurance/control submittals
1. Test reports: Upon request, submit test reports from recognized testing laboratories.
2. Submit the following documentation.
   a. Manufacturer's certificate stating that products comply with specified requirements.
   b. Manufacturer's flow schedule for the distribution system.
   c. Documentation that the installer is trained to install the manufacturer's products.

F. Closeout submittals: Submit the following documents.
   1. Warranty documents specified herein.
   2. Operation and maintenance data.
   3. Manufacturer's field reports specified herein.
   4. Final as-built piping layout drawing.

1.5 QUALITY ASSURANCE
A. Installer qualifications: Installer shall have successfully completed the Uponor Piping Systems Training Course and is able to provide proof/verification. Course shall be conducted by the manufacturer or a manufacturer's representative.
   1. Regulatory requirements and approvals: Ensure the piping distribution system complies with all applicable codes and regulations.
   2. Certifications: Provide letters of certification indicating: Installer uses skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed tradesperson.
   3. Pre-installation meetings:
      a. Verify project requirements, excavation conditions, system performance requirements, manufacturer's installation instructions and warranty requirements.
      b. Review project construction timeline to ensure compliance or discuss modifications as required.
      c. Interface with other trade representatives to verify areas of responsibility.
      d. Establish the frequency and construction phase the project engineer intends for site visits and inspections by the tubing manufacturer's representative.

1.6 DELIVERY, STORAGE AND HANDLING
A. General: Comply with Division 1 Product Requirement Section.
B. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
D. Storage and protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
   1. Store PEX piping in cartons or under cover to avoid dirt or foreign material from entering the piping.
   2. Do not expose white PEX tubing to direct sunlight for more than one month or red or blue PEX tubing to direct sunlight for more than 6 months. If construction delays are encountered, cover the tubing to prevent exposure to direct sunlight.
   3. Store piping on a flat surface to prevent unwanted deformation.

1.7 WARRANTY
A. Project warranty: Refer to Conditions of the Contract for project warranty provisions.
B. Manufacturer's warranty: PEX-a manufacturer system warranty shall cover piping and fittings for a duration of 25 years from the date of installation. Piping system
warranty shall apply to potable water distribution and water service systems constructed of pipe and fitting products sourced from the same manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS


B. Requests for substitutions will be considered by way of written request prior to bid date.

C. For exterior and underground use: PVC piping Acceptable manufacturer: Charlotte Pipe company.

2.2 DOMESTIC WATER PIPING AND FITTINGS

A. Performance requirements:
   1. PEX-a piping and fittings shall meet the following pressure and temperature ratings per ASTM F876:
      a. 200 degrees F (93 degrees C) at 80 psi (551 kPa).
      b. 180 degrees F (82 degrees C) at 100 psi (689 kPa).
      c. 73.4 degrees F (23 degrees C) at 160 psi (1,102 kPa).
   2. PEX-a piping and fittings shall be tested for compliance by an independent third-party agency.
   3. Minimum bend radius (cold bending): Six times the outside diameter.
   4. Show compliance with ASTM E119 and ANSI/UL 263 through certification listings through UL.
      a. UL Design No. L557 1 hour wood frame floor/ceiling assemblies.
      b. UL Design No. K913 2 hour concrete floor/ceiling assemblies.
      c. UL Design No. U372 1 hour wood stud/gypsum wallboard wall assemblies.
      d. UL Design No. V444 1 hour steel stud/gypsum wallboard wall assemblies.
   5. PEX-a piping shall be tested to comply with the ASTM F2023 requirement for minimum chlorine resistance at the end use condition of 100% of the time at 140°F (60°C) at 80 psi (0.55 MPa) gauge pressure.
      a. PEX-a piping and tubing material designation codes shall be PEX 5106 or PEX 5306.

B. Piping: To be use for interior application.
   1. Uponor AquaPEX®
      a. PEX-a (Engel-method crosslinked polyethylene), ASTM F876 and F877 (CAN/CSA-B137.5), SDR 9, CTS, 1/2 inch (16mm) through 3 inch (75mm) nominal pipe size.
   2. Uponor AquaPEX pre-sleeved piping
      a. High-density polyethylene (HDPE) corrugated sleeved PEX-a (Engel-method crosslinked polyethylene), ASTM F876 and F877 (CAN/CSA-B137.5), SDR 9, CTS, 1/2 inch (16mm) and 3/4 inch (19 mm) nominal pipe size.
   3. Uponor pre-insulated piping
      a. Factory fabricated and assembled Uponor AquaPEX PEX-a piping with a closed-cell polyethylene foam insulation, 1/2 inch (16mm) through 2 inch (51mm) nominal pipe size.
         1) Insulation shall not be exposed to groundwater.

C. Fittings:
   1. Uponor ProPEX®
a. Third-party certified to NSF 14 and ASTM F1960 cold-expansion with PEX reinforcing ring and shall comply with ASTM F876 and ASTM F877, 1/2 inch through 3 inch nominal pipe size fittings manufactured from the following material types:

b. Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked “F1960”.

2. Uponor multiport tees and elbows: Multiple-outlet fitting complying with ASTM F877 (CAN/CSA B137.5); with ASTM F1960 inlets and outlets.

   a. Type L copper branch manifold with lead-free brass valve outlets
   b. Type L copper branch manifold without valves, with lead-free brass outlets.

D. PVC PIPE AND FITTINGS: To be use for underground and exterior application.
   1. PVC Pipe: ASTM D 1785, Schedule 40.
   3. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer.
   4. All pipe and fittings shall be manufactured in the United States.

2.3 TRANSITION FITTINGS

A. PEX-to-metal transition fittings:
   1. Manufacturers: Provide fittings from the same manufacturer of the piping.
   2. Third-party certified to NSF 14 and ASTM F1960 cold-expansion with PEX reinforcing ring and shall comply with ASTM F876 and ASTM F877, 1/2 inch through 3 inch nominal pipe size fittings manufactured from the following material types:
   3. PEX-a to thread transition: One-piece Lead free (LF) brass fitting with male or female threaded adapter and ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
   4. PEX-a to copper sweat transition: One-piece lead free (LF) brass fitting with sweat adapter and ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
   5. PEX-a to copper press transition: One-piece lead free (LF) brass fitting with one ASME B16.51 copper press end and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
   6. PEX-a to flange transition: Two-piece fitting with one steel flange conforming to ASME B16.5 and one lead free (LF) brass adapter conforming to ASTM F1960.
   7. PEX-a to groove transition: One-piece lead free (LF) brass fitting with one CSA B242-05 groove end in either iron pipe size (IPS) or copper tube size (CTS) and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
   8. PEX-a to water meter transition: Two-piece fitting with one NPSM union thread and one ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.

B. PEX-to-thermoplastic transition fittings:
   1. PEX-a to CPVC transition: Thermoplastic fitting with one spigot or socket end and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.

C. PVC fittings: Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
D. **ASTM F 656.**
   1. Adhesive primer shall have a VOC content of 550 g/L or less.
   2. Adhesive primer shall comply with the testing and product requirements of the Texas Department of Public Health’s “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.”
   3. Adhesive primer shall have a VOC content of 510 g/L or less.
   4. Adhesive shall comply with the testing and product requirements of the Texas Department of Public Health’s “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.”

E. **VALVES:**
   1. Refer to section 22 0523 General Duty valves for plumbing piping.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

A. Site verification of conditions: Verify that site conditions are acceptable for installation of the domestic water piping. Do not proceed with installation until unacceptable conditions are corrected.

#### 3.2 INSTALLATION

A. Install domestic water piping according to approved shop drawings and coordination drawings.

B. Comply with manufacturer’s product data, including product technical bulletins, installation instructions and design drawings, including the following.

2. PEX shall not be installed in areas within five feet of a UV light source, such as LED and fluorescent light fixtures or other UV generating devices.
3. White PEX shall not be installed outdoors where it is exposed to direct sunlight for more than one month; red or blue PEX shall not be installed outdoors where it is exposed to direct sunlight for more than six months.
4. PEX piping shall be installed per ASTM E84 requirements for plenum applications.
5. Install PEX-a Pipe Support and provide all required hangers and supporting strapping as required by manufacturer to provide a code compliant installation.
6. Install PEX piping in straight runs free of sags and kinks and provide bend supports at all 1/2 inch and 3/4 inch drops.
7. All PEX piping penetrations through wall plates shall be protected or shielded as required to prevent damage to piping.
8. PEX tubing passing through metal studs shall use grommets or sleeves at the penetration.
9. Install PEX piping from the multiport tee or manifold to each fixture as a home run.
10. Install PEX-a Pipe Support, fixed anchor points and hangers in compliance with Uponor Plumbing Design Assistance Manual (PDAM) to minimize expansion and contraction.
11. Install PEX piping at each fixture with out of the wall support bracket to secure piping and prevent excess movement when water stops or shut valves are operated.

12. Install all PEX manifolds centered in access panels to permit servicing.

C. Below ground and exterior use installation.

1. Installation shall comply with the latest installation instructions published by Charlotte Pipe and Foundry and shall conform to all applicable plumbing, fire, and building code requirements.

2. Buried pipe shall be installed in accordance with ASTM F 1668.

3. Solvent cement joints shall be made in a two-step process with primer conforming to ASTM F 656 and solvent cement conforming to ASTM D 2564.

4. The system shall be protected from chemical agents, fire-stopping materials, thread sealant, plasticized-vinyl products, or other aggressive chemical agents not compatible with PVC compounds.

5. The system shall be hydrostatically tested after installation.

D. Backfill

1. The PVC piping system will be backfilled with clean sand material.
   a. Minimum vertical distance from the bottom of the tubing to the trench floor is 6 inches (150 mm).
   b. Minimum lateral distance from the side of the tubing to the trench wall is 6 inches (150 mm).
   c. Install a minimum of 12 inches (300 mm) of clean fill over the top of the piping.

2. The balance of the trench can be backfilled with native soil void of stone greater than 2 inches (50mm) in diameter.

E. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following:


F. PEX-a hangers and supports

   a. Note: Per ICC PMG-1006, the above maximum hanger spacing requirements may be extended with the use of a continuous support channel such as Uponor PEX-a Pipe Support.

2. Horizontal PEX-a piping with PEX-a Pipe Support: Install supports for PEX-a piping with horizontal support channel in accordance with manufacturer's recommendations and the following maximum spacing:
   a. 3 inch nominal and smaller: Maximum span, 8 feet (2.4 m).
   b. Support 1-1/2 inch and smaller fittings within 12 inches (0.3 m).

   a. Support vertical in-wall piping every 5 feet (1.5 m).
   b. Support riser piping at the base of each floor and every 5 feet (1.5 m) vertically.
      1) Refer to the Uponor Piping Systems Installation Guide, current edition, for additional requirements.
G. Piping schedule
   1. Above ground domestic water piping shall be the following:
      a. 3 inch (75mm) and smaller
         1) PEX-a piping with engineered polymer (EP) or lead-free brass ASTM F1960 cold-expansion fittings.
      b. 2 inch (51mm) and smaller:
         1) Pre-Insulated PEX-a piping with engineered polymer (EP) or lead-free brass ASTM F1960 cold-expansion fittings.
   2. Domestic water piping installed below ground shall be any of the following:
      a. PVC sch. 40. Protect all slab penetrations.
   3. Domestic water piping installed within slabs shall be the following:
      a. 3 inch (75mm) and smaller:
         1) PEX-a piping. No joints or fittings shall be installed within slab. Protect all slab penetrations.
      b. 1/2 inch (13 mm) and 3/4 inch (19 mm):
         1) Pre-sleeved PEX-a piping. No joints or fittings shall be installed within slab. Protect all slab penetrations.
      c. 2 inch (51mm) and smaller:
         1) Pre-Insulated PEX-a piping. No joints or fittings shall be installed within slab. Protect all slab penetrations.

H. Pipe joint construction
   1. PEX-a connections:
      a. Install per manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL
   A. Pressure testing PEX pipe and fittings: Pressure test PEX-a piping systems in accordance with local code and manufacturer's requirements.
   B. System flushing, pressure testing and system conditioning procedure:
      1. Hydrostatic pressure testing shall be completed in accordance with local Codes and the Uponor Plumbing Design Assistance Manual (PDAM).
      2. Leave joints uninsulated and exposed for the duration of the test.
      3. Flush the domestic water system with ambient temperature, clean, potable water unless there is a risk of damage due to freezing.
      4. After completing each hydrostatic leak testing procedure, drain the system until empty.
      5. If testing with compressed air, do not exceed 120 psi.

3.4 CLEANING
   A. Remove temporary coverings and protection of adjacent work areas.
   B. Repair or replace damaged installed products.
   C. Clean the installed products in accordance with manufacturer's instructions prior to Owner's acceptance.
   D. Water system disinfection
      1. Uponor AquaPEX piping should be disinfected in accordance with AWWA C651, Standard for Disinfecting Water Mains, or local codes.
      2. Use non-petroleum-based cleaners
      3. Not exceed a pH of 11
      4. Have water temperatures less than 140°F (60°C)
      5. Use a chlorine solution of 50 parts per million (ppm) for 24 hours or 200 ppm for three hours for disinfection.
6. To prevent reduced service life of system components, disinfection solutions should not stand in the system longer than 24 hours. Flush the system with potable water after disinfection.

3.5 PROTECTION
A. Protect installed work from damage caused by subsequent construction activity on the site.
B. Water system will not be accepted until negative bacteriological test is made on water taken from system. Repeat dosing as necessary until such negative test is accomplished.

END OF SECTION
PART 1 - GENERAL

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

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

PART 2 - PRODUCTS

2.1 BALANCING VALVES
A. Calibrated Balancing Valves: Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.
B. Manufacturers:
   1. Armstrong Pumps, Inc.
   3. ITT Industries; Bell & Gossett Div.
   4. Taco, Inc.
   6. 2" and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.
   7. 2" and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.
   8. 2.5" and Larger: Cast-iron, Y-pattern body with bronze disc and flanged or grooved ends.
C. B. Memory-Stop Balancing Valves, NPS 2 (DN 50) and smaller: MSS SP-110, ball valve, rated for 400-psig (2760-kPa) minimum CWP. Include two-piece, copper-alloy body with full-port, chrome-plated brass ball, replaceable seats and seals, threaded or solder-joint ends, and vinyl-covered steel handle with memory-stop device.
D. Manufacturers:
   1. Conbraco Industries, Inc.
   2. Crane Co., Crane Valve Group; Crane Valves.
   4. NIBCO INC.
   5. Red-White Valve Corp.
2.2 STRAINERS
A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch (1.2-mm) round perforations, unless otherwise indicated.
   1. Pressure Rating: 125-psig (860-kPa) minimum steam working pressure, unless otherwise indicated.
   2. NPS 2 (DN 50) and Smaller: Bronze body, with female threaded ends.
   3. NPS 2-1/2 (DN 65) and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.

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

2.4 KEY-OPERATION HYDRANTS
A. Manufacturers:
   1. Josam Co.
   3. Woodford Manufacturing Co.
B. General: ASME A112.21.3M, key-operation hydrant with pressure rating of 125 psig.
   1. Inlet: 3/4 “ or NPS 1” threaded or solder joint.
   3. Operating Keys: One with each key-operation hydrant.
C. Moderate-Climate, Concealed-Outlet Wall Hydrants: ASSE 1019, self-drainable with flush-mounting box with cover, integral nonremovable hose-connection vacuum breaker, and concealed outlet.
   1. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
D. Hot and Cold, Nonfreeze Concealed-Outlet Wall Hydrants: With deep flush-mounting box with cover; hot- and cold-water casings and operating rods to match wall thickness; concealed outlet; wall clamps; and factory- or field-installed, nonremovable and manual drain-type, hose-connection vacuum breaker complying with ASSE 1011.

2.5 ROOF HYDRANTS
A. Design Criteria:
   1. Provide dual check backflow preventer.
2. Non-freeze.
3. Drain port - connect to drain

2.6 TRAP SEAL PRIMER VALVES
A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:
B. Manufacturers:
1. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Precision Plumbing Products, Inc.
5. 125-psig (860-kPa) minimum working pressure.
6. Bronze body with atmospheric-vented drain chamber.
7. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
8. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
9. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.7 MISCELLANEOUS PIPING SPECIALTIES
A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, metal-bellows type with pressurized metal cushioning chamber. Sizes indicated are based on ASSE 1010 or PDI-WH 201, Sizes A through F.
B. Manufacturers:
1. Josam Co.
3. Tyler Pipe; Wade Div.
C. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet, of design suitable for pressure of at least 125 psig (860 kPa); integral [or field-installed,] nonremovable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.
D. Roof Flashing Assemblies: Manufactured assembly made of [4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm-)] [6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch- (2.4-mm-)] thick, lead flashing collar and skirt extending at least [6 inches (150 mm)] [8 inches (200 mm)] [10 inches (250 mm)] from pipe with galvanized steel boot reinforcement, and counterflashing fitting.
E. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
F. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semiopen top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.
G. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
H. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
I. Vent Terminals: Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.
J. Expansion Joints: ASME A112.21.2M, assembly with cast-iron body with bronze sleeve, packing gland, and packing; of size and end types corresponding to connected piping.

2.8 SLEEVE PENETRATION SYSTEMS
A. Manufacturers:
1. ProSet Systems, Inc.
B. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
1. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
3. Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

2.9 FLASHING MATERIALS
A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Use: 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
   2. Vent Pipe Flashing: 3-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
   3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
C. Fasteners: Metal compatible with material and substrate being fastened.
D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
E. Solder: ASTM B 32, lead-free alloy.
F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.
   1. Not required to meet NSF International Standards for Lead Free.
   2. Category Four Approved Products. See Section 01 62 00 for definitions of Categories:
      1) Jay R. Smith: 5907.
      2) Prier: P-RH2.
      3) Woodford: RHY2-MS.
   3. Water Hammer Arrestors:
      1. Design Criteria:
         2) Nesting type, air pre-charged bellows with casing.
         3) Bellows constructed of stabilized 18-8 stainless steel.

PART 3 - EXECUTION
3.1 INSTALLATION
A. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
B. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
C. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
D. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
E. Install expansion joints on vertical risers, stacks, and conductors if indicated.

3.2 CONNECTIONS
A. Install piping adjacent to equipment to allow service and maintenance.
B. Ground equipment.
C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
D. Connect plumbing specialties and devices that require power.

3.3 FLASHING INSTALLATION
A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
1. **Lead Sheets**: Burn joints of lead sheets 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.

B. **Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane**.
   1. **Pipe Flashing**: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
   2. **Sleeve Flashing**: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
   3. **Embedded Specialty Flashing**: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. **Set flashing on floors and roofs in solid coating of bituminous cement**.

D. **Secure flashing into sleeve and specialty clamping ring or device**.

E. **Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to "Sheet Metal Flashing and Trim."

F. **Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess**.

### 3.4 FIELD QUALITY CONTROL

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

**END OF SECTION**
PART 1 - GENERAL

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

1.2 ADMINISTRATIVE REQUIREMENTS
A. Pre-Cover Observation.
   1. Contact Architect/Engineer prior to covering any section of pipe.
   2. All piping all be under pressure during observation

1.3 REFERENCES
A. Reference Standards:
   1. International Code Council:
      a. ICC IPC-2012, 'International Plumbing Code'.

1.4 PERFORMANCE REQUIREMENTS
A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1.5 SUBMITTALS
A. Product Data: For pipe, tube, fittings, and couplings.
B. Shop Drawings: For solvent drainage system, include plans, elevations, sections, and details.
C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 QUALITY ASSURANCE
A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PVC PIPING
A. PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
   1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
B. PVC Special Fittings: ASTM F 409, drainage-pattern tube and tubular fittings with ends as required for application.
C. Plenum Vent Lines: In areas of building with a return air plenum.
   1. Approved Types:
      a. Service weight, single-hub or no-hub type cast iron soil pipe meeting requirements of ASTM A74.
      b. Joint Material:
         1) Single-Hub: Rubber gaskets meeting requirements of ASTM C564.
         2) No-Hub Pipe: Neoprene gaskets with stainless steel cinch bands.
      c. Fittings:
d. Cast Iron Pipe: Hub and spigot, except fittings for no-hub pipe shall be no-hub, and meet requirements of ASTM A74.

1) Joint Material: Rubber gaskets meeting requirements of ASTM C564.

2.2 EXECUTION

2.3 PIPING INSTALLATION

A. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

B. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.

C. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep ¼ bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8- bend fittings if 2 fixture are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

D. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

E. Re-verify building drainage piping slope before covering pipe in trench if left uncovered over a 24 hour period of subjected to exterior water. If slope of piping has changed, provide new shoring material to maintain original slope after trench has been covered.

F. Install soil and waste drainage and vent piping at the code required minimum slopes, unless otherwise indicated:

G. Install engineered soil and waste drainage and vent piping systems in locations indicated and as follows:
   3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

I. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

J. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

2.4 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section "Plumbing Fixtures."
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

2.5 FIELD QUALITY CONTROL
A. Field Tests:
   1. Conduct tests for leaks and defective work. Notify Architect before testing.
   2. Thermoplastic Pipe System:
      a. Before backfilling and compacting of trenches, fill waste and vent system with water to roof level or 10 feet minimum, and show no leaks for two hours. Correct leaks and defective work.
      b. After backfilling and compacting of trenches is complete but before placing floor slab, re-test as specified above. Uncover pipe and correct leaks and defective work. Re-backfill and compact and re-test.
B. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
C. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
E. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
   5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

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

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Products Furnished But Not Installed Under this Section as described in Contract Documents.
   1. Cleanouts.
   2. Floor drains.

1.2 PERFORMANCE REQUIREMENTS
A. Provide components and installation capable of producing piping systems with following
   minimum working-pressure ratings, unless otherwise indicated:
   2. Storm Drainage Piping: 10-foot head of water.

1.3 SUBMITTALS
A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate
   materials, finishes, dimensions, required clearances, and methods of assembly of components;
   and piping and wiring connections for the following:
   1. Cleanouts, floor drains, and roof drains.
   2. Roof flashing assemblies.
   3. Grease interceptors (if applicable)
   4. Sleeve penetration systems.

PART 2 - PRODUCTS

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

2.2 FLASHING MATERIALS
A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and
   thicknesses, unless otherwise indicated:
   1. General Use: 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
   2. Vent Pipe Flashing: 3-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
   3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm)
   minimum thickness.
C. Fasteners: Metal compatible with material and substrate being fastened.
D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units
   required for installation; matching or compatible with material being installed.
E. Solder: ASTM B 32, lead-free alloy.
F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.
2.3 CLEANOUTS
A. Cleanouts: Comply with [ASME A112.36.2M] [ASME A112.3.1] <Insert other>.
   1. Application: [Floor cleanout] [Wall cleanout] [For installation in exposed piping].
   2. Products:
      a. Josam Co.
      b. Mifab
      d. Tyler Pipe, Wade Div.

2.4 FLOOR DRAINS
A. Floor Drains.
   1. Products:
      a. Josam Co.
      b. Mifab
      d. Tyler Pipe, Wade Div.
      e. Zurn Industries, Inc.

PART 3 - EXECUTION
3.1 INSTALLATION
A. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of
   1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck
   plate flush with floor and centered over backwater valve cover, and of adequate size to remove
   valve cover for servicing.
C. Install expansion joints on vertical risers, stacks, and conductors if indicated.
D. Install cleanouts in aboveground piping and building drain piping according to the following,
   unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage
      piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100
      feet (30 m) for larger piping.
   4. Locate at base of each vertical soil and waste stack.
E. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below
   floors.
F. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished
   wall, for cleanouts located in concealed piping.
G. Install flashing flange and clamping device with each stack and cleanout passing through floors
   with waterproof membrane.
H. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according
   to manufacturer's written instructions.
I. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm)
   clearance between vent pipe and roof substrate.
J. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with
   finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with
      grates depressed according to the following drainage area radii:
      a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch
         (6.35-mm) total depression.
      b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
      c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than
         1-inch (25-mm) total depression.
3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

K. Install roof drains at low points of roof areas according to roof membrane manufacturer’s written installation instructions.
1. Install roof-drain flashing collar or flange so no leakage occurs between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

L. Install interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

1. Flush with In-Ground Installation: Set unit and extension, if required, with cover flush with finished grade.
2. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

M. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.

N. Fasten recessed-type plumbing specialties to reinforcement built into walls.

O. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.

P. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS
A. Install piping adjacent to equipment to allow service and maintenance.
B. Ground equipment.
C. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.
D. Connect plumbing specialties and devices that require power according to Division Sections.

E. Interceptor Connections: Connect piping, flow-control fittings, and accessories.
1. Grease Interceptors: Connect inlet and outlet to unit, and flow-control fitting and vent to unit inlet piping.

3.3 FLASHING INSTALLATION
A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
1. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.
D. Secure flashing into sleeve and specialty clamping ring or device.
E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings.
F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
3.4 FIELD QUALITY CONTROL
A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled trap seal primer systems and their installation, including piping and electrical connections. Report results in writing.
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION
A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes plumbing fixtures and related components.

1.3 DEFINITIONS
A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

1.4 SUBMITTALS
A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.

1.5 QUALITY ASSURANCE
A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
   1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
D. NSF Standard: Comply with NSF 61, “Drinking Water System Components—Health Effects,” for fixture materials that will be in contact with potable water.
E. TAS: Texas Accessibility Standards.

1.6 COORDINATION
A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. For fixture descriptions in other Part 2 articles where the subparagraph titles “Products,” and “Manufacturers” introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:
   1. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.

2.2 LAVATORY FAUCETS
A. Lavatory Faucet: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.
   1. Products:
      b. Eljer.
      c. Kohler.
2.3 SINK FAUCETS
A. Sink Faucet: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.
   1. Manufacturers:
      b. Eljer
      c. Kohler

2.4 TOILET SEATS
A. Toilet Seat: Solid plastic.
   1. Manufacturers:
      a. Bemis.
      b. Beneke.
      c. Centoco.
      d. Church.

2.5 PROTECTIVE SHIELDING GUARDS
A. Protective Shielding Guard, Manufactured, plastic enclosure for covering for hot- and cold-water supplies and trap and drain piping and complying with ADA requirements.
   1. Manufacturers:
      a. Engineered Brass Co.
      b. Plumerex
      c. Truebro.

2.6 FIXTURE SUPPORTS
A. Water-Closet Support: Water-closet combination carrier designed for accessible and standard mounting heights. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
   1. Manufacturers:
      a. Mifab
      b. Josam.
      c. Wade.
      d. Zurn
   B. Urinal Support: Wall urinal support system with top support plate. Complete with Dura-Coated rectangular steel uprights with welded feet, adjustable support plate and mounting fasteners.
      1. Manufacturers:
         a. Zurn
         b. Wade
         c. Mifab
   C. Lavatory Support: Lavatory support system with concealed arms. Complete with Dura-Coated rectangular steel uprights with welded feet, cast iron adjustable headers, concealed arms, steel sleeves, alignment truss, and mounting fasteners.
      1. Manufacturers:
         a. J.R. Smith
         b. Zurn
         c. Mifab
   D. Sink Support: Type II, sink carrier with hanger plate, bearing studs, and tie rod. Include steel uprights with feet.
      1. Manufacturers:
         a. Josam.
         b. J.R. Smith
         c. Zurn.

2.7 WATER CLOSETS
A. Water Closets: Accessible, wall-hanging, back-outlet, vitreous-china fixture designed for flushometer valve operation.
1. Products:
   4. TOTO USA, Inc.

B. Water Closets: Ligature Resistant Institutional Combination Lavatory/Toilet
   1. Products:
      a. ACORN
      b. All others shall be submitted for pre-approval prior to bid date.

2.8 LAVATORIES, SINKS
   A. Lavatories,: Accessible, counter top, vitreous-china fixture.
      1. Products:
         a. American Standard, Inc.
         b. Kohler Co.
         c. Toto
         d. CRANE

2.9 SINKS
   A. Sinks: Commercial, counter-mounting, stainless-steel fixture.
      1. Products:
         a. Elkay Manufacturing Co.
         b. Just Manufacturing Co.

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

PART 3 - EXECUTION

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

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

3.3 CONNECTIONS
A. Piping installation requirements are specified in other Division 22 & 23 sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect water supplies from water distribution piping to fixtures.
C. Connect drain piping from fixtures to drainage piping.
D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.
E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
F. Ground equipment.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL
A. Verify that installed fixtures are categories and types specified for locations where installed.
B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

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

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

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

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes the following:
      1. Drinking fountains.
      2. Self-contained drinking fountains.
      3. Fixture supports.

1.3 DEFINITIONS
   A. Accessible Drinking Fountain: Fixture that can be approached and used by people with disabilities.
   B. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
   C. Fitting: Device that controls flow of water into or out of fixture.
   D. Fixture: Drinking fountains, unless one is specifically indicated.

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

1.5 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
   D. TAS: Texas Accessibility Standards.

1.6 COORDINATION
   A. Coordinate roughing-in and final fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified below.
      1. Elkay.
      2. Halsey Taylor.

2.2 DRINKING FOUNTAINS
   A. Drinking Fountains: Accessible, wall-hanging fixture made of stainless steel.
      1. Receptor Shape: Rectangular and oval, refer to model numbers.
5. Bottle filling station.
6. Non-Filtered non refrigerated.
7. Sanitary sensor activated.
8. Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve.
10. Support: Type I carrier. Refer to "Fixture Supports" Article.

2.3 FIXTURE SUPPORTS
A. Off-Floor, Plumbing Fixture Supports: ASME A112.6.1M, water-cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
   1. Available Manufacturers:
      2. Manufacturers:
         a. Josam Co.
         c. Tyler Pipe; Wade Div.
         d. Zurn Specifications Drainage Operation.
   3. Type I: Hanger-type carrier with two vertical uprights.
   4. Type II: Bilevel, hanger-type carrier with three vertical uprights.
   5. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
B. Examine walls and floors for suitable conditions where fixtures are to be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS
A. Use carrier off-floor supports for wall-hanging fixtures, unless otherwise indicated.
B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

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

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

END OF SECTION
DIVISION 23
HVAC

The Agreement, General Conditions Of The Contract For Construction, Supplementary Conditions Of The Contract For Construction, and all Addenda are a part of the Contract. The Contractor shall consult them in detail for instructions pertaining to the Work. The Contractor shall also consult all other divisions and sections of the Project Manual, and all Drawings in the execution of the work of the Contract.

The Contractor shall provide all labor, materials, systems, equipment, items, articles, operations, and/or methods listed, implied, mentioned, or scheduled in the Contract Documents and/or necessary and/or required for the satisfactory completion of the Work.

The listing of work, requirements, and products in this section is not intended to be conclusive. The Contractor shall check all other parts of the Contract Documents and shall provide all miscellaneous items of work and products necessary for the satisfactory completion of the Work described in the Contract Documents.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions

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

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

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

1.3 COORDINATION
   A. All mechanical work shall be done under sub-contract to a General Contractor. Mechanical Contractor shall coordinate all work through General Contractor, even in areas where only mechanical work is to take place.
   B. Coordination between all trades shall take place on a regular basis to avoid conflicts between disciplines and equipment clearances.
   C. Work shall take place with minimal disruption to Owner’s operations in areas surrounding the new building.
   D. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.
   E. Fully coordinate with electrical contractor for providing power to mechanical equipment.
   F. Mechanical Contractor is responsible for all control wiring including thermostat(s). This includes all conduit, wire, and accessories both low voltage and source voltage for the controls’ system. Mechanical Contractor will provide all the necessary actuators, relays, software, hardware, and all necessary accessories required for a fully functional controls’ system.

1.4 UTILITIES
   1. Coordinate with power, water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
   2. Obtain any approvals required from utilities to relocate utilities.
   3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

1.5 CONTRACTOR USE OF PREMISES
A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
   1. Owner Occupancy: Allow for Owner occupancy and use by the public.
   2. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
   1. Temporary fencing around construction areas.
   2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
   3. Temporary fencing around equipment while site work is in progress.

1.6 SUBMITTALS

A. To extradite the submittal process more efficiently, DO NOT piece-meal the submittals. Submit entire mechanical or plumbing in a bound enclosure. This will eliminate delays in the submittal process.

PART 2 - PRODUCT (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following basic mechanical materials and methods to complement other Sections.
   1. Piping materials and installation instructions common to most piping systems.
   2. Concrete base construction requirements.
   3. Escutcheons.
   4. Dielectric fittings.
   5. Flexible connectors.
   6. Mechanical sleeve seals.
   7. Equipment nameplate data requirements.
   8. Nonshrink grout for equipment installations.
   10. Installation requirements common to equipment specification sections.
   11. Cutting and patching.
   12. Touchup painting and finishing.

1.2 DEFINITIONS
A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
F. The following are industry abbreviations for plastic materials:
   G. PVC: Polyvinyl chloride plastic.
H. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene propylene diene terpolymer rubber.

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

1.4 QUALITY ASSURANCE
A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
B. Protect stored pipes, ductwork, equipment, and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
C. Protect flanges, fittings, and piping specialties from moisture and dirt.
D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

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

1.7 OPERATION PRIOR TO ACCEPTANCE
A. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, he may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated.
B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments, and complete punch list items before final acceptance by the Owner.
C. The date of acceptance by the Engineer, for beneficial use by the Owner, shall be the beginning date of the warranty period.

1.8 SPACE AND EQUIPMENT ARRANGEMENT
A. The size of each item of mechanical equipment shown on the Drawings is based on the dimensions of a particular manufacturer as indicated. While other manufacturers may be acceptable, it shall be the responsibility of the Contractor to determine whether or not the equipment he proposes to furnish will fit into the space. Shop drawings shall be prepared when required by the engineer to indicate a suitable arrangement.
B. Install equipment in a manner to permit access to all surfaces. Install valves, motors, drives, lubricating devices, filters, and other accessory items in a position to allow removal for service without requiring the disassembly of another part.
C. Provide access panels acceptable to the Engineer for equipment that is concealed above ceiling space.
D. Large equipment assemblies or components which will be installed in the building, and which are too large to permit access through doorways, stairways or shafts, shall be brought to the site and placed in the appropriate spaces before the enclosing structure is completed. Provisions shall be implemented by the Contractor to ensure that the equipment will not be damaged in any way during the associated construction procedures.

1.9 START-UP OF EQUIPMENT AND SYSTEMS
A. Whenever the manufacturer of a particular item of equipment or a particular system makes available a start-up service after completion of the installation, such manufacturer’s start-up service (rendered by the manufacturer or his authorized representative) shall be provided.
B. Witnessing and explanations of start-up services shall be included as part of the “Instruction of Owner’s Personnel” as specified below.

1.10 INSTRUCTION OF OWNER’S PERSONNEL
A. Provide the services of competent engineers or technicians acceptable to the Engineer to instruct representatives of the Owner in complete and detailed operation and maintenance of each item of equipment, and each system. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner’s personnel and the letter of release acknowledged.
C. In providing the instructions to the Owner’s personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner’s personnel shall be familiarized with such manuals. Operating and maintenance manuals used for instructions shall include piping diagrams, valve identification charts, control and interlocking wiring diagrams, manufacturers’ operation and maintenance manuals, parts lists (with sources identified), and other data as appropriate for each system, and as required elsewhere in the Specifications to be furnished to the Owner prior to final acceptance of the project.
D. Provide the Owner with three (3) complete sets of all maintenance manuals, pamphlets, brochures or instructions. This material shall be catalogued, indexed and bound into books.

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

PART 2 - PRODUCTS
2.1 STANDARD PRODUCTS
A. Each item of equipment furnished under this Division of the Specifications shall be essentially the standard product of the manufacturer. Where two or more units of the same kind or class of equipment are required, these shall be the products of a single manufacturer; however, the component parts of the equipment need not be the products of one manufacturer.
B. Materials and equipment shall be of the base quality normally used in good commercial practice, and shall be the products of reputable domestic manufacturers unless otherwise specified. Each major component shall bear a nameplate giving the name and address of the manufacturer, and the catalog number or designation of the component.

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

2.3 LOCAL PARTS AND SERVICE
A. Each item of equipment furnished on this project shall have local representation, factory-authorized service, and an adequate stock of repair parts. “Local” shall be defined, for this purpose, as “within 50 miles of the project site.”

2.4 FLAME SPREAD PROPERTIES OF MATERIALS
A. Materials used for insulation, acoustical linings, adhesives, jackets and coatings, and combinations of these materials, shall each have a flame spread rating of 25 or less, and a smoke developed rating of 50 or less, as determined by an independent testing laboratory in accordance with NFPA-255.

2.5 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Dielectric Unions:
      b. Zurn Industries, Inc.; Wilkins Div.
   2. Mechanical Sleeve Seals:
      a. Calpico, Inc.
      b. Metraflex Co.
      c. Thunderline/Link-Seal.

2.6 MECHANICAL SLEEVE SEALS
A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.7 PIPING SPECIALTIES
A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
   1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
   2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
   3. Cast Iron: Cast or fabricated “wall pipe” equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
   4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
      a. Underdeck Clamp: Clamping ring with set screws.
   B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
      1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
      2. OD: Completely cover opening.
      3. Cast Brass: One piece, with set screw.
         a. Finish: Rough brass.
         b. Finish: Polished chrome-plate.
      4. Cast-Iron Floor Plate: One-piece casting.

2.8 GROUT
A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
   2. Design Mix: 5000-psig, 28-day compressive strength.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS
A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Sections specify unique piping installation requirements.

B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

C. Install piping at indicated slope.

D. Install components with pressure rating equal to or greater than system operating pressure.

E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

F. Install piping free of sags and bends.

G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

I. Install piping to allow application of insulation plus 1-inch clearance around insulation.

J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

K. Install fittings for changes in direction and branch connections.

L. Install couplings according to manufacturer's written instructions.

M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
   1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish.
   2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
   3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
   4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
   5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.

N. Sleeves are not required for core drilled holes.

O. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Build sleeves into new walls and slabs as work progresses.
   3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. Steel, Sheet-Metal Sleeves: For pipes smaller than 6-inch NPS.
      b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
   4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants.
   5. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.

Q. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe or pipe insulation and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
   3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions.
   Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

S. Fire-Banner Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

V. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
   b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
   c. Align threads at point of assembly.
   d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
   e. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
   a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   b. PVC Nonpressure Piping: ASTM D 2855.
   c. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.
   a. Plain-End Pipe and Fittings: Use butt fusion.
   b. Plain-End Pipe and Socket Fittings: Use socket fusion.

W. Piping Connections: Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.2 EQUIPMENT AND MATERIAL INSTALLATION - COMMON REQUIREMENTS
A. Install equipment and material to provide maximum possible headroom, if mounting heights are not indicated.
B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
E. Install equipment and ductwork giving right of way to piping installed at required slope.
F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.3 PAINTING AND FINISHING
A. Refer to paint materials, surface preparation, and application of paint.
B. Do not paint piping specialties with factory-applied finish.
C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 CONCRETE BASES
A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psig, 28-day compressive-strength concrete and reinforcement as specified.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE
A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.6 CUTTING AND PATCHING
A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
B. Repair cut surfaces to match adjacent surfaces.

3.7 GROUTING
A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
B. Clean surfaces that will come into contact with grout.
C. Provide forms as required for placement of grout.
D. Avoid air entrapment during placing of grout.
E. Place grout, completely filling equipment bases.
F. Place grout on concrete bases to provide smooth bearing surface for equipment.
G. Place grout around anchors.
H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes hangers and supports for mechanical system piping and equipment.

1.2 DEFINITIONS
A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS
A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.4 SUBMITTALS
A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.
B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

1.5 QUALITY ASSURANCE
A. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze by a qualified professional engineer.
   1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Pipe Hangers:
      a. Globe Pipe Hanger Products, Inc.
      b. Grinnell Corp.
      c. Michigan Hanger Co., Inc.

2.2 MANUFACTURED UNITS
A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
   1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
   2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
   1. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
   2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

2.3 MISCELLANEOUS MATERIALS
A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
   1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
   2. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
   3. Extension Hinged Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.

D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.

E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
   2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
   3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
   4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
   1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
   2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
   4. C-Clamps (MSS Type 23): For structural shapes.
   5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
   6. Steel Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
   7. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
   8. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
   1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.

H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification sections, install the following types:
   1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
   2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
   1. Field assemble and install according to manufacturer's written instructions.

C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional supports at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

E. Install hangers and supports complete with necessary inserts, bolts, nuts, washers, and other accessories.

F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

I. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits according to ASME B31.9.
   2. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
      d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
      e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
   4. Insert Material: Length at least as long as protective shield.

3.3 EQUIPMENT SUPPORTS
   A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
   B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.4 ADJUSTING
   A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
PART 1 - GENERAL

1.1 WORK INCLUDED
A. Pipe, and equipment hangers, supports and associated anchors.
B. Sleeves and seals.
C. Flashing and sealing equipment and pipe stacks.

1.2 SUBMITTALS
A. Submit shop drawings and product data under provisions of specification.
B. Indicate hanger and support framing and attachment methods.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS
A. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
B. Hangers for Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
C. Hangers for Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods; cast iron roll and stand for pipe sizes 6 inches and over.
E. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
F. Wall Support for Pipe Sizes 4 Inches and over: Adjustable steel yoke and cast iron roll.
G. Vertical Support: Steel riser clamp.
H. Floor Support for Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
I. Floor Support for Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
J. Roof Pipe Supports and Hangers: Galvanized Steel Channel System as manufactured by Portable Pipe Hangers, Inc. or approved equal.
   • For pipes 2-1/2” and smaller - Type PP10 with roller
   • For pipes 3” through 8” - Type PS
   • For multiple pipes - Type PSE - Custom
L. For installation of protective shields refer to specification section 15140-3.03.
M. Shields for Vertical Copper Pipe Risers: Sheet lead.
N. Pipe Rough-In Supports in Walls/Chases: Provide preformed plastic pipe supports, Sioux Chief “Pipe Titan”, Holdrite or equal.

2.2 HANGER RODS
A. Galvanized Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.3 INSERTS
A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING
A. Metal Flashing: 20 gage galvanized steel.
B. Lead Flashing: 4 lb. /sq. ft. sheet lead for waterproofing; 1 lb. /sq. ft. sheet lead for soundproofing.
C. Caps: Steel, 20 gage minimum; 16 gage at fire resistant elements.
D. Coordinate with roofing contractor/architect for type of flashing on metal roofs.

2.5 EQUIPMENT CURBS
A. Fabricate curbs of hot dipped galvanized steel.
2.6 SLEEVES
   A. Sleeves for Pipes through Non-fire Rated Floors: Form with 18 gage galvanized steel, tack welded to form a uniform sleeve.
   B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Form with steel pipe, schedule 40.
   C. Sleeves for Pipes through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated steel sleeves including seals, UL listed.
   D. Sleeves for Round Ductwork: Form with galvanized steel.
   E. Sleeves for Rectangular Ductwork: Form with galvanized steel.
   F. Fire Stopping Insulation: Glass fiber type, non-combustible, U.L. listed.
   G. Caulk: Paintable 25-year acrylic sealant.
   H. Pipe Alignment Guides: Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted, two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

2.7 FABRICATION
   A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
   B. Design hangers without disengagement of supported pipe.
   C. Design roof supports without roof penetrations, flashing or damage to the roofing material.

2.8 FINISH
   A. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION
3.1 INSERTS
   B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
   C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.
   D. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. Verify with structural engineer prior to start of work.

3.2 PIPE HANGERS AND SUPPORTS
   A. Support horizontal piping as follows:

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>MAX. HANGER SPACING</th>
<th>HANGER DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Steel Pipe)</td>
<td></td>
<td></td>
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<tr>
<td>1/2 to 1-1/4 inch</td>
<td>7'-0&quot;</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>1-1/2 to 3 inch</td>
<td>10'-0&quot;</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>4 to 6 inch</td>
<td>10'-0&quot;</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>8 to 10 inch</td>
<td>10'-0&quot;</td>
<td>5/8&quot;</td>
</tr>
<tr>
<td>12 to 14 inch</td>
<td>10'-0&quot;</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>15 inch and over</td>
<td>10'-0&quot;</td>
<td>7/8&quot;</td>
</tr>
<tr>
<td>(Copper Pipe)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2 to 1-1/4 inch</td>
<td>5'-0&quot;</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>1-1/2 to 2-1/2 inch</td>
<td>8'-0&quot;</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>3 to 4 inch</td>
<td>10'-0&quot;</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>6 to 8 inch</td>
<td>10'-0&quot;</td>
<td>1/2&quot;</td>
</tr>
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</table>
FACILITY REPAIRS

100% CONSTRUCTION DOCUMENTS

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(Cast Iron)

<table>
<thead>
<tr>
<th>Size</th>
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<th>Thickness</th>
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<tbody>
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<td>1/2&quot;</td>
</tr>
<tr>
<td>8 to 10 inch</td>
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<td>5/8&quot;</td>
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<td>3/4&quot;</td>
</tr>
<tr>
<td>15 inch and over</td>
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<td>7/8&quot;</td>
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(PVC Pipe)

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<th>Length</th>
<th>Thickness</th>
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</thead>
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<td>3/8&quot;</td>
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<tr>
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<td>1/2&quot;</td>
</tr>
<tr>
<td>10 and over</td>
<td>4'-0&quot;</td>
<td>5/8&quot;</td>
</tr>
</tbody>
</table>

B. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
C. Place a hanger within 12 inches of each horizontal elbow and at the vertical horizontal transition.
D. Use hangers with 1-1/2 inch minimum vertical adjustment.
E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
H. Support riser piping independently of connected horizontal piping.
I. Install hangers with nut at base and above hanger; tighten upper nut to hanger after final installation adjustments.
J. Portable pipe hanger systems shall be installed per manufacturers' instructions.
K. Distances between supports are maximum distance. Supports shall be provided to carry the pipe/equipment load.

3.3 INSULATED PIPING: COMPLY WITH THE FOLLOWING INSTALLATION REQUIREMENTS.
A. Clamps: Attach galvanized clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
B. Saddles: Install galvanized protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
C. Shields: Install protective shields MSS Type 40 on cold and chilled water piping that has vapor barrier. Shields shall span an arc of 180 degrees and shall have dimensions in inches not less than the following:

<table>
<thead>
<tr>
<th>NPS</th>
<th>Length</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 THROUGH H 3-1/2</td>
<td>12</td>
<td>0.048</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td>0.060</td>
</tr>
<tr>
<td>5 &amp; 6</td>
<td>18</td>
<td>0.060</td>
</tr>
<tr>
<td>8 THROUGH H 14</td>
<td>24</td>
<td>0.075</td>
</tr>
<tr>
<td>16 THROUGH H 24</td>
<td>24</td>
<td>0.105</td>
</tr>
</tbody>
</table>

D. Piping 2" and larger provide galvanized sheet metal shields with calcium silicate at hangers/supports.
E. Insert material shall be at least as long as the protective shield.
F. Thermal Hanger Shields: Install where indicated, with insulation of same thickness as piping.

3.4 EQUIPMENT BASES AND SUPPORTS
A. Provide equipment bases of concrete.
B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
C. Construct support of steel members. Brace and fasten with flanges bolted to structure.
D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING
A. Provide flexible flashing and metal counter flashing where piping and ductwork penetrate...
weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 8 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter flash and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

D. Seal floor shower mop sink and all other drains watertight to adjacent materials.

E. Provide curbs for mechanical roof installations 8 inches minimum high above roofing surface. Contact architect for all flashing details and roof construction. Seal penetrations watertight.

3.6 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Extend sleeves through floors minimum one inch above finished floor level. Caulk sleeves full depth with fire rated thermfiber and 3M caulking and provide floor plate.

C. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with U.L. listed fire stopping insulation and caulk seal airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

D. Fire protection sleeves may be flush with floor of stairways.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
1. Balancing airflow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
6. Reporting results of the activities and procedures specified in this Section.
B. Related Sections include the following:
1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.2 DEFINITIONS
A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
E. Report Forms: Test data sheets for recording test data in logical order.
F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
K. Test: A procedure to determine quantitative performance of a system or equipment.
L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
N. CTI: Cooling Tower Institute.
P. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.3 SUBMITTALS
A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
B. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
C. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.4 QUALITY ASSURANCE
A. Agent Qualifications for larger projects: Engage a testing, adjusting, and balancing agent certified by AABC.
B. Agent Qualifications for smaller projects: Engage a testing, adjusting, and balancing agent certified by NEBB.
C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
   2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC’s "National Standards for Testing, Adjusting, and Balancing."
F. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.
G. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems;" Section II, "Required Instrumentation for NEBB Certification."
H. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.5 PROJECT CONDITIONS
A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.6 COORDINATION
A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 WARRANTY
A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION
3.1 EXAMINATION
A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
   1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.
C. Examine project record documents described in specifications.
D. Examine Architect's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
E. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
G. Examine system and equipment test reports.
H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
K. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
L. Examine equipment for installation and for properly operating safety interlocks and controls.
M. Examine automatic temperature system components to verify the following:
   1. Dampers, valves, and other controlled devices operate by the intended controller.
   2. Dampers and valves are in the position indicated by the controller.
   3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
   4. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
   5. Sensors are located to sense only the intended conditions.
   6. Sequence of operation for control modes is according to the Contract Documents.
   7. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
   8. Interlocked systems are operating.
   9. Changeover from heating to cooling mode occurs according to design values.
N. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

A. Complete system readiness checks and prepare system readiness reports. Verify the following:
   1. Permanent electrical power wiring is complete.
   2. Automatic temperature-control systems are operational.
   3. Equipment and duct access doors are securely closed.
4. Balance, fire dampers are open.
5. Ceilings are installed in critical areas where air-pattern adjustments are required and access
to balancing devices is provided.
6. Windows and doors can be closed so design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES
A. Perform testing and balancing procedures on each system according to the procedures
contained in AABC national standards and this Section.
B. Perform testing and balancing procedures on each system according to the procedures
contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental
Systems" and this Section.
C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the
minimum extent necessary to allow adequate performance of procedures. After testing and
balancing, close probe holes and patch insulation with new materials identical to those
removed. Restore vapor barrier and finish according to the insulation Specifications for this
Project.
D. Mark equipment settings with paint or other suitable, permanent identification material, including
damper-control positions, valve indicators, fan-speed-control levers, and similar controls and
devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES
A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and
recommended testing procedures. Crosscheck the summation of required outlet volumes with
required fan volumes.
B. Prepare schematic diagrams of systems' "as-built" duct layouts.
C. For variable-air-volume systems, develop a plan to simulate diversity.
D. Check the airflow patterns from the outside-air louvers and dampers and the return- and
exhaust-air dampers, through the supply-fan discharge and mixing dampers.
E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
F. Verify that motor starters are equipped with properly sized thermal protection.
G. Check dampers for proper position to achieve desired airflow path.
H. Check for airflow blockages.
I. Check condensate drains for proper connections and functioning.
J. Check for proper sealing of air-handling unit components.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES
A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems.
B. Adjust fans to deliver total design airflow within the maximum allowable rpm listed by the fan
manufacturer.
   1. Measure fan static pressures to determine actual static pressure as follows:
      a. Measure outlet static pressure as far downstream from the fan as practicable and
         upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible,
         upstream from flexible connection and downstream from duct restrictions.
   2. Measure static pressure across each air-handling unit component.
      a. Simulate dirty filter operation and record the point at which maintenance personnel must
         change filters.
   3. Compare design data with installed conditions to determine variations in design static
      pressures versus actual static pressures. Compare actual system effect factors with calculated
      system effect factors to identify where variations occur. Recommend corrective action to
      align design and actual conditions.
   4. Adjust fan speed higher or lower than design with the approval of the Architect. Make
      required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate
      fan-speed changes.
   5. Do not make fan-speed adjustments that result in motor overload. Consult equipment
      manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor
amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.

C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
   a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.

D. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer’s written instructions and calculating factors.

E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 MOTORS
A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer, model, and serial numbers.
   4. Efficiency rating if high-efficiency motor.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.7 CONDENSING UNITS
A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.8 HEAT-TRANSFER COILS
A. Electric-Heating Coils: Measure the following data for each coil:
   1. Nameplate data.
   2. Airflow.
   3. Entering- and leaving-air temperatures at full load.
   4. Voltage and amperage input of each phase at full load and at each incremental stage.
   5. Calculated kW at full load.
   6. Fuse or circuit-breaker rating for overload protection.

3.9 TEMPERATURE TESTING
A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
B. Measure outside-air, wet- and dry-bulb temperatures.

3.10 TEMPERATURE-CONTROL VERIFICATION
A. Verify that controllers are calibrated and commissioned.
B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
C. Record controller settings and note variances between set points and actual measurements.
D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
E. Verify free travel and proper operation of control devices such as damper and valve operators.
F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
G. Confirm interaction of electrically operated switch transducers.
H. Confirm interaction of interlock and lockout systems.
I. Verify main control supply-air pressure and observe compressor and dryer operations.
J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.
K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.11 TOLERANCES
A. Set HVAC system airflow and water flow rates within the following tolerances:
   1. Supply and Exhaust Fans: Plus 5 to plus 10 percent.
   2. Air Outlets and Inlets: 0 to minus 10 percent.
   3. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.12 FINAL REPORT
A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder; tabulated and divided into sections by tested and balanced systems.
B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
   1. Include a list of the instruments used for procedures, along with proof of calibration.
C. Final Report Contents: In addition to the certified field report data, include the following:
   1. Fan curves.
   2. Manufacturers' test data.
   3. Field test reports prepared by system and equipment installers.
   4. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of testing, adjusting, and balancing Agent.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   9. Signature of testing, adjusting, and balancing Agent who certifies the report.
   10. Summary of contents, including the following:
       a. Design versus final performance.
       b. Notable characteristics of systems.
       c. Description of system operation sequence if it varies from the Contract Documents.
   11. Nomenclature sheets for each item of equipment.
   12. Data for terminal units, including manufacturer, type size, and fittings.
   13. Notes to explain why certain final data in the body of reports vary from design values.
   14. Test conditions for fans and pump performance forms, including the following:
       a. Settings for outside-, return-, and exhaust-air dampers.
       b. Conditions of filters.
       c. Cooling coil, wet- and dry-bulb conditions.
       d. Face and bypass damper settings at coils.
       e. Fan drive settings, including settings and percentage of maximum pitch diameter.
       f. Settings for supply-air, static-pressure controller.
       g. Other system operating conditions that affect performance.
E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

F. Roof Top Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer’s serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Sheave make, size in inches (mm), and bore.
   i. Number of belts, make, and size.
   j. Number of filters, type, and size.
2. Motor Data: Include the following:
   a. Make and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
3. Test Data: Include design and actual values for the following:
   a. Total airflow rate in cfm (L/s).
   b. Total system static pressure in inches wg (Pa).
   c. Fan rpm.
   d. Discharge static pressure in inches wg (Pa).
   e. Preheat coil static-pressure differential in inches wg (Pa).
   f. Cooling coil static-pressure differential in inches wg (Pa).
   g. Heating coil static-pressure differential in inches wg (Pa).
   h. Outside airflow in cfm (L/s).
   i. Return airflow in cfm (L/s).
   j. Outside-air damper position.
   k. Return-air damper position.
   l. Discharge air temperature.

G. Electric-Coil Test Reports: For electric duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data: Include the following:
   a. System identification.
   b. Location.
   c. Coil identification.
   d. Capacity in Btuh (kW).
   e. Number of stages.
   f. Connected volts, phase, and hertz.
   g. Rated amperage.
   h. Discharge air temperature.
2. Test Data: Include design and actual values for the following:
   a. Heat output in Btuh (kW).
   b. Airflow rate in cfm (L/s).
   c. Air velocity in fpm (m/s).
   d. Entering-air temperature in deg F (deg C).
   e. Leaving-air temperature in deg F (deg C).
   f. Voltage at each connection.
g. Amperage for each phase.

H. Fan Test Reports: For exhaust fans, include the following:

1. Fan Data: Include the following:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and size.
   e. Manufacturer's serial number.
   f. Arrangement and class.

2. Motor Data: Include the following:
   a. Make and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Number of belts, make, and size.

3. Test Data: Include design and actual values for the following:
   a. Total airflow rate in cfm (L/s).
   b. Total system static pressure in inches wg (Pa).
   c. Fan rpm.
   d. Discharge static pressure in inches wg (Pa).
   e. Suction static pressure in inches wg (Pa).

I. Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, include the following:

1. Unit Data: Include the following:
   a. Unit identification.
   b. Location.
   c. Unit make and model number.
   d. Manufacturer’s compressor serial numbers.
   e. Compressor make.
   f. Compressor model and serial numbers.
   g. Refrigerant weight in lb (kg).

2. Test Data: Include design and actual values for the following:
   a. Entering-air, dry-bulb temperature in deg F (deg C).
   b. Leaving-air, dry-bulb temperature in deg F (deg C).
   c. Control settings.
   d. Unloader set points.
   e. Low-pressure-cutout set point in psig (kPa).
   f. High-pressure-cutout set point in psig (kPa).
   g. Suction pressure in psig (kPa).
   h. Suction temperature in deg F (deg C).
   i. Condenser refrigerant pressure in psig (kPa).
   j. Condenser refrigerant temperature in deg F (deg C).
   k. Oil pressure in psig (kPa).
   l. Oil temperature in deg F (deg C).
   m. Voltage at each connection.
   n. Amperage for each phase.
   o. The kW input.
   p. Number of fans.

3.13 ADDITIONAL TESTS

A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.2 SUMMARY
A. This Section includes the following mechanical identification materials and their installation:
   1. Equipment nameplates.
   2. Equipment markers.
   3. Access panel and door markers.
   4. Pipe markers.
   5. Duct markers.
   6. Valve tags.

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

1.4 COORDINATION
A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
B. Coordinate installation of identifying devices with location of access panels and doors.
C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES
A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
   1. Data:
      a. Manufacturer, product name, model number, and serial number.
      b. Capacity, operating and power characteristics, and essential data.
      c. Labels of tested compliances.
   2. Location: Accessible and visible.
   3. Fasteners: As required to mount on equipment.
B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
   1. Terminology: Match schedules as closely as possible.
   2. Data:
      a. Name and plan number.
      b. Equipment service.
      c. Design capacity.
      d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
   3. Size: 2-1/2 by 4 inches (64 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.
   4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES
A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
   1. Colors: Comply with ASME A13.1, unless otherwise indicated.
   2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
   3. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.
   4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.


E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils (0.08 mm) thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.

2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

2.3 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers, with numbering scheme [approved by Architect] <Insert other>. Provide 5/32-inch (4-mm) hole for fastener.

1. Material: 3/32-inch- (2.4-mm-) thick laminated plastic with 2 black surfaces and white inner layer.

2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Divisions. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Pumps, compressors, chillers, condensers, and similar motor-driven units.
2. Heat exchangers, coils, evaporators, and similar equipment.
3. Fans, blowers, primary balancing dampers, and mixing boxes.
4. Packaged HVAC central-station and zone-type units.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.

b. Fire department hose valves and hose stations.

c. Meters, gages, thermometers, and similar units.

d. Pumps, compressors, chillers, condensers, and similar motor-driven units.

e. Heat exchangers, coils, evaporators, and similar equipment.

f. Fans, blowers, primary balancing dampers, and mixing boxes.
g. Packaged HVAC central-station and zone-type units.

h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.

1. Identify mechanical equipment with equipment markers in the following color codes:
   a. Green: For cooling equipment and components.
   b. Yellow: For heating equipment and components.
   c. Orange: For combination cooling and heating equipment and components.

2. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

4. Include signs for the following general categories of equipment:
   a. Main control and operating valves, including safety devices.
   b. Pumps, compressors, chillers, condensers, and similar motor-driven units.
   c. Heat exchangers, coils, evaporators, and similar equipment.
   d. Fans, blowers, primary balancing dampers, and mixing boxes.
   e. Packaged HVAC central-station and zone-type units.
   f. Tanks and pressure vessels.
   g. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

D. Install access panel markers with screws on equipment access panels.

### 3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Pretensioned pipe markers. Use size to ensure a tight fit.

2. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches (38 mm) wide, lapped at least 3 inches (75 mm) at both ends of pipe marker, and covering full circumference of pipe.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.

### 3.4 DUCT IDENTIFICATION

A. Install duct markers with permanent adhesive on air ducts in the following color codes:

1. Green: For cold-air supply ducts.
2. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
3. ASME A13.1 Colors and Designs: For hazardous material exhaust.

4. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

### 3.5 VALVE-TAG INSTALLATION
A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

1. Valve-Tag Size and Shape:
   a. Cold Water: 1-1/2 inches (38 mm), round.
   b. Hot Water: 1-1/2 inches (38 mm), round.
   c. Fire Protection: 2 inches (50 mm), round.

C. Valve-Tag Color:
   a. Cold Water: Green.
   b. Hot Water: Yellow.
   c. Fire Protection: Red.

1. Letter Color:

3.6 VALVE-SCHEDULE INSTALLATION
A. Mount valve schedule on wall in accessible location in each major equipment room.

3.7 ADJUSTING
A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.8 CLEANING
A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes semirigid and flexible duct, plenum, and breeching insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.2 SUBMITTALS
A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.3 QUALITY ASSURANCE
A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING
A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
B. Deliver and store all insulation with protective material until installation. Any material left exposed to moisture and/or particulates shall be removed and replaced.
C. Any installed insulation left temporarily incomplete shall be covered with protective material until final connections can be installed.

1.5 COORDINATION
A. Coordinate clearance requirements with duct Installer for insulation application.

1.6 SCHEDULING
A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Mineral-Fiber Insulation:
   a. CertainTeed Manson.
   b. Knauf FiberGlass GmbH.
   c. Owens-Corning Fiberglas Corp.
   d. Schuller International, Inc.

2.2 INSULATION MATERIALS
A. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.

2.3 FIELD APPLIED JACKET

2.4 ACCESSORIES AND ATTACHMENTS
A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd. (270 g/sq. m).
   1. Tape Width: 4 inches (100 mm).
B. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
   1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb (45 kg) for direct pull perpendicular to the adhered surface.

2.5 VAPOR RETARDERS
A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS
A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Apply multiple layers of insulation with longitudinal and end seams staggered.
E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
F. Keep insulation materials dry during application and finishing.
G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
H. Apply insulation with the least number of joints practical.
I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
L. Apply insulation with integral jackets as follows:
   1. Pull jacket tight and smooth.
   2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
   3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
N. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.
1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.

2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.

O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
   1. Seal penetrations with vapor-retarder mastic.
   2. Apply insulation for exterior applications tightly joined to interior insulation ends.
   3. Seal insulation to roof flashing with vapor-retarder mastic.

P. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.

Q. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.

R. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
   1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.
   1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
   2. Install anchor pins and speed washers on sides and bottom of horizontal ducts and all sides of vertical ducts as follows:
      a. On duct sides with dimensions 18 inches (450 mm) and smaller, along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
      b. On duct sides with dimensions larger than 18 inches (450 mm). Space 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
      c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
      d. Do not over-compress insulation during installation.
   3. Impale insulation over anchors and attach speed washers.
   4. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
   5. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch (13-mm) staples, 1-inch (25 mm) o.c., and cover with pressure-sensitive tape having same facing as insulation.
   6. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches (450 mm) o.c.
   7. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round duct elbows with individually mitered gores cut to fit the elbow.
   8. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- (150-mm-) wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches (150 mm) o.c.
   9. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 DUCT SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.

C. Insulate the following plenums and duct systems:
   1. Indoor concealed supply-, return-, and outside-air ductwork.
   2. Indoor exposed supply-, return-, and outside-air ductwork.
   3. Indoor concealed range-hood exhaust ductwork.
   4. Indoor concealed dishwasher ductwork.

D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
   1. Factory-insulated flexible ducts.
   2. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
   3. Flexible connectors.
   5. Testing agency labels and stamps.
   7. Access panels and doors in air-distribution systems.

3.6 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

A. Service: Round and rectangular, supply-air ducts, concealed.
   2. Thickness: 3 inches (R-8 or greater)
   3. Number of Layers: One.
   5. Vapor Retarder Required: Yes.

B. Service: Round and rectangular, return-air ducts, outside air duct, concealed or exposed.
   2. Thickness: 2 inches (50 mm).
   3. Number of Layers: One.
   5. Vapor Retarder Required: Yes.

C. Service: Round and rectangular, supply and return-air ducts, exposed and in mechanical rooms.
   1. Material: 2" liner insulation
   2. Thickness: 2 inches (50 mm).
   3. Number of Layers: One.
   5. Vapor Retarder Required: No

D. Service: Round and rectangular, exhaust air ducts, concealed & exposed and in mechanical rooms.
   1. Material: 1" Interior liner
   2. Thickness: 1 inch
   3. Number of Layers: One.
   5. Vapor Retarder Required: No

END OF SECTION
SECTION 23 2300
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY
A. Includes But Not Limited To:
   1. Furnish and install piping and specialties for refrigeration systems as described in Contract
      Documents.
B. Products Installed But Not Furnished Under This Section:

1.2 REFERENCES
A. Association Publications:
   1. Federal Emergency Management Agency (FEMA) / Vibration Isolation and Seismic Control
      Manufacturers Association (VISCMA) / American Society of Civil Engineers (ASCE):
      a. FEMA 412, 'Installing Seismic Restraints For Mechanical Equipment' (December 2002).
   2. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA):
      a. VISCMA 101-12, 'Seismic Restraint Specification Guidelines for Mechanical, Electrical, and
         Plumbing Systems'.
      b. VISCMA 102-12, 'Vibration Isolation Specification Guidelines for Mechanical, Electrical, and
         Plumbing Systems'.
B. Definitions:
   1. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and
      releases heat by a change of state (condenses) from gas back to a liquid.
   2. Vibration Isolation: Vibration reduction in which an isolation system is placed between the
      source of unwanted vibration and an item which needs to be shielded from the vibration.
C. Reference Standards:
   1. American National Standards Institute (ANSI) / American Society of Heating, Refrigerating and
      Air-Conditioning Engineers (ASHRAE):
      b. ANSI/ASHRAE Standard 34-2010, 'Designation and Classification of Refrigerants'.
   2. American National Standards Institute / American Welding Society:
      a. ANSI/AWS A5.8M/A5.8-2011, 'Specification for Filler Metals for Brazing and Braze Welding'.
   3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
      a. '2011 ASHRAE Handbook - HVAC Applications'.
      1) Chapter 48, 'Noise and Vibration Control'.
   4. ASTM International:
      a. ASTM A36/A36M-08, 'Standard Specification for Carbon Structural Steel'.
      b. ASTM B280-08, 'Standard Specification for Seamless Copper Tube for Air Conditioning and
         Refrigeration Field Service'.
   5. National Fire Protection Association / American National Standards Institute:
      a. NFPA 90A-2012, 'Installation of Air Conditioning and Ventilating Systems'.
   6. Underwriters Laboratories:

1.3 SUBMITTALS
A. Action Submittals:
   1. Shop Drawings: Show each individual equipment and piping support.
B. Informational Submittals:
   1. Qualification Statements: Technician certificate for use of HFC and HCFC refrigerants.

1.4 QUALITY ASSURANCE
A. Regulatory Agency Sustainability Approvals:
   1. Refrigerants:
      a. Underwriters Laboratories / Underwriters Laboratories of Canada:
         1) Comply with requirements of UL 2182.
B. Qualifications.
   1. Installer: Refrigerant piping shall be installed by refrigeration contractor licensed by State and by technicians certified in use of HFC and HCFC refrigerants.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Airtec,
      b. Cush-A-Clamp by ZSI Manufacturing,
      c. Elkhart Products Corp.,
      d. Emerson Climate Technologies,
      e. Handy & Harman Products
      f. Harris Products Group,
      g. Henry Valve Co,
      h. Hilti Inc,
      i. Hydra-Zorb Co,
      j. JB Industries,
      k. Mueller Steam Specialty,
      l. Nibco Inc,
      m. Packless Industries, Parker Corp,
      n. Sporlan Valve Co.
      o. Sherwood Valves,
      p. Thomas & Betts,
      q. Unistrut, Div of Atkore International, Inc.
      r. Universal Metal Hose.
      s. Vibration Mountings & Controls,
      t. Virginia KMP Corp,

B. Materials:
   1. Refrigerant Piping:
      b. Do not use pre-charged refrigerant lines.
   2. Refrigerant Fittings:
      a. Wrought copper with long radius elbows.
      b. Category For Approved Manufacturers.
         1) Mueller Streamline.
         2) Nibco Inc.
         3) Elkhart.
   3. Suction Line Traps:
      a. Manufactured standard one-piece traps.
      b. Category For Approved Manufacturers.
         1) Mueller Streamline.
         2) Nibco Inc.
         3) Elkhart.
   4. Tee Access:
      a. Brass:
         1) Category For Approved Manufacturers.
            a) JB Industries: Part #A3 Series with Factory Cap and Valve Core.
      5. Connection Material:
         a. Brazing Rods in accordance with ANSI/AWS A5.8M/A5.8:
            1) Copper to Copper Connections:
               a) Classification BCuP-4 Copper Phosphorus (6 percent silver).
               b) Classification BCuP-5 Copper Phosphorus (15 percent silver).
2) Copper to Brass or Copper to Steel Connections: Classification BAg-5 Silver (45 percent silver).

3) Do not use rods containing Cadmium.

b. Flux:
   1) Type Two Acceptable Products:
      a) Stay-Silv White Brazing Flux by Harris Products Group.
      b) High quality silver solder flux by Handy & Hamon.
      c) Equal as approved by Architect before use.

6. Valves:
   a. Expansion Valves:
      1) For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.

      2) Size valves to provide full rated capacity of cooling coil served. Coordinate selection with evaporator coil and condensing unit.

      3) Category For Approved Manufacturers:
         a) Emerson Climate Technologies.
         b) Henry.
         c) Mueller.
         d) Parker.
         e) Sporlan.

   b. Manual Refrigerant Shut-Off Valves:
      1) Ball valves designed for refrigeration service and full line size.

      2) Valve shall have cap seals.

      3) Valves with hand wheels are not acceptable.

      4) Provide service valve on each liquid and suction line at compressor.

      5) If service valves come as integral part of condensing unit, additional service valves shall not be required.

      6) Category For Approved Manufacturers:
         a) Henry.
         b) Mueller.
         c) Sherwood.
         d) Virginia.

7. Filter-Drier:
   a. On lines 3/4 inch (19 mm) outside diameter and larger, filter-drier shall be replaceable core type with Schraeder type valve.

   b. On lines smaller than 3/4 inch (19 mm) outside diameter, filter-drier shall be sealed type with brazed end connections.

   c. Size shall be full line size.

   d. Category For Approved Manufacturers:
      1) Emerson Climate Technologies.
      2) Mueller.
      3) Parker.
      4) Sporlan.
      5) Virginia.

8. Sight Glass:
   a. Combination moisture and liquid indicator with protection cap.

   b. Sight glass shall be full line size.

   c. Sight glass connections and sight glass body shall be solid copper or brass, no copper-coated steel sight glasses allowed.

   d. Category For Approved Product:
      1) HMI by Emerson Climate Technologies.

9. Flexible Connectors:
   a. Designed for refrigerant service with bronze seamless corrugated hose and bronze braiding.

   b. Category For Approved Products:
1) Vibration Absorber Model VAF by Packless Industries.
2) Vibration Absorbers by Virginia KMP Corp.
3) Anaconda 'Vibration Eliminators' by Universal Metal Hose.
4) Style 'BF' Spring-flex freon connectors by Vibration Mountings.

10. Refrigerant Piping Supports:
    a. Base, Angles, And Uprights: Steel meeting requirements of ASTM A36.
    b. Securing Channels:
        1) At Free-Standing Pipe Support:
           a) Class One Quality Standard: P-1000 channels by Unistrut.
           b) Acceptable Manufacturers: Hilti, Thomas & Betts.
           c) Equal as approved by Architect before installation.
        2) At Wall Support:
           a) Class One Quality Standard: P-3300 channels by Unistrut.
           b) Acceptable Manufacturers: Hilti, Thomas & Betts.
           c) Equal as approved by Architect before installation.
        3) At Suspended Support:
           a) Class One Quality Standard: P-1001 channels by Unistrut.
           b) Acceptable Manufacturers: Hilti, Thomas & Betts.
           c) Equal as approved by Architect before installation.
        4) Angle Fittings:
           a) Class One Quality Standard: P-2626 90 degree angle by Unistrut.
           b) Acceptable Manufacturers: Hilti, Thomas & Betts.
           c) Equal as approved by Architect before installation.
    c. Pipe Clamps:
       1) Type Two Acceptable Manufacturers:
          a) Hydra-Zorb.
          b) ZSI Cush-A-Clamp.
          d) Equal as approved by Architect before installation.
    d. Protective Cover: 18 ga (1.2 mm) steel, hot-dipped galvanized.

11. Locking Refrigerant Cap:
    a. Provide and install on charging valves:
       1) Class One Quality Standard: ‘No Vent’ locking refrigerant cap.
       2) Acceptable Manufacturers: Airtec.
       3) Equal as approved by Architect before installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refrigerant Lines:
   1. Install as high in upper mechanical areas as possible. Do not install underground or in tunnels.
   2. Slope suction lines down toward compressor one inch/10 feet (25 mm in 3 meters). Locate traps at vertical rises against flow in suction lines.

B. Connections:
   1. Refrigeration system connections shall be copper-to-copper, copper-to-brass, or copper-to-steel type properly cleaned and brazed with specified rods. Use flux only where necessary. No soft solder (tin, lead, antimony) connections will be allowed in system.
   2. Braze manual refrigerant shut-off valve, sight glass, and flexible connections.
   3. Circulate dry nitrogen through tubes being brazed to eliminate formation of copper oxide during brazing operation.

C. Specialties:
   1. Install valves and specialties in accessible locations. Install refrigeration distributors and suction outlet at same end of coil.
   2. Install thermostatic bulb as close to cooling coil as possible. Do not install on vertical lines.
   3. Install equalizing line in straight section of suction line, downstream of and reasonably close to thermostatic bulb. Do not install on vertical lines.
4. Provide flexible connectors in each liquid line and suction line at both condensing unit and evaporator on systems larger than five tons. Anchor pipe near each flexible connector.

D. Refrigerant Supports:
   1. Support Spacing:
      a. Piping 1-1/4 inch (32 mm) And Larger: 8 feet (2.450 m) on center maximum.
      b. Piping 1-1/8 inch (28.5 mm) And Smaller: 6 feet (1.80 m) on center maximum.
      c. Support each elbow.
   2. Isolate pipe from supports and clamps with Hydrozorb or Cush-A-Clamp systems.
   3. Run protective cover continuous from condensing units to risers or penetrations at building wall.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
   1. Make evacuation and leak tests in presence of Architect's Engineer after completing refrigeration piping systems. Positive pressure test will not suffice for procedure outlined below.
      a. Draw vacuum on each entire system with two stage vacuum pump. Draw vacuum to 300 microns using micron vacuum gauge capable of reading from atmosphere to 10 microns. Do not use cooling compressor to evacuate system nor operate it while system is under high vacuum.
      b. Break vacuum with nitrogen and re-establish vacuum test. Vacuum shall hold for 30 minutes at 300 microns without vacuum pump running.
      c. Conduct tests at 70 deg F (21 deg C) ambient temperature minimum.
      d. Do not run systems until above tests have been made and systems started up as specified. Inform Owner's Representative of status of systems at time of final inspection and schedule start-up and testing if prevented by outdoor conditions before this time.
      e. After testing, fully charge system with refrigerant and conduct test with Halide Leak Detector.
      f. Recover all refrigerant in accordance with applicable codes. Do not allow any refrigerant to escape to atmosphere.

B. Non-Conforming Work:
   1. If it is observed that refrigerant lines are being or have been brazed without proper circulation of nitrogen through lines, all refrigerant lines installed up to that point in time shall be removed and replaced at no additional cost to Owner.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
   A. Includes But Not Limited To:
      1. Coordinate installation of condensate drain piping with Section 22 0510 as described in
         Contract Documents.

1.2 REFERENCES
   A. Reference Standards:
      1. ASTM International:
         b. ASTM D1785-12, ‘Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe,
            Schedules 40, 80, and 120’.

PART 2 - PRODUCTS

2.1 SYSTEMS
   A. Materials:
      1. Condensate Drains:
         a. Interior Lines: CPVC sch. 40 meeting requirements of ASTM D2846.
         b. Exterior Lines: CPVC sch. 80 meeting requirements of ASTM D2846.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Condensate Drains:
      1. Support piping and protect from damage.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
   A. This Section includes the following:
      1. Backdraft dampers.
      3. Fire dampers.
      4. Tuning vanes.
      5. Duct-mounted access doors and panels.
      6. Flexible ducts.
      7. Flexible connectors.
      8. Duct accessory hardware.

1.2 SUBMITTALS
   A. Product Data: For the following:
      1. Backdraft dampers.
      3. Fire dampers.
      4. Duct-mounted access doors and panels.
      5. Flexible ducts.
   B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
      2. Fire-damper installations, including sleeves and duct-mounted access doors and panels.
   C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

1.3 QUALITY ASSURANCE
   A. NFPA Compliance: Comply with the following NFPA standards:
      1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
      2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.4 EXTRA MATERIALS
   A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
      1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS
   A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
   B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.
   C. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
   D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT DAMPERS
   A. Description: Suitable for horizontal or vertical installations.
   B. Frame: 0.052-inch- (1.3-mm-) thick, galvanized, sheet steel, with welded corners and mounting flange.
   C. Blades: 0.025-inch- (0.6-mm-) thick, roll-formed aluminum.
D. Blade Seals: Vinyl.
E. Blade Axles: Galvanized steel.
F. Tie Bars and Brackets: Galvanized steel.
G. Return Spring: Adjustable tension.

2.3 MANUAL-VOLUME DAMPERS
A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
   1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
   2. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized, sheet steel.
   4. Tie Bars and Brackets: Galvanized steel.
C. Jackshaft: 1-inch- (25-mm-) diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
   1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.
D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch (2.4 mm) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 FIRE DAMPERS
A. General: Labeled to UL 555.
B. Fire Rating: One and one-half hours.
C. Fire Rating: One and one-half hours.
D. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
E. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.
   1. Minimum Thickness: 0.052 inch (1.3 mm) or 0.138 inch (3.5 mm) thick as indicated, and length to suit application.
   2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
F. Mounting Orientation: Vertical or horizontal as indicated.
G. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized steel blade connectors.
H. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.
I. Fusible Link: Replaceable, 165 deg F (74 deg C) rated as indicated.

2.5 TURNING VANES
A. Fabricate to comply with SMACNA’s "HVAC Duct Construction Standards-Metal and Flexible."
B. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.6 DUCT-MOUNTED ACCESS DOORS AND PANELS
A. General: Fabricate doors and panels airtight and suitable for duct pressure class.
B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.
C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
E. Insulation: 1-inch (-25-mm-)- thick, fibrous-glass or polystyrene-foam board.

2.7 FLEXIBLE CONNECTORS
A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
B. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
C. Extra-Wide Metal-Edged Connectors: Factory fabricated with a strip of fabric 5-3/4 inches (146 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
D. Transverse Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 4-3/8-inch- (111-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
   1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
   2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp, and 360 lbf/inch (63 N/mm) in the filling.
F. Conventional, Outdoor System Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
   1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
   2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp, and 440 lbf/inch (77 N/mm) in the filling.

2.8 FLEXIBLE DUCTS
A. General: Comply with UL 181, Class 1.
B. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch- (38-mm-) thick, glass-fiber insulation around a continuous inner liner.
   1. Reinforcement: Steel-wire helix encapsulated in inner liner.
   3. Inner Liner: Polyethylene film.
C. Pressure Rating: 6-inch wg (1500 Pa) positive, 1/2-inch wg (125 Pa) negative.

2.9 ACCESSORY HARDWARE
A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness.
B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch (6-mm), zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches (75 to 450 mm) to suit duct size.
D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION
3.1 INSTALLATION
A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.
   1. Install fusible links in fire dampers.

E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.
   1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
   2. Install access panels on side of duct where adequate clearance is available.

F. Label access doors according to Division "Mechanical Identification."

3.2 ADJUSTING
A. Adjust duct accessories for proper settings.
B. Adjust fire dampers for proper action.
C. Final positioning of manual-volume dampers is specified in Section "Testing, Adjusting, and Balancing."

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.2 SUMMARY
   A. This Section includes rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air-conditioning systems in pressure classes from minus 2- to plus 10-inch wg.

1.3 DEFINITIONS
   A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula Btu x in./h x sq. ft. x deg F or W/m x K at the temperature differences specified. Values are expressed as Btu or W.

1.4 SYSTEM DESCRIPTION
   A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by Architect.

1.5 SUBMITTALS
   A. Product Data: For duct liner and sealing materials.
   B. Shop Drawings: Show details of the following:
      1. Duct layout indicating pressure classifications and sizes on plans.
      2. Fittings.
      3. Penetrations through fire-rated and other partitions.
      4. Coordination with other trades and including but not limited to: structural members, electrical lights and conduits, plumbing lines, & fire sprinkler lines.
   C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items.
   D. Duct Construction Standards: Provide a copy of the duct construction standards to be used for each pressure classification in this project. Duct Construction Standards must comply with the latest edition of SMACNA “HVAC Duct Construction Standards – Metal and Flexible.”
   E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
   F. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.6 QUALITY ASSURANCE
   B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.
   C. Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.
C. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation.
D. Deliver and store all ductwork with protective material until installation. Any material left exposed to moisture and/or particulates shall be removed and replaced.
E. Any installed ductwork or piping system left temporarily incomplete shall be covered with protective material until final connections can be installed.
F. All ductwork and/or liner insulation to be wrapped with protective material until installation. Any ductwork or insulation left exposed to the environment or contaminating particulate matter shall be replaced at the contractor's expense.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS
A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.
C. Stainless Steel: ASTM A 480/A 480M, Type 316, sheet form with No. 4 finish for surfaces of ducts exposed to view; and Type 304, sheet form with No. 1 finish for concealed ducts.
D. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 SEALANT MATERIALS
A. Joint and Seam Sealants, General: The term “sealant” is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
   1. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
   2. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.3 HANGERS AND SUPPORTS
A. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.
   1. Hangers Installed in Corrosive Atmospheres: Electro-galvanized, all-thread rod or galvanized rods with threads painted after installation.
   2. Straps and Rod Sizes: Comply with latest edition of SMACNA's "HVAC Duct Construction Standards–Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.
B. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
C. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
   3. Supports for Aluminum Ducts: Aluminum support materials, unless materials are electrolytically separated from ductwork.

2.4 RECTANGULAR DUCT FABRICATION
A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to the latest edition of SMACNA's "HVAC Duct Construction Standards–Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

B. Fabricate range hood exhaust ducts with 0.0598-inch-thick, galvanized sheet for concealed ducts and 0.0500-inch-thick stainless steel for exposed ducts. Weld and flange seams and joints. Comply with NFPA 96.

C. Fabricate dishwasher hood exhaust ducts with 0.0500-inch-thick stainless steel. Weld and flange seams and joints.

D. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:
   1. Supply Ducts between AHU and Air Terminal Units: 3-inch wg.
   2. Supply Ducts after air terminal units and on constant volume supply equipment: 1-inch wg (250 Pa), positive pressure

E. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of unbraced panel area, unless ducts are lined.

2.5 ROUND FABRICATION
A. Round Ducts: Fabricate spiral seam supply and return ducts of galvanized steel according to SMACNA’s "HVAC Duct Construction Standards—Metal and Flexible." Snap Lock Longitudinal seam ductwork will not be allowed. Adjustable elbows will not be allowed.

B. Spiral seam round or oval duct may NOT be substituted for rectangular duct at the contractor’s option.

2.6 FLAT OVAL DUCT FABRICATION
A. Flat oval duct shall be double-wall insulated with 1” acoustic and thermal insulation and have a perforated inner liner.

B. Duct lengths shall be fabricated using spiral lock seam and fittings shall be sealed, screwed, and leak tested; all fittings and ductwork shall NOT have flanges in exposed areas (at the discretion of owner).

C. Material shall be G60 galvanized steel.

D. All ductwork under this section shall be equal to: McGill Airflow Superior Grade Double Walled Flat Oval Ductwork

E. Prior approval of any alternative manufacturer’s equal product must be approved prior to bid date.

F. Rectangular duct and Spiral/round duct may NOT be substituted for flat oval duct at the contractor’s option.

2.7 DUCT STORAGE
A. All duct must have end capped with plastic covers on both ends from end of fabrication to duct installation. If this is not provided at the field, vacuum ducts before final acceptance to remove dust and debris.

PART 3 - EXECUTION
3.1 DUCT INSTALLATION, GENERAL
A. Duct installation requirements are specified in other Division Sections. Drawings indicate general arrangement of ducts, fittings, and accessories.

B. Construct and install each duct system for the specific duct pressure classification indicated.

C. Install round ducts in lengths not less than 10 feet (3 m), unless interrupted by fittings.

D. Install ducts with fewest possible joints.

E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.

F. Install couplings tight to duct wall surface with a minimum of projections into duct.

G. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.

K. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

L. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches (38 mm).

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and firestopping sealant. Fire and smoke dampers are specified in Division Section "Duct Accessories." Firestopping materials and installation methods are specified in other Divisions.

### 3.2 Seam and Joint Sealing

A. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards—Metal and Flexible." All duct to be sealed to SMACNA seal class A which requires sealing all transverse joints, longitudinal seams and duct wall penetrations regardless of pressure classification.

B. Seal externally insulated ducts before insulation installation.

C. All ducts shall be inspected after sealing is complete and prior to insulation installation. Provide the engineer with a minimum 7 days notice prior to beginning duct insulation.

### 3.3 Hanging and Supporting

A. Install rigid round and rectangular metal duct with support systems indicated in the latest edition of SMACNA's "HVAC Duct Construction Standards—Metal and Flexible."

B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

C. Support vertical ducts at a maximum interval of 16 feet and at each floor.

D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

### 3.4 Connections

A. Connect equipment with flexible connectors according to Section "Duct Accessories."

B. For branch, outlet and inlet, and terminal unit connections, comply with the latest edition of SMACNA's "HVAC Duct Construction Standards—Metal and Flexible."

### 3.5 Duct Application

A. Service: Round and rectangular, supply/return/outside-air ducts, concealed.

B. Sheet-metal with wrap insulation

C. Service: Round and rectangular, supply/return/outside-air ducts, exposed and in mechanical rooms.
   1. Sheet-metal double wall with lined insulation in-between.
   2. Inner sheet-metal duct shall be perforated in areas with acoustical requirements, ref. plans.

### 3.6 Field Quality Control

A. Disassemble, reassemble, and seal segments of systems as required to accommodate leakage testing and as required for compliance with test requirements.

B. 25% of the duct installed after the air handling units and (prior to the air terminal units, when applicable) shall be tested in the presence of the Architect, at static pressures equal to maximum design pressure of system or section being tested. The sections of duct to be tested shall be chosen by the architect or engineer after installation of the duct. If pressure classifications are not indicated, test entire system at maximum system design pressure. Do not
pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

C. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual."

D. Maximum Allowable Leakage: Comply with requirements for Leakage Classification 3 for round, Leakage Classification 12 for rectangular ducts in pressure classifications less than and equal to 2-inch wg (both positive and negative pressures), and Leakage Classification 6 for pressure classifications from 2- to 10-inch wg.

E. Remake leaking joints and retest until leakage is less than maximum allowable.

3.7 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect the system.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Includes But Not Limited To:
   1. Furnish and install supply air branch duct runouts to diffusers as described in Contract Documents.

1.2 REFERENCES
A. Reference Standards:
   1. National Fire Protection Association / American National Standards Institute:
   2. Underwriters Laboratories:

PART 2 - PRODUCTS

2.1 SYSTEM
A. Manufacturers:
   1. Manufacturer Contact List:
      a. Anco Products Inc,
      b. Thermaflex by Flexible Technologies
      c. Flexmaster USA Inc, Houston, TX
B. Materials:
   1. Ducts:
      a. Formable, flexible, circular duct which shall retain its cross-section, shape, rigidity, and shall not restrict airflow after bending.
      b. Insulation:
         1) Nominal 1-1/2 inches (38 mm), 3/4 lb per cu ft (12 kg per cu m) density fiberglass insulation with air-tight, polyethylene or polyester core, sheathed in seamless vapor barrier jacket factory installed over flexible assembly.
         2) Assembly, including insulation and vapor barrier, shall meet Class I requirement of NFPA 90A and be UL 181 rated, with flame spread of 25 or less and smoke developed rating of 50 or under.
         3) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
            1) ANCO-FLEX 4625 by Anco Products.
            2) M-KC by Thermaflex by Flexible Technologies.
            3) Type 6M Insulated by Flexmaster.

2.2 CONSTRUCTION FEATURES
A. Duct Fabric
   1. A Spunbond Nylon fabric, mechanically locked to the duct helix without the use of adhesives.
B. Duct Helix:
   1. Made from corrosive resistant galvanized steel, the duct helix is mechanically formed to attach the duct fabric without the use of adhesives.
C. Vapor Barrier:
   1. Fire retardant, reinforced aluminum material. Excellent strength at low temperatures. Will not age harden.
D. Insulation:
   1. Insulation Fiberglass insulation jacket, factory wrapped, rated to R6 within building envelope.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct in fully extended condition free of sags and kinks, using 60 inch maximum lengths.
B. Make duct connections by coating exterior of duct collar for 3 inches with duct sealer and securing duct in place over sheet metal collar with specified cinch bands.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes centrifugal fans and vent sets.

1.2 PERFORMANCE REQUIREMENTS
A. Project Altitude: Base air ratings on actual site elevations.
B. Operating Limits: Classify according to AMCA standards.

1.3 SUBMITTALS
A. Product Data: Include rated capacities, furnished specialties, and accessories for each unit scheduled and include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material gages and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.
B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
C. Maintenance Data: For centrifugal fans to include in maintenance manuals specified in specifications.

1.4 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
C. Lift and support units with manufacturer's designated lifting or supporting points.

1.6 COORDINATION
A. Coordinate size and location of structural support members and/or shaft locations.
B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in these documents.

1.7 EXTRA MATERIALS
A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Greenheck.

2.2 HOUSINGS
A. Roof Mounted Centrifugal Exhaust Fan.
   1. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy.
aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength. An integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections. Bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

2.3 WHEELS
A. Roof Mounted Centrifugal Exhaust Fan
   1. Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

2.4 SHAFTS
A. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
B. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
C. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

2.5 BEARINGS
A. Pre-lubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.
   1. Ball-Bearing Rating Life: ABMA 9, L50 of 200,000 hours.
   2. Roller-Bearing Rating Life: ABMA 11, L50 of 200,000 hours.

2.6 BELT DRIVES
A. Description: Factory mounted, with final alignment and belt adjustment made after installation.
   1. Service Factor Based on Fan Motor: 1.5.
B. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
C. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
D. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
E. Motor Mount: Adjustable for belt tensioning.

2.7 ACCESSORIES
A. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
B. Companion Flanges: Galvanized steel, for duct connections.
C. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
D. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
E. Spark-Resistant Construction: AMCA 99 (where required).
F. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
G. Weather Cover: Enamelled-steel sheet with ventilation slots, bolted to housing.

2.8 MOTORS
A. Refer to Section “Motors” for general requirements for factory-installed motors.
B. Motor Construction: NEMA MG 1, general purpose, continuous duty, high efficiency, Design B.
C. Enclosure Type: [Open dripproof] [Totally enclosed, fan cooled].

2.9 SOURCE QUALITY CONTROL
A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION
3.1 INSTALLATION
A. Install centrifugal fans level and plumb.
B. Install units with clearances for service and maintenance.
C. Label fans according to requirements specified in Section "Mechanical Identification."

3.2 CONNECTIONS
A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
B. Install ducts adjacent to fans to allow service and maintenance.
C. Ground equipment.
D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL
A. Equipment Startup Checks:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
   5. Verify lubrication for bearings and other moving parts.
B. Starting Procedures:
   1. Energize motor and adjust fan to indicated rpm.
   2. Measure and record motor voltage and amperage.
C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
E. Shut unit down and reconnect automatic temperature-control operators.
F. Refer to Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
G. Replace fan and motor pulleys as required to achieve design airflow.
H. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.4 ADJUSTING
A. Adjust damper linkages for proper damper operation.
B. Adjust belt tension.
C. Lubricate bearings.

3.5 CLEANING
A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.6 DEMONSTRATION
A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.
   1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
   2. Review data in maintenance manuals. Refer to specifications Section "Closeout Procedures."
   3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.2 DEFINITIONS
A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
C. Register: A combination grille and damper assembly over an air opening.

1.3 SUBMITTALS
A. Product Data: For each model indicated, include the following:
   1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
   2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
   3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
   4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS
A. Diffusers, registers, and grilles are scheduled on Drawings.
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Titus.
   2. Price

2.2 SOURCE QUALITY CONTROL
A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. Coordinate device locations with ceiling...
C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING
A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING
A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Packaged air handling units.
   B. Refrigeration components

1.02 RELATED SECTIONS
   A. Section - Motors
   B. Section - Vibration Isolation.
   C. Section - Ductwork Insulation.
   D. Section - Ductwork.
   E. Section - Ductwork Accessories: Flexible duct connections.
   F. Section - Controls and Instrumentation
   G. Section - Equipment wiring systems.

1.03 REFERENCES
   A. ASHRAE 90.1 ENERGY STANDARD FOR BUILDINGS EXCEPT LOW RISE RESIDENTIAL BUILDINGS
   B. ANSI/AHRI 340/360 - PERFORMANCE RATING OF COMMERCIAL INDUSTRIAL UNITARY AIR CONDITIONING AND HEAT PUMP EQUIPMENT AND CONDENSING UNITS GREATER THAN 65,000BTU/h AND BELOW 250,000BTU/h
   C. AHRI 340 - Commercial and Industrial Unitary Heat pump Equipment, (heat pumps above 135,000 Btuh).

1.04 QUALITY ASSURANCE
   A. Air Handling Units: Product of manufacturer regularly engaged in production of components who issues complete catalog data on total product.

1.05 SUBMITTALS
   A. Submit unit performance data including: capacity, nominal and operating performance.
   B. Submit Mechanical Specifications for unit and accessories describing construction, components and options.
   C. Submit shop drawings indicating overall dimensions as well as installation, operation and service clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.
   D. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
   B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.07 ENVIRONMENTAL REQUIREMENTS
   A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.08 WARRANTY
   A. Provide one year parts warranty.

PART 2 PRODUCTS

2.01 SUMMARY
A. The contractor shall furnish and install air handling units(s) as shown as scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

B. APPROVED MANUFACTURERS
   1. Trane:
   2. Carrier:
   3. Lennox:
   4. Substitutions: [prior approval required] as indicated under the general and/or supplemental conditions of these specifications.

2.02 GENERAL
   A. Provide indoor-mounted, draw-thru, packaged air handling unit(s). Unit(s) shall be factory-assembled including direct-expansion evaporator coil, expansion valve(s), check valves, condensate drain pan, centrifugal fan assembly with fan motor(s) and mounting bracket sheaves, drives and belts, filters, and electrical controls. Units shall be suitable for either horizontal or vertical airflow configuration and be used with or without ductwork.

2.03 CASING
   A. Unit casing shall be constructed of zinc-coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned and finished with a baked enamel finish.
   B. Unit casing shall be completely insulated with fire-retardant, permanent, foil-faced, odorless glass fiber material.

2.04 FANS
   A. Provide fan section with forward curved, double width, double inlet, centrifugal type fan.
   B. Provide self-aligning, grease lubricated, ball or roller bearings with permanent lubrication fittings.
   C. Factory mount motor on slide rails. Provide access to motor, drive, and bearings through removable casing panels.
   D. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
   E. Provide cast iron or steel variable and adjustable pitched sheaves, dynamically balanced, bored to fit shafts and keyed.

2.05 COILS
   A. Provide configured aluminum fin surface mechanically bonded to copper tubing coil. Enclose coils with headers and return bends fully contained within casing. Coil shall have factory installed expansion valves and factory pressure and leak tested at 375 psig.
   B. Provide double sloped condensate drain pan constructed of PVC with external connections on either side of unit. The drain pan shall be removable for cleaning.

2.06 MOTORS
   A. For additional static requirements, Odyssey Split Systems offer standard belt drive motors to meet and exceed a wide range of airflow needs.

2.07 FILTERS
   A. Provide one inch throwaway filters, factory installed. Provide access from side panel for removal. Filter rack shall be field convertible to two inch capability with field provided two inch throwaway filters.

2.08 CONTROLS
   A. Provide factory installed and wired controls including fan contactor, low voltage terminal strip and single point power entry.
B. Provide factory installed FROSTAT to prevent coil freezing at low evaporator temperatures.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions.
B. Install unit on vibration isolators.

END OF SECTION
The Agreement, General Conditions Of The Contract For Construction, Supplementary Conditions Of The Contract For Construction, and all Addenda are a part of the Contract. The Contractor shall consult them in detail for instructions pertaining to the Work. The Contractor shall also consult all other divisions and sections of the Project Manual, and all drawings in the execution of the work of the Contract.

The Contractor shall provide all labor, materials, systems, equipment, items, articles, operations, and/or methods listed, implied, mentioned, or scheduled in the Contract Documents and/or necessary and/or required for the satisfactory completion of the Work.

The listing of work, requirements, and products in this section is not intended to be conclusive. The Contractor shall check all other parts of the Contract Documents and shall provide all miscellaneous items of work and products necessary for the satisfactory completion of the Work described in the Contract Documents.
PART 1 - GENERAL

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

1.2 WORK COVERED BY CONTRACT DOCUMENTS
   A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.
   B. General Scope of Work:
      1. Providing new panels, feeders, conduits, disconnect, fire alarm, electrical to HVAC equipment, electrical to plumbing equipment, rough-in for voice/data system, data cabling and new light fixtures.

1.3 COORDINATION
   A. All electrical work shall be done under sub-contract to a General Contractor. Electrical Contractor shall coordinate all work through General Contractor, even in areas where only electrical work is to take place.
   B. Work shall take place with minimal disruption to Owner’s operations in areas surrounding the new building. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.
   C. Fully coordinate with mechanical contractor for providing power to mechanical equipment.

1.4 UTILITIES
   1. Coordinate with power company and provide conduit, and trenching from transformer to power source. Coordinate with water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
   2. Obtain any approvals required from utilities to relocate utilities.
   3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

1.5 CONTRACTOR USE OF PREMISES
   A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
      1. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
   B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
      1. Temporary fencing around construction areas.
      2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
      3. Temporary fencing around equipment while site work is in progress.

1.6 SUBMITTALS
   1. To extradite the submittal process more efficiently, do not piece-meal the submittals. Submit entire electrical in a bound enclosure. This will eliminate delays in the submittal process. Unbound submittals shall be returned without review. Submit electronic files and hardcopies as requested by the Architect. Refer to Architectural documents.
PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION
SECTION 26 0110
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes the following:
   1. Raceways.
   2. Building wire and connectors.
   4. Electrical identification.
   5. Electricity-metering components.
   6. Concrete equipment bases.
   7. Electrical demolition.
   8. Cutting and patching for electrical construction.

1.3 DEFINITIONS
A. EMT: Electrical metallic tubing.
B. FMC: Flexible metal conduit.
C. IMC: Intermediate metal conduit.
D. LFMC: Liquidtight flexible metal conduit.
E. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS
A. Product Data: For electricity-metering equipment.
B. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.
C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with NFPA 70.

1.6 COORDINATION
A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
   1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
C. Coordinate electrical service connections to components furnished by utility companies.
   1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
   2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Architectural documents.
E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES
A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.
D. Slotted-Steel Channel Supports: Comply with Division Section "Metal Fabrications" for slotted channel framing.
   1. Channel Thickness: Selected to suit structural loading.
   2. Fittings and Accessories: Products of the same manufacturer as channel supports.
E. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
G. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
H. Expansion Anchors: Carbon-steel wedge or sleeve type.
I. Toggle Bolts: All-steel springhead type.

2.2 ELECTRICAL IDENTIFICATION
K. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
L. Raceway and Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.
   1. Type: Pretensioned, wraparound plastic sleeves. Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the item it identifies.
   2. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
   3. Color: Black letters on orange background.
   4. Legend: Indicates voltage.
M. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick (25 mm wide by 0.08 mm thick).
N. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
   1. Not less than 6 inches wide by 4 mils thick (150 mm wide by 0.102 mm thick).
   2. Compounded for permanent direct-burial service.
   3. Embedded continuous metallic strip or core.
   4. Printed legend that indicates type of underground line.
O. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
P. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.
Q. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch (1.6-mm) minimum thickness for signs up to 20 sq. in. (129 sq. cm) and 1/8-inch (3.2-mm) minimum thickness for larger sizes. Engraved legend in black letters on white background.

R. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.

S. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm), galvanized-steel backing, with colors, legend, and size appropriate to the application. 1/4-inch (6-mm) grommets in corners for mounting.

T. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.2 EQUIPMENT FOR UTILITY COMPANY’S ELECTRICITY METERING
A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
B. Meter Sockets: Comply with requirements of electrical power utility company.

2.3 CONCRETE BASES
A. Concrete Forms and Reinforcement Materials: As specified in Division Section “Cast-in-Place Concrete.”
B. Concrete: 3000-psi (20.7-MPa), 28-day compressive strength as specified in Division Section “Cast-in-Place Concrete.”

2.4 TOUCHUP PAINT
A. For Equipment: Equipment manufacturer’s paint selected to match installed equipment finish.
B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION
3.1 ELECTRICAL EQUIPMENT INSTALLATION
A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 RACEWAY AND CABLE INSTALLATION
A. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
B. Install raceways and cables at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.
C. Use temporary raceway caps to prevent foreign matter from entering.
D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
E. Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.
F. Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1-inch (25-mm) concrete cover.
   1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
   2. Space raceways laterally to prevent voids in concrete.
3. Install conduit larger than 1-inch trade size (DN27) parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.

4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.

5. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for exposed parallel raceways.

G. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.

H. Install telephone and signal system raceways, 2-inch trade size (DN53) and smaller, in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.

I. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of 72-inch (1830-mm) flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.

J. Set floor boxes level and trim after installation to fit flush to finished floor surface.

3.3 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.

E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb (90-kg) design load.

3.4 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Install 1/4-inch- (6-mm-) diameter or larger threaded steel hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Simultaneously install vertical conductor supports with conductors.

J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.
K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
   1. Wood: Fasten with wood screws or screw-type nails.
   2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
   3. New Concrete: Concrete inserts with machine screws and bolts.
   4. Existing Concrete: Expansion bolts.
   5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
   6. Steel: Welded threaded studs or spring-tension clamps on steel.
      a. Field Welding: Comply with AWS D1.1.
   7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
   8. Light Steel: Sheet-metal screws.
   9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.5 IDENTIFICATION MATERIALS AND DEVICES

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

C. Self-Adhesive Identification Products: Clean surfaces before applying.

D. Identify raceways and cables with color banding as follows:
   1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches (51 mm) wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
   2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (8-m) maximum intervals in congested areas.
   3. Colors: As follows:
      c. Telecommunication System: Green and yellow.

E. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

F. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches (150 to 200 mm) below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm), overall, use a single line marker.

G. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
1. Phase A: Black.
2. Phase B: Red.
3. Phase C: Blue.
5. Ground: Green.

H. Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
   1. Phase A: Brown.
   2. Phase B: Orange.
   3. Phase C: Yellow.
   4. Neutral: White with a colored stripe or gray.
   5. Ground: Green.

I. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

J. Install engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch- (9-mm-) high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

3.6 Utility Company Electricity-Metering Equipment
   A. Install equipment according to utility company’s written requirements. Provide grounding and empty conduits as required by utility company.

3.7 Firestopping
   A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division Section “Firestopping.”

3.8 Concrete Bases
   A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger, in both directions, than supported unit. Follow supported equipment manufacturer’s anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section “Cast-in-Place Concrete.”

3.9 Cutting and Patching
   A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
   B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.10 Field Quality Control
   A. Inspect installed components for damage and faulty work, including the following:
      1. Raceways.
      2. Building wire and connectors.
      4. Electrical identification.
      5. Concrete bases.
      6. Electrical demolition.
      7. Cutting and patching for electrical construction.
      8. Touchup painting.

3.11 Refinishing and Touchup Painting
A. Refinish and touch up paint. Paint materials and application requirements are specified in Division Section "Painting."
   1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
   2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
   3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.12 CLEANING AND PROTECTION
A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED REQUIREMENTS
A. The General Provisions, Supplemental General Provisions, Special Provisions, Specification Sections and all relevant documents shall form a part of this Section of the Specifications, and shall be incorporated in this Section and each Section 260000 hereinafter as if repeated verbatim herein. All conditions imposed by these documents shall be applicable to all portions of the work under this Section. Certain specific paragraphs of said references may be referred to hereinafter in this Section. These references are intended to point out specific items to the Contractor, but in no way relieve him of the responsibility of reading and complying with all relevant parts of the entire Specification.
B. The Contractor shall examine and coordinate with all Contract Drawings and Specifications, and all Addenda issued. Failure to comply shall not relieve him of responsibility. The omission of details of other portions of the work from this Section shall not be used as a basis for a request for additional compensation.
C. The specific features and details for other portions of the work related to the construction in progress or to the adjacent building shall be determined by examination at the site.

1.2 SCOPE OF WORK
A. The requirements contained in this Section apply to all work performed under these Specifications.
B. The work covered by this Section of the Specifications comprises the furnishing of labor, material, equipment, transportation, tools and services, and performing operations required for, and reasonably incidental to, the installation of the work in accordance with the applicable Contract Documents, and subject to the terms and conditions of the Contract.
C. Refer to other Sections of the Specifications for related work.

1.3 DEFINITION OF "CONTRACTOR"
A. Where the word “Contractor” is used under any Section of this Section of the Specifications, it shall mean the Contractor engaged to execute the work included under that Section, even though this Contractor may be technically described as a Subcontractor, or an authorized representative.
B. If the Contractor, engaged to execute a portion of the work, employs a Subcontractor to perform some of that work, he shall be completely responsible for the proper execution of this Subcontractor’s work, in full conformity with the Contract Documents.

1.4 RESPONSIBILITY OF THE CONTRACTOR
A. The Contractor shall be responsible for all work of every description in connection with this Section of the Specifications. The Contractor shall specifically and distinctly assume, and does so assume, all risk for damage or injury from whatever cause to property or person used or employed on or in connection with this work and of all damages or injury to any person or property wherever located, resulting from an action or operation under the Contract in connection with the work, and undertake the responsibility to defend the Owner against all claims on account of any such damage or injury.
B. The Contractor will be held responsible for the satisfactory execution and completion of the work in accordance with the true intent of the Contract Documents. The Contractor shall provide without extra charge all incidental items required as part of the work, even though it may not be specifically indicated. If the Contractor has reason for objecting to the use of any material, equipment, device or method of construction as indicated, the Contractor shall make report of such objections to the Owner's Representative, obtain proper approval and adjustment to the Contract, and shall proceed with the work.

1.5 TERMINOLOGY
A. Whenever the words "furnish", "provide", "furnish and install", "provide and install", and similar
phrases occur, it is the intent that the materials, equipment and devices described be furnished, installed and connected under this Section, complete for operation, unless specifically noted to the contrary.

B. It is also the intent, unless specifically noted to the contrary, that all materials, equipment and devices described and specified under this Section of the Specifications be similarly furnished, installed and connected under this Section, whether or not a phrase as described in the preceding paragraph has been actually included.

C. Whenever the words “Owner’s Representative” occurs, it is intended to refer to the Architect, Engineer and/or specific Owner’s Representative responsible for or capable of providing the necessary direction pertaining to the referenced issue.

1.6 ORDINANCES, PERMITS AND CODES

A. It shall be the Contractor’s duty to perform the work and provide the materials covered by these specifications in conformance with all ordinances and regulations of all authorities having jurisdiction.

B. All work herein shall conform to all applicable laws, ordinances and regulations of the local utility companies.

C. The Contractor shall obtain and pay for all permit and connection fees as required for the complete installation of the specified systems, equipment, devices and materials.

D. The Contractor shall obtain permits, plan checks, inspections and approvals applicable to the work as required by the regulatory authorities. Fees and costs of any nature whatsoever incidental to these permits, inspections and approvals shall be assumed and paid by the Contractor. The pro-rata costs, if any, for utilities serving this property will be paid for by the Owner and shall not be included as part of this Contract.

E. The work shall be in accordance with, but shall not be limited to, the requirements of:
   1. National Fire Protection Association
   2. National Electrical Code
   5. Local City Building Codes
   6. State of Texas Building Codes

F. Codes and standards referred to are minimum standards. Where the requirements of the Drawings or Specifications exceed those of the codes and regulations, the Drawings and Specifications govern.

1.7 MATERIALS, EQUIPMENT AND DEVICE DESCRIPTION

A. Materials, equipment and devices shall be of the best quality customarily applied in quality commercial practice, and shall be the products of reputable manufacturers. Each major component shall bear a nameplate giving the name and address of the manufacturer, and the catalog number or designation of the component.

B. Materials, equipment and devices furnished under this Section of the Specifications shall be essentially the standard product of the specified manufacturer, or where allowed, an alternate manufacturer. Where two or more units of the same kind or class of a specific item are required, these shall be the products of a single manufacturer; however, the component parts of the item need not be the products of one manufacturer.

C. In describing the various materials, equipment and devices, in general each item will be described singularly, even though there may be a multiplicity of identical items. Also, where the description is only general in nature, exact sizes, duties, space arrangements, horsepower requirements and other data shall be determined by reference to the Contract Documents.

D. Space allocations for materials, equipment and devices have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer whether indicated or not. The Contractor shall verify that all materials, equipment and devices proposed for use on this project are within the constraints of the allocated space.
1.8 QUALITY ASSURANCE
A. Materials, equipment and devices shall be new and of the quality specified, and shall be free from defects at the time of installation. Materials, equipment and devices damaged in shipment or otherwise damaged or found defective prior to acceptance by the Owner shall not be repaired at the job site, but shall be replaced with new materials, equipment or devices identical with those damaged, unless specifically approved otherwise by the Owner’s Representative.
B. Wherever a UL standard has been established for a particular type of material, equipment or device, each item of such material, equipment or device provided on this project shall meet the requirements of the UL standard in every way, and shall be UL listed and labeled.

1.9 REFERENCE STANDARDS
A. Materials, equipment, devices and workmanship shall comply with applicable local, county, state and national codes, laws and ordinances, utility company regulations and industry standards.
B. In case of differences between building codes, state laws, local ordinances, industry standards, utility company regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Owner’s Representative in writing of any such difference. Should the Contractor perform any work that does not comply with local codes, laws and ordinances, industry standards or other governing regulations, the work shall be corrected at noncompliance deficiencies with the Contractor bearing all costs.
C. In addition to the aforementioned ordinances, industry standards published by the following organizations shall apply:

- AABM - American Association of Battery Manufacturers
- ADA - American’s with Disabilities Act
- AIA - American Institute of Architects
- ANSI - American National Standards Institute
- ASTM - American Society for Testing and Materials
- CBM - Certified Ballast Manufacturers Association
- ETL - Electrical Testing Laboratories
- FM - Factory Mutual
- ICEA - Insulated Cable Engineers Associated
- IEEE - Institute of Electrical and Electronic Engineers
- IES - Illuminating Engineering Society
- IRI - Industrial Risk Insurance
- NBS - National Bureau of Standards
- NEC - National Electrical Code
- NECA - National Electrical Contractors Association
- NEMA - National Electrical Manufacturers Association
- NESC - National Electrical Safety Code
- NETA - National Electrical Testing Association
- NFPA - National Fire Protection Association
- UL - Underwriters Laboratories

1.10 DRAWINGS AND SPECIFICATIONS
A. The interrelation of the Drawings (including the schedules) and the Specifications are as follows:
   1. The Drawings establish quantities, locations, dimensions and details of materials, equipment and devices. The schedules on the Drawings indicate the capacities, characteristics and components.
2 The Specifications provide written requirements for the quality, standard and nature of the materials, equipment, devices and construction systems.

B. The Drawings and Specifications shall be considered as being compatible; therefore, the work called for by one and not by the other shall be furnished and installed as though called for by both. Resolution of conflicts between Drawings and Specifications shall be as follows:

1 If the Drawings and Specifications disagree in themselves, or with each other, the Contractor’s pricing shall be based on furnishing and installing the most expensive combination of quality and quantity of work indicated for a complete operable system. Contractor is responsible to notifying the Architect and Engineer. In the event of this type of disagreement, the resolution shall be determined by the Owner’s Representative. The contractor shall assume for an operable system at the most expensive combination as per the latest National Electrical Code. The contractor shall review all drawings and specifications prior to bid date.

2 The Contractor shall be responsible for bringing any conflicts in the Drawings and the Specifications to the attention of the Owner’s Representative immediately, prior to bid date.

3 In general, if there is conflict between the Drawings and Specifications, the Drawings shall govern the Specifications.

4 Where the Specifications do not fully agree with schedules on the Drawings, the schedules shall govern. Actual numerical dimensions indicated on the Drawings govern scale measurements and large scale details govern small scale drawings.

5 Materials, equipment and devices called for on the Drawings and not indicated herein, shall be completely provided and installed as though it were fully described herein.

6 Materials, equipment and devices called for herein shall be completely provided and installed, whether or not it is fully detailed, scheduled or indicated on the Drawings.

C. The Contractor shall examine the Drawings and Specifications of the other portions of the work for fixtures and finishes in connection with this work. The Contractor shall carefully examine the Drawings to determine the general construction conditions, and shall familiarize himself with all limitations caused by such conditions.

D. When discrepancies exist between scale and dimension, or between the Drawings of the various portions of the work, they shall be called to the attention of the Owner’s Representative for further instruction, whose instructions shall be final and binding and work promptly resumed without any additional cost to the Owner.

E. Review the construction details of the building(s) as illustrated on the Drawings of the other portions of the work, i.e., architectural, structural, civil, landscape, etc., and be guided thereby. Route conduits and set all boxes as required by the pace of the general construction.

F. The Drawings diagrammatically show the sizes and locations of the various equipment and devices, and the sizes of the major interconnecting wires, without showing exact details as to elevations, offsets, control wiring and other installation requirements. Carefully layout the work at the site to conform to the architectural and structural conditions, to avoid obstructions and to permit proper grading of pipe associated with other portions of the work. In cooperation with other Contractors, determine the exact location of equipment and devices and connections thereto by reference to the submittals and rough-in drawings, and by measurements at the site. Make minor relocations necessitated by the conditions at the site, or directed by the Owner’s Representative, without additional cost to the Owner.

G. The Drawings and Specifications are intended to describe and illustrate systems which will not interfere with the structure of the building(s), fit into the available spaces, and insure complete and satisfactory operating installations. Prepare installation drawings as required for all critical areas illustrating the installation of the work in this Section as related to the work of all other Sections and correct all interferences with the other portions of the work or with the building structures before the work proceeds.

H. The Drawings do not indicate the existing electrical installations other than to identify modifications or extensions thereto. Visit the site and ascertain the conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work. Failure to comply with this shall not constitute grounds for any additional payment in connection with removing or modifying any part of the existing installation or installing any new or
temporary work under this Section.

1.11 SUBMITTALS

A. Submit product data and shop drawings in accordance with the Specifications.
B. Process product data and shop drawings to insure that the proposed materials, equipment and devices conform to the requirements of the Contract Documents, and that there are no omissions or duplications. Provide layouts, fabrication information and data for systems, materials, equipment and devices proposed for the project.
C. Submittals shall be provided for review and approval on all systems, equipment, devices and materials proposed for use on this project. Submittals shall include, but not be limited to, the following:
   1. Lighting and Appliance Panelboards
   2. Disconnect Switches
   3. Circuit Breakers and Fuses
   4. Materials: conduit, conductors, connectors, supports, etc.
   5. Lighting Fixtures, Lamps and Control Systems/Devices
   6. Wiring Devices
   7. Transformers
   8. Distribution Panelboards
   9. Motor Control Center
   10. As indicated on each submittal section
D. The product data shall not consist of manufacturer’s catalogs or cut sheets that contain no indication of the exact item offered. The submission on individual items shall designate the exact item offered.
E. Do not submit detailed quantitative listings of materials, equipment and devices. It is the Contractor’s responsibility to provide proper sizes and quantities to conform to Contract Documents.
F. Assemble submittals on related items procured from a single manufacturer in bound brochures or other suitable package form, rather than submitting a multiplicity of loose sheets.
G. Prepare shop drawings whenever equipment proposed varies in physical size and arrangement from that indicated thus causing rearrangement of equipment space, where tight spaces require extreme coordination between this work and other work, where called for elsewhere in these Specifications and where specifically requested by the Owner’s Representative. Shop drawings shall be prepared at a scale of not less than 1/4 inch equals 1 foot.
H. The Contractor shall sign the submittal as an indication of compliance with the Contract Documents. If there are any deviations from the Contract Documents, he shall so indicate on the submittal. Any deviations not so indicated shall be cause for rejection and removal of the non-complying equipment at the Contractor’s expense.

1.12 SUBSTITUTIONS

A. Where a single manufacturer is mentioned by trade name or manufacturer’s name, unless specifically noted otherwise, it is the only manufacturer that will be accepted.
B. Where multiple manufacturers are listed, none other than those manufacturers will be accepted.
C. Manufacturers not listed will be considered for substitution prior to bid only. The substitute manufacturer shall submit a complete copy of the appropriate technical specification section minimum seven (7) business days prior to bid with each sub-paragraph noted with the comment, “compliance”, “deviation”, “alternate” or “not applicable”. In the case of non-primary, vendor-supplied items, the name of the sub-vendor supplying said item, including model number, shall be indicated.
   1. By noting the term “compliance” or “C”, it shall be understood that the manufacturer is in full compliance with the item specified and will provide exactly the same with no deviations.
   2. By noting the term “deviation” or “D”, it shall be understood that the manufacturer prefers to provide a different component in lieu of that specified. Manufacturer shall indicate all deviations.
3 By noting the term "alternate" or "A", it shall be understood that the manufacturer proposes to provide the same operating function but prefers to do it in a different manner. An alternate shall be fully described as to what the manufacturer proposes to provide.

4 By noting the term "not applicable" or "N/A", it shall be understood that the specified item is not applicable to the project.

D. It shall be understood that space allocations have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer whether indicated or not. If any item of equipment or device is offered in substitution which differs substantially in dimension or configuration from that indicated on the Drawings or specifications, provide as part of the submittal 1/4 inch equals 1 foot scaled drawings showing that the substitute can be installed in the space available without interfering with other portions of the work or with access for operations and maintenance in the completed project.

E. Where substitute equipment or devices requiring different arrangement or connections from that indicated is accepted by the Owner's Representative, install the equipment or devices to operate properly and in harmony with the intent of the Contract Documents, making all incidental changes in piping, ductwork or wiring resulting from the equipment or device selection without any additional cost to the Owner. The Contractor shall pay all additional costs incurred by other portions of the work in connection with the substituted equipment or device.

F. The Owner's Representative reserves the right to call for samples of any item of material, equipment or device offered in substitution, together with a sample of the specific item when, in their opinion, the quality of the item and/or the appearance is involved, and it is deemed that an evaluation of the item may be better made by visual inspection.

G. When any request for a substitution of material, equipment or device is submitted and rejected, the item named in the Contract Documents shall be furnished. Repetitive submittal of substitutions for the same item will not be considered.

1.13 INSTALLATION DRAWINGS
A. Prepare installation drawings for coordinating the work of this Section with the work of other Sections, to illustrate its concealment in finished spaces, to avoid obstructions, and to demonstrate the adaptability of any item of material, equipment or device in the space upon which the Contract Documents are based.

B. Use these drawings in the field for the actual installation of this work. Provide three (3) copies, not for approval, to the Owner's Representative for his information, review and record.

1.14 WORKMANSHIP AND INSTALLATION
A. In no case shall the Contractor provide a class of material, equipment, device or workmanship less than that required by the Contract Documents or applicable codes, regulations, ordinances or standards. All modifications which may be required by a local authority having legal jurisdiction over all or any part of the work shall be made by the Contractor without any additional charge. In all cases where such authority requires deviations from the requirements of the Drawings or Specifications, the Contractor shall report same to the Owner's Representative and shall secure his approval before the work is started.

B. The work shall be performed by properly licensed technicians skilled in their respective trades. All materials, equipment and devices shall be installed in accordance with the recommendations of the manufacturer and in the best standard practice to bring about results of a first class condition.

C. The NECA "Standards of Installation" as published by the National Electrical Contractors Association shall be considered a part of these Specifications, except as specifically modified by other provisions contained in these Specifications.

1.15 INSPECTION OF SITE
A. The accompanying drawings do not indicate existing installations other than to identify modifications of and extensions thereto. The Contractor shall visit the site, inspect the installations and ascertain the conditions to be met and the work to be performed. Failure to comply with this shall not constitute ground for any additional payments in connection with removing or
modifying any part of the existing installations and/or installing any new work under this Section.

B. Review construction details of the adjacent building presently under construction during the site inspection and include all work required to modify the existing installations and install new materials, comprising a part of the installation. Review all construction details of the new building as illustrated on the drawings and be guided thereby.

1.16 WARRANTY
A. All materials, equipment, devices and workmanship shall be warranted for a period of one year from the date of acceptance by the Owner’s Representative for beneficial use by the Owner, except that where specific equipment is noted to have extended warranties. The warranty shall be in accordance with AIA Document A201. The Contractor shall be responsible for the proper registration of these warranties so that the Owner can make all proper claims should future need develop.

B. The Contractor shall furnish to the Owner's Representative for transmittal to the Owner, the name, address and telephone number of those persons responsible for service on systems and equipment covered by the warranty.

1.17 OPERATION PRIOR TO ACCEPTANCE
A. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, the Contractor may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments and complete punch list items before final acceptance by the Owner.

1.18 INSTRUCTION OF OWNER'S PERSONNEL
A. Provide the services of competent engineers and/or technicians acceptable to the Owner's Representative to instruct other representatives of the Owner in the complete and detailed operation of each item of equipment or device of all the various electrical systems. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.

B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.

C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals. Operating and maintenance manuals used for instructions shall include wiring diagrams, manufacturer's operating and maintenance instructions, parts lists (with sources identified), and other data as appropriate for each system.

1.19 SCHEDULE AND SEQUENCE OF WORK
A. The Contractor shall meet and cooperate with the Owner and Owner's Representative to schedule and sequence this work so as to insure meeting scheduled completion dates and avoid delaying other portions of the work. Work requiring special sequencing shall be at no additional cost to the Owner and shall have no impact on the schedule.

1.20 INSTALLATION INSPECTIONS AND CERTIFICATIONS
A. Obtain timely inspections of the installation by the regulatory authorities. Remedy any deficiencies to the satisfaction of the inspecting official.

B. Upon final completion of the work, obtain certificates of acceptance from the regulatory authorities. Deliver the certificates to the Owner's Representative for transmission to the Owner.

1.21 EQUIPMENT INSTALLATION
A. Install equipment and devices in a manner to permit access to all surfaces or components, requiring such access, without the need to disassemble other unrelated parts of the work.

B. Equipment specified to be factory assembled and tested prior to shipment shall not be disassembled at the job site and reassembled at its final location. Apparatus not so specified...
may be disassembled and reassembled in the proper location.
C. Furnish all scaffolding, rigging and hoisting required for the installation of all the work.

1.22 CONCRETE HOUSEKEEPING PADS
A. Concrete housekeeping pads shall be provided for all floor mounted equipment, unless noted or required otherwise.
B. All pads shall be not less than 3-1/2” high and extend a maximum 3” beyond the actual equipment size. Coordinate the proper size of the pad with the equipment furnished. Pads shall be poured in forms built of new dressed lumber with corners chamfered using sheet metal or triangular wood strips nailed to the form. Use 6 x 6 No. 3 mesh for reinforcing. Install heavy duty adjustable anchor bolts, set in the form and positioned using templates, prior to pouring concrete. After the equipment is set on the pad, the equipment shall be aligned, leveled and fully grouted to the pad and all void spaces shall be filled with a non-shrinking grout.
C. Perform all concrete work specified to be provided under this Section in strict accordance with the applicable provisions of Section, CONCRETE.

1.23 SLEEVES
A. Each conduit, regardless of material, which passes through a concrete slab, masonry wall, or roof or portion of the building structure shall be free from the structure and shall pass through a sleeve.
B. All sleeves shall be constructed from electrical-metallic tubing or equivalent weight galvanized steel tubing and shall be flush on both sides of the surface penetrated, unless noted otherwise. All sleeves penetrating the roof areas shall extend a minimum 10 inches above the roof with approved weatherproof counterflashing attached to the conduit above the roof. All sleeves penetrating floors shall extend a minimum of 6 inches above the finished floors. The sleeves shall be sized to allow free passage of the conduit to be inserted.
C. Sleeves passing through walls or floors on or below grade or in moist areas shall be constructed of galvanized rigid steel and shall be designed with a suitable flange in the center to form a waterproof passage. After the conduit has been installed in the sleeves, the void space around the conduit shall be caulked and filled with an asphalt-base compound to insure a waterproof penetration. Jute twine caulking shall not be used due to susceptibility to termite infestation.

1.24 ESCUTCHEONS
A. In each finished space, provided a chromium plated, sectional escutcheon on each conduit, or hanger rod penetrating a wall, floor or ceiling.
B. Size escutcheons and collars to fit snugly around conduit and rods.
C. Where required, provide escutcheons with set screws so that they fit snugly against the finished surface.

1.25 ACCESS PANELS
A. Provide wall and ceiling access panels for unrestricted access to all concealed electrical equipment items and devices installed behind furrings, chases or non-removable suspended ceilings.
B. Access panels shall be UL listed and labeled as required to suit the fire rating of the surface in which installed, with mounting straps, concealed hinges, screwdriver locks, 180 degree open door design, 16 gauge steel construction and door and frame finished in prime coat finish. Panels shall be 1/2-inch by 12-inch minimum size, but shall be larger as the access requirement of the concealed electrical equipment item or device increases.

1.26 SEALING OF PENETRATIONS
A. All penetrations in horizontal or vertical fire-rated construction shall be sealed using approved fire-rated sealing materials equivalent to the following:
   1. Foam: Dow Corning 3-6548 RTV silicone foam, liquid component Part 4 (black) and liquid component Part B (off-white).
   2. Sealant: Dow Corning 96-081 RTV silicone adhesive sealant.
   3. Damming Materials: Mineral fiberboard, mineral fiber matting, mineral fiber putty, plywood or particle board, as selected by applicator.
B. Preparation: Remove combustible materials and loose impediments from penetration opening...
and involved surfaces. Remove free liquid and oil from penetration surfaces.

C. Installation: In accordance with manufacturer’s instructions, install damming materials and sealant to cover and seal penetration openings; inject foam mixtures into openings.

D. In addition to the Dow Corning products, equal products by Spec Seal Firestop Products, 3M Fire Barrier or CS240 Firestop are acceptable.

1.27 PROTECTION OF APPARATUS

A. At all times take every precaution to properly protect apparatus from damage due to dust, dirt, water, etc., or from damage due to physical forces. Include the erection of temporary shelters as required, to adequately protect any apparatus stored at the site, the cribbing of any apparatus directly above the construction, and the covering of apparatus in the incomplete building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above to the entire satisfaction of the Owner’s Representative will be sufficient cause for the rejection of the pieces of apparatus in question.

B. Responsibility for the protection of apparatus extend also to existing apparatus involved in this Section of the work, whether such apparatus is designated to be used temporarily and later removed, or is to be reused as a part of the permanent installation. Erect temporary sheltering structures, provide temporary bracing and supports, or cover equipment as required or directed to afford proper protection for that equipment.

C. The Contractor shall protect this work and the work of all other Contractors from damage by his work or workmen and shall make good any damage thus caused. He shall also be responsible for the proper protection of his equipment, machinery, materials and accessories delivered and installed on the job.

1.28 INSTALLATION OF CONTROL AND OPERATING DEVICES

A. The highest operable part of controls (light switches, dimmer switches, emergency power off devices, etc.), receptacles (electrical and communications) and other operable devices shall be 48” above finish floor. The lowest operable part shall be no less than 15” above finished floor. For purposes of uniformity, unless noted otherwise, the top of a device shall be maximum 48” AFF and the bottom of a device shall be minimum 15” AFF. Refer to the electrical symbols list on the Drawings for specific requirements.

B. Visual alarm appliances shall be placed 80” above finished floor (the highest floor level within a space) or 6” below the ceiling, whichever is lower.

1.29 INSTALLATION AND CONNECTION OF OTHER SECTION’S EQUIPMENT

A. Verify the electrical requirements of all equipment furnished under other Sections, separate contracts, or by the Owner. Install conduit, power wiring, control wiring, devices, etc., as required for complete operation of all equipment.

1.30 OPTION TO RELOCATE OUTLETS AND RELATED DEVICES

A. The location of power, data and telephone outlets, wall switches and other related devices may be relocated at the Owner’s option, at no additional cost to the Owner, to a point within 10 feet of their present location provided the Contractor is notified prior to installation.

1.31 COOPERATION AND CLEAN-UP

A. It shall be the responsibility of the Contractor to cooperate fully to keep the job site in a clean and safe condition. Upon the Contractor shall immediately remove all of his tools, equipment, surplus materials and debris.

B. After he installation is complete and before the equipment is energized, clean the interior and exterior of all equipment thoroughly. Clean equipment, removing all debris, rubbish and foreign materials. Each component shall be cleaned and all dust and other foreign material. Components shall be cleaned of oxidation. The inside and outside of all switchgear shall also be wiped clean with lemon-oil rag after all other cleaning is complete. Any portion of the work requiring touch-up finishing shall be so finished to equal the specified finish on the product.

1.32 RECORD DRAWINGS AND DOCUMENTATION FOR OWNER

A. The Contractor shall obtain at his own expense a complete set of blueline prints on which to
keep an accurate record of the installation of all materials, equipment and devices covered by the Contract. The Contractor shall record up to date information at least once a week and retain the set of prints on site for periodic review by the Architect/Engineer. The record drawings shall indicate the location of all equipment and devices, and the routing of all systems. If the Contractor prepared large scale installation drawings of electrical rooms, conduit routing, busduct, routing, etc., these drawings or reproducible sepias therefrom shall be revised as required to accurately illustrate the actual installation. All conduit buried in concrete slabs, walls and below grade shall be located by dimension; both horizontally and by vertical elevation, unless a surface mounted device in each space indicates the exact location.

B. Upon anticipated completion of the job, obtain one complete reproducible set of the original drawings on which to neatly, legibly and accurately transfer all project related notations and deliver these record drawings to the Architect/Engineer at job completion before final payment and delivery to the Owner. This information shall be delivered prior to final acceptance.

C. The Contractor shall accumulate in duplicate during the job progress, the following data prepared in indexed 3-ring looseleaf, hard-back binders sized for 8-1/2 inch by 11 inch sheets. No binder shall exceed 3-1/2 inches thick. This data shall be turned over to the Owner's Representative for review and subsequent delivery to the Owner prior to final acceptance.

1. Warranties, guarantees and manufacturer’s directions on material, equipment and devices covered by the Contract.
2. Approved lighting fixture brochures, wiring diagrams and control diagrams.
3. Copies of approved submittals and shop drawings.
4. Operating instructions and recommended maintenance procedures for major apparatus.
5. Copies of all other data and/or drawings required during construction.
6. Repair parts list of major apparatus, including name, address and telephone number of local supplier or representative.
7. Tag charts and diagrams hereinbefore specified.

1.33 FINAL OBSERVATION

A. The purpose of the final observation is to determine whether the Contractor has completed the construction in accordance with the Contract Documents and that in the Owner Representative’s opinion the installation is satisfactory for final acceptance by the Owner.

B. It shall be the responsibility of the Contractor to assure that the installation is ready for final acceptance prior to calling upon the Owner’s Representative to make a final observation.
SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS
A. Product data Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE
A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
   B. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Deliver wires and cables according to NEMA WC 26.

1.6 COORDINATION
A. Coordinate layout and installation of cables with other installations.
   B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. Wires and Cables:
         b. BICC Brand-Rex Company.
         c. Carol Cable Co., Inc.
         d. Senator Wire & Cable Company.
         e. Southwire Company.
      2. Connectors for Wires and Cables:
         a. AMP Incorporated.
         b. General Signal; O-Z/Gedney Unit.
         c. Monogram Co.; AFC.
         d. Square D Co.; Anderson.
         e. 3M Company; Electrical Products Division.

2.2 BUILDING WIRES AND CABLES
A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.
   B. Rubber Insulation Material: Comply with NEMA WC 3.
   C. Thermoplastic Insulation Material: Comply with NEMA WC 5.
   D. All wire shall be soft drawn annealed copper(with conductivity of not less than 98% that of pure copper) with THHN/THWN 600-volt color coded insulation.
E. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 8.
F. Conductor Material: Copper.
G. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.
H. Plenum rated cable for all cables above the ceiling.

2.3 CONNECTORS AND SPLICES
A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 “Wire and Insulation Applications” Article.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRE AND INSULATION APPLICATIONS
A. Service Entrance: TypeXHHW-2 or THWN, in raceway.
B. Feeders: Type 75C insulation THWN-2, in raceway; stranded for #8 and larger; solid for #10 and smaller.
C. Fire-Pump Feeder: Type MI, 3-conductor.
D. Branch Circuits: Type THWN-2 in raceway, stranded for #10 and larger; solid for #8 and smaller; minimum #12 size.
E. Fire Alarm Circuits: Type THWN-2, in raceway.
F. Class 1 Control Circuits: Type THWN-2, in raceway.
G. Class 2 Control Circuits: Type THWN-2, in raceway.
H. Equipment or any device rated 100 amperes or less, conductor shall be rated 60C as per National Electrical Code.
I. Equipment or any device rated over 100 amperes, conductor shall be rated 75C as per National Electrical Code.

3.3 INSTALLATION
A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."
B. Remove existing wires from raceway before pulling in new wires and cables.
C. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
E. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
F. Support cables according to Section "Basic Electrical Materials and Methods."
G. Seal around cables penetrating fire-rated elements according to Section "Firestopping."
H. Identify wires and cables according to Section "Basic Electrical Materials and Methods."
I. Identify wires and cables according to Section "Electrical Identification."

3.4 CONNECTIONS
A. Conductor Splices: Keep to minimum.
B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
C. Use splice and tap connectors compatible with conductor material.
D. Use oxide inhibitor in each splice and tap connector for aluminum conductors.
E. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.
F. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1.

B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes grounding and bonding of electrical systems and equipment. Grounding
      requirements specified in this Section may be supplemented by special requirements of systems
      described in other Sections.
   B. Related Sections include the following:
      1. List below only products, construction, and equipment that the reader might expect to find in
         this Section but are specified elsewhere.
      2. Section "Underground Ducts and Utility Structures" for ground test wells.

1.3 SUBMITTALS
   A. Revise this Article to suit Project and office practice. Frequently, no product submittal is required
      for this Section.
   B. Product Data: For each type of product indicated.
   C. Retain paragraph above if Product Data are required for each product specified. Retain
      paragraph below if Product Data are required only for selected products.
   D. Product Data: For the following:
      1. Ground rods.
      2. Chemical rods.
   E. Field Test Reports: Submit written test reports to include the following:
      1. Test procedures used.
      2. Test results that comply with requirements.
      3. Results of failed tests and corrective action taken to achieve test results that comply with
         requirements.

1.4 QUALITY ASSURANCE
   A. Retain paragraph and subparagraph below if Contractor or manufacturer selects testing
      agency. Delete if Contractor is allowed to perform ground-resistance testing.
   B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article
      100, by a testing agency acceptable to authorities having jurisdiction, and marked for
      intended use.
      1. Comply with UL 467.
   C. Comply with NFPA 70; for overhead-line construction and medium-voltage underground
      construction, comply with IEEE C2.
   D. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering
      products that may be incorporated into the Work include, but are not limited to, the following:
   B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to
      Division 1 Section "Materials and Equipment."
   C. Manufacturers: Subject to compliance with requirements, provide products by one of the
      following:
      1. See Editing Instruction No. 1 in the Evaluations for cautions about naming products and
         manufacturers.
      2. Grounding Conductors, Cables, Connectors, and Rods:
         a. Apache Grounding/Erico Inc.
b. Boggs, Inc.
c. Chance/Hubbell.
d. Copperweld Corp.
e. Dossert Corp.
g. Framatome Connectors/Burndy Electrical.
h. Galvan Industries, Inc.
i. Hastings Fiber Glass Products, Inc.
j. Ideal Industries, Inc.
k. ILSCO.
l. Kearney/Cooper Power Systems.
m. Korns: C. C. Korns Co.; Division of Robroy Industries.
n. Lightning Master Corp.
o. Lyndle XIT Grounding.
q. Raco, Inc.; Division of Hubbell.
r. Robbins Lightning, Inc.
s. Salisbury; W. H. Salisbury & Co.
t. Superior Grounding Systems, Inc.
u. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS
A. For insulated conductors, comply with Section "Conductors and Cables."
B. Material: copper.
C. Equipment Grounding Conductors: Insulated with green-colored insulation.
D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
E. Grounding Electrode Conductors: Stranded insulated cable.
F. Underground Conductors: stranded, unless otherwise indicated.
G. Sizes and types below are typical. Adjust to suit Project conditions and requirements.
H. Copper Bonding Conductors: As follows:
   1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch (6.4 mm) in diameter.
   2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
   3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
   4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
I. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS
A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES
A. Copper-clad steel is most common. See Evaluations for discussion on where other materials might be more appropriate.
B. Ground Rods: Copper-clad steel.
   1. Select paragraph above or paragraph and subparagraph below. Sectional types are used when rods longer than 10 feet (3 m) are installed.
   2. Size: 3/4 by 120 inches (19 by 3000 mm) in diameter.
C. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.

D. Test Wells: Provide handholes as specified in Section "Underground Ducts and Utility Structures."

PART 3 - EXECUTION

3.1 APPLICATION
A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
B. In raceways, use insulated equipment grounding conductors.
C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.
F. Grounding Bus: Install in electrical and telephone/communication equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Use insulated spacer; space 1 inch (25.4 mm) from wall and support from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
   2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.
G. Underground Grounding Conductors: Use tinned copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade or bury 12 inches (300 mm) above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS
A. NEC permits two basic types of equipment grounding conductors: metallic raceway or cable sheath as the conductor, or a separate equipment grounding conductor. The installation of an equipment grounding conductor provides an additional degree of safe operation when compared to relying on raceway as the conductor. Revise paragraphs and subparagraphs in this Article to suit Project.
B. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specified types, larger sizes, or more conductors than required by NFPA 70 are indicated.
C. Install equipment grounding conductors in all feeders and circuits.
D. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. armored and metal-clad cable runs.
E. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
F. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
G. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
H. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate
equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

I. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

J. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

K. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

L. Coordinate paragraph and subparagraphs below with Drawings and Specification Sections for systems referenced. Edit to suit Project.

M. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.


2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

N. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

3.3 INSTALLATION

A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

1. Drive ground rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

F. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

G. Bond each aboveground portion of gas piping system upstream from equipment shut off valve.

H. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.

I. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, Paragraph 250-81(c), using a minimum of 20 feet (6 m) of bare copper conductor not smaller
than No. 4 AWG. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

3.4 CONNECTIONS
A. Coordinate paragraph and subparagraphs below with Drawings.
B. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
C. Exothermic-Welded Connections: Comply with manufacturer’s written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
E. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
F. Connections at Test Wells: Use compression-type connectors on conductors and make bolted-and clamped-type connections between conductors and ground rods.
G. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.
H. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
I. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL
A. Testing: Perform the following field quality-control testing:
1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench in accordance with manufacturer’s written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level at service disconnect enclosure grounding terminal, and at ground rods. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
a. NFPA 70 has minimum value of 25 ohms. See Evaluations for discussion on appropriate grounding resistance values. Values listed below are typical; adjust to suit Project conditions.

b. Equipment Rated 500 kVA and Less: 10 ohms.
c. Equipment Rated 500 to 1000 kVA: 5 ohms.
d. Equipment Rated More Than 1000 kVA: 3 ohms.
e. Substations and Pad-Mounted Switching Equipment: 5 ohms.
f. Manhole Grounds: 10 ohms.

3.6 GRADING AND PLANTING
A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Section “Landscaping.” Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED REQUIREMENTS
   B. Comply with this section, as applicable. Refer to other sections for coordination of work.

1.2 SCOPE OF WORK
   A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of supporting devices, including related systems and accessories.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
   A. Unistrut Corp.
   B. B-Line Systems, Inc.
   C. Midland Ross-Kindorf

2.2 MATERIALS
   A. Suspension Hangers
      1. Suspension hangers for individual conduit runs shall be zinc plated formed steel type.
   B. Vertical Supports
      1. Malleable iron one hole pipe straps shall be used for vertical runs
   C. Clamps
      1. Beam clamps shall be used for bar joists and beams.
   D. Anti-Vibration Hangers
      1. Anti-vibration hangers shall be combination type having a double deflection neoprene element in series with a steel coil spring; double deflection of 0.30”; steel coil spring shall be selected from a 1” static deflection series with a minimum additional travel to solid of ½”; spring diameters shall be large enough to permit 15 degree angular misalignment of the rod connecting the hanger to the ceiling support without rubbing the hanger box.

2.3 LIGHT FIXTURE HANGERS
   A. Refer to Section 26 5100
   B. Corrosive Areas: PVC; at factory apply a minimum of 10-mil-thick PVC coating, bonded to metal, inside and outside.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Hangers
      1. Approved hangers and stiff leg supports shall be installed in quantity and size as required to carry the weight of raceway and contents and shall be arranged to prevent vibration transmission to the building and allow for raceway movement.
      2. Hangers shall be supported by means of uncoated solid steel rods which are threaded to allow vertical adjustments. Lock nuts shall be provided in sufficient number and location to lock all rod adjustments permanently at the adjusted height. Two lock nuts shall be used unless the nut tightens against a threaded socket. Minimum rod diameters shall be as follows:

<table>
<thead>
<tr>
<th>NOMINAL CONDUIT SIZE</th>
<th>ROD DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2” through 2”</td>
<td>1/4”</td>
</tr>
</tbody>
</table>
1. Hanger spacing shall be as required for proper and adequate support raceway, but in no case shall be less than one hanger per 8'-0' of raceway length except that conduit less than 1" diameter shall be supported at least every 6'-0'.

2. Where numerous conduits are run parallel to one another, they may be supported from a trapeze type hanger arrangement with strut bottom.

3. Anti-vibration type hangers shall be provided for equipment as required to minimize vibration and/or as directed by the Architect/Engineer.

4. Support of hangers shall be by means of sufficient quantities of individual after set steel expansion shields, or beam clamps attached to structural steel.

5. Stiff-legs shall be furnished and installed in cases where support from overhead structure is not possible.

6. Ceiling mounted lighting fixtures shall be supported from the building structure at two opposite corners. The Contractor shall provide fixture hangers to properly interface with the ceiling system.

C. Furnish and install complete any additional structural support steel, brackets, fasteners, etc., as required to adequately support all raceway and equipment.

1. Support of hangers from concrete slabs shall be by means of sufficient quantity of "U" brackets attached with after set expansion shields and bolts.

2. Support of hangers from concrete tees shall be by means of sufficient quantity of angle iron brackets attached with after set expansion shields and bolts.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
   1. Edit lists below to suit Project.
   2. Raceways include the following:
      a. RMC.
      b. IMC.
      c. PVC externally coated, rigid steel conduits.
      d. PVC externally coated, IMC.
      e. EMT.
      f. FMC.
      g. LFMC.
      h. LFNC.
      i. RNC.
      j. ENT.
      k. Wireways.
      l. Surface raceways.
   3. Boxes, enclosures, and cabinets include the following:
      a. Device boxes.
      b. Floor boxes.
      c. Outlet boxes.
      d. Pull and junction boxes.
      e. Cabinets and hinged-cover enclosures.
B. Related Sections include the following:
   1. List below only products and equipment for this Project that the reader might expect to find in this Section but are specified elsewhere. Verify that Section titles listed below are correct for this Project’s Specifications because Section titles may have changed since this Section was updated.
   2. Section "Basic Electrical Materials and Methods" for raceways and box supports.
   3. Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS
A. EMT: Electrical metallic tubing.
B. ENT: Electrical nonmetallic tubing.
C. FMC: Flexible metal conduit.
D. IMC: Intermediate metal conduit.
E. LFMC: Liquidtight flexible metal conduit.
F. LFNC: Liquidtight flexible nonmetallic conduit.
G. RMC: Rigid metal conduit.
H. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS
A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
B. Delete below except for custom enclosures.
C. Shop Drawings: Include layout drawings showing components and wiring for nonstandard boxes, enclosures, and cabinets.

1.5 QUALITY ASSURANCE
A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
2. DF Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

B. Comply with NECA's "Standard of Installation."
C. Comply with NFPA 70.

1.6 COORDINATION
A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Metal Conduit and Tubing:
   a. Alflex Corp.
   b. Anamet, Inc.; Anaconda Metal Hose.
   c. Anixter Brothers, Inc.
   d. Carol Cable Co., Inc.
   e. Cole-Flex Corp.
   f. Electri-Flex Co.
   g. Flexcon, Inc.; Coleman Cable Systems, Inc.
   h. Grinnell Co.; Allied Tube and Conduit Div.
   i. Monogram Co.; AFC.
   j. Spiraduct, Inc.
   k. Triangle PWC, Inc.
   l. Wheatland Tube Co.

2. Nonmetallic Conduit and Tubing:
   a. Anamet, Inc.; Anaconda Metal Hose.
   b. Arnco Corp.
   c. Breeze-Illinois, Inc.
   d. Cantex Industries; Harsco Corp.
   e. Certainteed Corp.; Pipe & Plastics Group.
   f. Cole-Flex Corp.
   g. Condux International; Electrical Products.
   h. Electri-Flex Co.
   i. George-Ingraham Corp.
   j. Hubbell, Inc.; Raco, Inc.
   k. Lamson & Sessions; Carlon Electrical Products.
   l. R&G Sloan Manufacturing Co., Inc.
   m. Spiraduct, Inc.
   n. Thomas & Betts Corp.

3. Conduit Bodies and Fittings:
   a. Aluminum conduits NOT ACCEPTABLE.
   c. Crouse-Hinds; Div. of Cooper Industries.
   e. Hubbell, Inc.; Killark Electric Manufacturing Co.
4. Metal Wireways:
   c. Square D Co.

2.2 METAL CONDUIT AND TUBING
   A. Rigid Steel Conduit: ANSI C80.1.
   B. Rigid Aluminum Conduit: ANSI C80.5
   C. IMC: ANSI C80.6
   D. EMT and Fittings: ANSI C80.3
      1. Fittings: steel compression type.
      E. Fittings: NEMA FB 1; compatible with conduit/tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING
   A. RNC: NEMA TC 2, Schedule 40 or 80 PVC.
   B. RNC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.
   C. LFNC: UL 1660.

2.4 METAL WIREWAYS
   A. Material: Sheet metal sized and shaped as indicated.
   B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
   C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
   D. Select 1 of 4 paragraphs below.
   E. Wireway Covers: Screw – cover type flanged-and-gasketed type.
   F. Finish: Manufacturer’s standard enamel finish.

2.5 OUTLET AND DEVICE BOXES
   A. Sheet Metal Boxes: NEMA OS 1.
   B. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box with gasketed cover.

2.6 PULL AND JUNCTION BOXES
   A. Small Sheet Metal Boxes: NEMA OS 1.
   B. Cash-Metal Boxes NEMA FB 1, cast aluminum with gasketed cover.

2.7 ENCLOSURES AND CABINETS
   A. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
      1. Metal Enclosures: Steel, finished inside and out with manufacturer’s standard enamel.
   B. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer’s standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.
3.2 WIRING METHODS
A. Use a comprehensive wiring method schedule on Drawings or use this Article to specify where various raceway types are to be installed. Edit examples below, adding or deleting materials and methods to suit Project. Coordinate with Division 16 Section "Wires and Cables." Do not duplicate information on Drawings, in NFPA 70, or in other Division 16 Sections. List exceptions to stated requirements. Check code to avoid specifying uses not permitted.
B. Minimum sizes required: Unless larger conduit sizes are required by NEC, are shown on drawings or are required by the Work itself, provide the following minimum size conduits:
   1. Above grade: \( \frac{3}{4} \)"
   2. Below grade 2"C
C. Outdoors: Use the following wiring methods:
   1. Exposed: Rigid threaded hot-dipped galvanized steel. Do not use thread-less fittings.
   2. Concealed: Rigid steel.
   3. Underground, Single Run: Sch 40(heavy wall) PVC. All elbows for service entrance conduits are to be long-radius type.
   4. Underground, Grouped: Sch 40(heavy wall) PVC. All elbows for service entrance conduits are to be long-radius type.
   6. Boxes and Enclosures: NEMA 250, Type 3R.
D. Indoors: Use the following wiring methods:
   3. Underground, Single Run: Sch 40(heavy wall) PVC. All elbows for service entrance conduits are to be long-radius type.
   4. Underground, Grouped: Sch 40(heavy wall) PVC. All elbows for service entrance conduits are to be long-radius type.
   5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except in wet or damp locations, use LFMC.
   6. Damp or Wet Locations: Rigid steel conduit.
   7. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
      a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

3.3 INSTALLATION
A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
B. Select paragraph above or below.
C. Minimum Raceway Size: 3/4-inch trade size (DN21).
D. Conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
F. Install raceways level and square and at proper elevations. Provide adequate headroom.
G. Complete raceway installation before starting conductor installation.
H. Support raceways as specified in Section "Basic Electrical Materials and Methods."
I. Use temporary closures to prevent foreign matter from entering raceways.
J. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so
curved portion of bends is not visible above the finished slab.

K. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

L. Use raceway fittings compatible with raceways and suitable for use and location.
   For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.

M. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.

N. Raceways Embedded in Slabs (Must be indicated on drawings to be embedded. Please notify Engineer if required but not shown): Install in middle third of slab thickness where practical, and leave at least 1-inch (25-mm) concrete cover. Shall be approved by the Structural Engineer.
   1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
   2. Space raceways laterally to prevent voids in concrete.
   3. Run conduit larger than 1-inch trade size (DN27) parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
   4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.

O. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
   1. Run parallel or banked raceways together, on common supports where practical.
   2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

P. Join raceways with fittings designed and approved for the purpose and make joints tight.
   1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
   2. Use insulating bushings to protect conductors.

Q. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.

R. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.

S. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.

T. Telephone and Signal System Raceways, 2-Inch Trade Size (DN53) and Smaller: In addition to the above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

U. Delete paragraph below if not applicable.
V. Install raceway sealing fittings according to manufacturer's written instructions. Lo-
cated fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as the boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.
W. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screw-driver-operated, threaded flush plugs flush with floor for future equipment connections.
X. Flexible Connections: Use maximum of 6 feet (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.
Y. Delete paragraph below if no high-frequency installation.
Z. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in a nonmetallic sleeve.
AA. Do not install aluminum conduits embedded in or in contact with concrete.
BB. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
CC. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying the raceways to receptacle or fixture ground terminals.
1. Select each surface raceway outlet box, to which a lighting fixture is attached, of sufficient diameter to provide a seat for the fixture canopy.
2. Where a surface raceway is used to supply a fluorescent lighting fixture having central-stem suspension with a backplate and a canopy (with or without extension ring), no separate outlet box is required.
3. Provide surface metal raceway outlet box, and the backplate and canopy, at the feed-in location of each fluorescent lighting fixture having end-stem suspension.
4. Where a surface metal raceway extension is made from an existing outlet box on which a lighting fixture is installed, no additional surface-mounted outlet box is required. Provide a backplate slightly smaller than the fixture canopy.
DD. Set floor boxes level and adjust to finished floor surface.
EE. Select paragraph above for metal floor boxes and below for nonmetallic floor boxes.
FF. Set floor boxes level and trim after installation to fit flush to finished floor surface.
GG. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
HH. NO PVC CONDUIT ALLOWED ABOVE THE CEILING OR IN THE A/C RETURN PLENUM. PROVIDE RIGID CONDUIT. Contractor shall verify all MEP documents.

3.4 PROTECTION
A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
3.5 CLEANING

A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION
PART 1 GENERAL

1.1 RELATED REQUIREMENTS
B. Comply with ELECTRICAL Sections, as applicable. Refer to other sections for coordination of work.

1.2 SCOPE OF WORK
A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of electrical identification, including related accessories.
B. Provide electrical identification for the following:
   1. Panelboards, motor starters, contactors, disconnect switches, circuit breakers and other electrical equipment with nameplate identifying the item of equipment and the equipment serving the same.
   2. Raceways, junction boxes and pull boxes.
   3. Label each panelboard index indicating the room #s to the related circuit. Also add the index sheet in a laminated white core, plastic with beveled edges, minimum 1/16 inch thick. Lettering shall be machine-engraved, not less than 1/4" high, cut through the black or red surface to the white core.
   5. Wiring.
   6. Three phase motor rotation.

1.3 SUBMITTALS
A. Submit product data in accordance with Section for products specified under PART 2 - PRODUCTS.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Brady
B. Panduit
C. Thomas & Betts
D. Seton

2.2 IDENTIFICATION
A. Nameplates
   1. Nameplates shall be black engraved surface on white core for normal power circuits and red engraved surface on white core for emergency power circuits.
   2. Provide for each distribution panelboard, branch circuit panelboard, transformer and any other similar equipment furnished under this section identification as to its given name, voltage and origination of service. Examples are as follows:

   | 'LR1'    | 'LR2'    |
   | 120/240V | 120/240V |
   | FED FROM 'MDP' | FED FROM 'MDP' |

   3. Provide for each motor starter enclosure, circuit breaker enclosure, disconnect switch and any other similar equipment furnished under this section, identification as to the specific load that it serves and the origination of service. Examples are as follows:

   | 'AHU-1'   | 'CU-1'   |
   | FED FROM 'MDP' | FED FROM 'MDP' |

   4. Provide for each feeder protective device in each distribution panelboard and any other similar equipment furnished under this section, identification as to the specific load that it serves.
5. Nameplates shall be laminated, white core, plastic with beveled edges, minimum 1/16 inch thick. Lettering shall be machine-engraved, not less than 1/4” high, cut through the black or red surface to the white core.

B. Junction Boxes and Pull Boxes
   1. Identification shall be with a black permanent marking pen on the top of 4” x 4” junction box covers or on the back of an outlet box cover plate identifying the branch circuits and systems within the conduit. Pull boxes shall be provided with a nameplate stating voltage and system served.

C. Wiring Device Wall Plates
   1. On the back side of wiring device wall plates identify with a black permanent marking pen the panelboard and branch circuit number the device is served from.

D. Wire Markers
   1. Wire markers for identification of wiring shall be self-adhesive type having letters and numerals indicating serving equipment and feeder or branch circuit number.

E. Rotation Tags
   1. Rotation tags shall be brass or aluminum securely attached to equipment.

PART 3 EXECUTION

3.1 PREPARATION
   A. Surfaces to receive labels or nameplates shall be carefully prepared in accordance with the manufacturer’s instructions and recommendations.

3.2 NAMEPLATES
   A. Nameplates shall be properly attached to identify panelboards, feeder circuit breakers, disconnect switches, pull boxes and other similar equipment furnished under this section.

3.3 WIRE MARKERS
   A. Wire markers shall be applied to each conductor or cable within panelboards, motor starter enclosures, circuit breaker enclosures, disconnect switches, cabinets, junction boxes, pull boxes, and other similar equipment identifying the serving equipment and feeder or branch circuit from which the conductors originate.
SECTION 26 0573.13
SHORT-CIRCUIT STUDIES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes a computer-based, short-circuit study to determine the minimum required short-circuit ratings for all electrical equipment.

1.2 DEFINITIONS
A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
D. Power Systems Analysis Specialist: Professional or qualified engineer in charge of performing the study and documenting recommendations.
E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
F. SCCR: Short-circuit current rating.
G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.3 ACTION SUBMITTALS
A. Product Data:
1. Submit information on computer software program to be used for studies.
2. Submit the following after the approval of system submittals. Submittals shall be in digital form.
   a. Short-circuit study input data, including completed computer program input data sheets.
   b. Short-circuit study and equipment duty evaluation report; signed and dated by a professional or qualified engineer.
      1) Submit study report for action prior to receiving final approval of distribution equipment submittals. If completion of studies will cause delay in equipment manufacturing, obtain approval from Owner for preliminary submittal of sufficient accuracy to ensure that selection of devices and associated characteristics is satisfactory. All assumptions made in a preliminary submittal shall be clearly identified.
      2) Revised one-line diagram, reflecting any discrepancies noted or updates required based on data collected for the study.
      3) Study report shall include documentation of all equipment data used in the short-circuit and equipment duty analysis.
4) Study shall include a detailed listing of any electrical equipment found to be underrated for the calculated fault duty.

1.4 INFORMATIONAL SUBMITTALS
A. Qualification Data:
   1. For Power Systems Analysis Software.
   2. For Power System Analysis Specialist.

1.5 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data:
   1. Final Short-Circuit Study Report:
      a. Final one-line diagram.
      c. Short-circuit study data files.
      d. Power system data.
      e. Software data file in electronic format compatible with the software version used in the study.
      f. Software library data used for the study.

1.6 QUALITY ASSURANCE
A. Study shall be performed using commercially developed and distributed electrical power system analysis software.
B. Software algorithms and methodology shall comply with requirements of applicable standards and guides specified in this Section.
C. Manual calculations are unacceptable.
   1. Power System Analysis Software Qualifications: Computer program shall be designed to perform ANSI and IEC based short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
D. Power Systems Analysis Specialist Qualifications: Professional Engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this Professional Engineer.
E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed by Power Systems Analysis Specialist.

PART 2 - PRODUCTS
2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS
A. Basis-of-Design Product: Subject to compliance with requirements, provide EasyPower, LLC software with ANSI ShortCircuit, IEC ShortCircuit, Scenario Manager, SmartDuty and SmartBreaker or comparable product by one of the following:
   1. CGI CYME.
   2. Power Analytics, Corporation.
B. Comply with IEEE 399 and IEEE 551.
   1. Analytical features of power systems analysis software program shall have capability as listed in IEEE 399.
   2. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS
A. Executive summary of study findings.
B. Detailed list of all electrical equipment found to be underrated for the available short-circuit current.

C. Recommendations for resolving any issues found with underrated equipment.

D. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

E. One-line diagram of modeled power system, indicating the following:
   1. Protective device designations and ampere ratings.
   2. Conductor types, sizes, and lengths.
   3. Transformer size and impedance.
   4. Motor and generator designations and ratings.
   5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
   6. Any revisions to electrical equipment required by the study.

F. Protective Device Evaluation:
   1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment short-circuit ratings exceed available short-circuit current based on the applicable standards.
   3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

G. Short-Circuit Study Input Data:
   1. One-line diagram of system being studied.
   2. Utility or incoming power short-circuit data.
   4. Conductors.
   5. Transformer data.

H. Short-Circuit Study Output Reports:
   1. Low-Voltage Fault Report: Three-phase and single line to ground fault calculations, indicating the following for each overcurrent device location:
      a. Voltage.
      b. Calculated fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. Multiplying factor.
   2. High-Voltage Momentary Short-Circuit Report: Three-phase and single line to ground fault calculations, indicating the following for each equipment location:
      a. Voltage.
      b. Calculated symmetrical fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. Calculated asymmetrical fault currents:
         1) Based on fault-point X/R ratio.
2) Based on calculated symmetrical value multiplied by 2.6.

3. High-Voltage Interrupting Short-Circuit Report: Three-phase and single line to ground fault calculations, indicating the following for each equipment location:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. No AC Decrement (NACD) ratio.

4. Equipment Duty Report: For each protective device, indicate short-circuit ratings and calculated equipment duty for both ½ cycle and interrupting ratings as applicable. Calculated duty must automatically take into account any necessary derating factor due to the system X/R ratio and based on the actual maximum fault current through each device rather than the total bus fault current. All calculations to be based on the specific applicable test standards for each device such that no further interpretation of the results is necessary.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the study.
   1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Owner’s attention.
   2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the required input data to support the short-circuit study. Comply with requirements in Section 017839 “Project Record Documents” for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or their representative. Data must include, but not be limited to, the following:
   1. Product Data for Project’s overcurrent protective devices. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Obtain electrical power utility impedance at each service from the serving utility.
   3. For transformers, include kVA ratings, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
   4. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
   5. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
   6. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
   7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
8. Motor horsepower and NEMA MG 1 code letter designation.
9. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.
B. Calculate short-circuit currents in accordance with IEEE 551.
C. Base study on device characteristics supplied by device manufacturer.
D. Extent of electrical power system to be studied is indicated on Drawings.
E. Begin the scope of the short-circuit current and equipment duty analysis at the service, extending down to system overcurrent protective devices as follows:
   1. Down to and including all three-phase panelboards at voltages 208 V ac or higher.
F. For systems with multiple sources or multiple operating conditions, evaluate short-circuit and equipment duty for multiple scenarios as necessary to determine the maximum short-circuit current at each location.
G. Analysis software must factor in ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply this to the short-circuit and equipment duty calculations as recommended by applicable standards. Also account for the fault-current dc decrement to address asymmetrical current ratings of applicable electrical equipment and components.
H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
I. Equipment duty report must clearly indicate any protective device that is being applied outside its short-circuit rating.
J. For any equipment found to be underrated, the report shall include recommendations for resolving this deficiency.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard boundary distance and the incident energy to which personnel could be exposed during work on or near energized electrical equipment.

1.2 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

D. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

F. SCCR: Short-circuit current rating.

G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.


1.3 ACTION SUBMITTALS

A. Product Data: Submit information regarding computer software program to be used for studies.

B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:
   1. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
   2. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
   3. Exported data from computer-based, one-line diagram detailing the system data used for the arc-flash calculations, provided in .csv or Microsoft Excel format.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data:
   1. For Power Systems Analysis Software Developer.
   2. For Power System Analysis Specialist.
B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 CLOSEOUT SUBMITTALS

A. Arc-Flash Hazard Analysis:
   1. Provide final arc-flash hazard analysis report in hard copy and digital format.
   2. Provide digital file containing electrical system model in a format consistent with power system analysis software used to perform study.
   3. Provide library files for power system analysis software used to perform study.

1.6 QUALITY ASSURANCE

A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
C. Manual calculations are unacceptable.
D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
   1. Computer program shall be designed to perform arc-flash analysis.
E. Power Systems Analysis Specialist Qualifications: Professional or qualified engineer in charge of performing the arc-flash study, analyzing the arc-flash results, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional or qualified engineer.
F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide software developed and sold by EasyPower software with ANSI ShortCircuit, ArcFlash, PowerProtector, Scenario Manager, SmartDuty and SmartBreaker or comparable product by one of the following:
   1. CGI CYME.
   2. Power Analytics, Corporation.
B. Software must provide results consistent with the requirements of the latest versions of IEEE 1584 and NFPA 70E.
C. Software capable of creation and storage of unlimited number of operating scenarios. All scenarios stored in the same project model file. System changes made to the base case automatically propagated to each operating scenario.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.
B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
C. One-line diagram, indicating the following:
1. Protective device designations, locations, and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.
6. Utility sources.

D. Study Input Data: As described in "Power System Data" Article.

E. Equipment Duty Report: As specified in Section 260573.13 "Short-Circuit Studies."

F. Data on all protective devices; manufacturers, types, sizes and adjustable settings that were used for the arc-flash calculations.

G. List of protective devices found to be inoperable or with signs of impending failure. These devices must be clearly listed and excluded from use in determination of the arc time.

H. Equipment Duty Study: Report to verify that all protective devices have adequate short-circuit ratings to interrupt the calculated maximum short-circuit current.

I. Arc-Flash Study Calculations and Output Reports:
   1. Arcing fault magnitude.
   2. Protective device clearing time.
   3. Duration of arc.
   5. Restricted approach boundary.
   7. Working distance.
   8. Incident energy.

J. Arc-Flash Study input data, scenario descriptions, and arc-flash calculations including a definition of terms and guide for interpretation of the arc-flash hazard report. Study input data must be provided in electronic form as .csv or Excel files.

2.3 ARC-FLASH WARNING LABELS

A. Provide a weatherproof, self-adhesive equipment label for each location requiring arc-flash hazard identification.
   1. Minimum Size: 6 inches wide by 4 inches high.
   2. Sample label submitted for review prior to printing of actual labels.

B. Content: Orange header with the wording, "WARNING, ARC-FLASH HAZARD, Arc-Flash and Shock Risk Assessment, Appropriate PPE Required." and the following information taken directly from the arc-flash hazard analysis:
   1. Equipment ID.
   2. Nominal voltage.
   3. Protection boundaries.
      a. Arc-flash boundary.
      b. Restricted approach boundary.
      c. Limited approach boundary.
5. Working distance.
6. Engineering report number, revision number, and issue date.

C. Completely machine printed, no field-applied markings.
D. Compliance: NFPA 70E.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine Project electrical equipment submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study. The report shall clearly state any assumptions that were necessary to complete the analysis.

3.2 ARC-FLASH HAZARD ANALYSIS
A. Comply with the latest versions of NFPA 70E for the arc-flash hazard analysis study.
B. Study all operating scenarios to determine the maximum incident energy at each location.
C. Submit proposed arc-flash analysis scenarios for review prior to performing arc-flash calculations. Arc-flash hazard analysis report shall indicate which scenario created the maximum arc-flash energy for each location. All arc-flash calculations must be performed in accordance with the procedures and recommendations contained in the latest version of IEEE 1584. Calculate the arc-flash hazard boundary and incident energy at all locations in electrical distribution system where personnel could service or examine equipment while energized.
D. Include all three-phase medium- and low-voltage equipment locations.
E. Calculate the limited and restricted approach boundaries for each location.
F. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources or fault current that changes with time during the fault. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented based on the recommendations in IEEE 399 and ANSI C37 where applicable.
G. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
   1. When the circuit breaker is in a separate enclosure.
   2. When the line terminals of the circuit breaker are separate from the work location.
H. Base arc-flash calculations on the time-current curve or operating time of the fastest upstream device using the predicted arcing current through that device. For medium-voltage circuit breakers, the breaker interrupting time must be automatically added to the relay operating time. Based on the recommendations in IEEE 1584 and sound engineering judgment, a maximum arc time of two seconds can be applied for situations where the protective device operating time is found to exceed two seconds.
3.3 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
   1. Verify completeness of data supplied on one-line diagram on Drawings. Call any discrepancies or missing information to Owner’s attention.
   2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
   3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer. Data shall include, but are not limited to, the following:
   1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Obtain electrical power utility impedance or available short-circuit current at each service.
   3. Short-circuit current at each system bus (three phase and line to ground).
   4. Voltage level at each bus.
   5. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio if available, tap settings, and phase shift.
   6. For reactors, provide manufacturer and model designation, voltage rating and impedance.
   7. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, short-circuit rating, continuous current rating, and settings for all adjustable settings.
   8. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
   9. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
  10. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
  11. Motor horsepower.
  12. Low-voltage conductor sizes, lengths, number, conductor material, and conduit material.
  13. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material.

3.4 LABELING

A. Apply one arc-flash label on the front cover of each section of the equipment and on side or rear covers with accessible live parts and hinged doors or removable plates for
each equipment included in the study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below shall have an arc-flash label applied to it:
   1. Motor-control center.
   2. Low-voltage switchboard.
   3. Switchgear.
   4. Medium-voltage switch.
   5. Low voltage transformers.
   6. Panelboard.
   7. Safety switch.
   8. Fused disconnect switch.
  10. Adjustable frequency drive.
  11. Control panel.

3.5 APPLICATION OF WARNING LABELS
   A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION
   A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the interpretation of arc-flash warning labels.

END OF SECTION
PART 1 - GENERAL

1.1 GENERAL SUMMARY
   A. RELATED SECTIONS
      1. Drawings and provisions necessary for any contractual agreement, including the following section(s).

1.2 DEFINITIONS
   A. BAS: Building Automation System
   B. IP: Internet protocol
   C. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event alarm signals, tabulated reports, and event logs.
   D. RS-485: A serial network protocol, similar to RS-232, complying with TIA-485-A

1.3 SYSTEM DESCRIPTION
   A. DESIGN PERFORMANCE REQUIREMENTS
      1. System shall have an architecture that is based upon three main concepts: 1) intelligent lighting control devices 2) stand-alone lighting control zones 3) network backbone for remote or time based operation.
      2. Intelligent lighting control devices shall consist of one or more basic lighting control components: occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
      3. System must interface directly with intelligent LED luminaires such that only CAT-5e cabling is required to interconnect luminaires with control components such as sensors and switches (see Networked LED Luminaires section)
      4. Intelligent lighting control devices shall communicate digitally, require <4 mA of current to function (Graphic wall stations excluded), and possess RJ-45 style connectors.
      5. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.
      6. Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.
      7. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
      8. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.
      9. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone “bus power supplies” shall not be required in all cases.
     10. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.
     11. System shall have one or more primary wall mounted network control “gateway” devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.
     12. System shall use “bridge” devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements.
13. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles.

14. Individual lighting zones shall be capable of being segmented into several “local” channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.

15. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via either the wired or Wi-Fi backbone.

16. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a space sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.

a. Auto-On / Auto-Off (via occupancy sensors)
   1) Zones with occupancy sensors automatically turn lights on when occupant is detected.
   2) Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
   3) Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.

b. Manual-On / Auto-Off (also called Semi-Automatic)
   1) Pushing a switch will turn lights on.
   2) Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.

c. Manual-On to Auto-On/Auto-Off
   1) Pushing a switch will turn lights on.
   2) After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.
   3) Sequence can be reset via scheduled (ex. daily each morning) events

d. Auto-to-Override On
   1) Zones with occupancy sensors automatically turn lights on when occupant is detected.
   2) Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
   3) Sequence can be reset via scheduled (ex. daily each morning) events

e. Manual-to-Override On
   1) Pushing a switch will turn lights on.
   2) Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
   3) Sequence can be reset via scheduled (ex. daily each morning) events

f. Auto On / Predictive Off
   1) Zones with occupancy sensors automatically turn lights on when occupant is detected.
   2) Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
   3) If switch is pressed, lights turn off and a short “exit timer” begins. After timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.

g. Multi-Level Operation (multiple lighting levels per manual button press)
   1) Operating mode designed specifically for bi-level applications
   2) Enables the user to cycle through the up to four potential on/off lighting states using only a single button.
   3) Eliminates user confusion as to which of two buttons controls which load
1) Mode available as a setting on all nLight devices that have single manual on/off switch (ex. nWSX, nPODM, nPODM-DX).
2) In addition to achieving bi-level lighting control by switching loads with relays, the ability to command dimming outputs to “step” in a sequence that achieves bi-level operation is present.
3) A taskbar style desktop application shall be available for personal lighting control.
4) An application that runs on “smart” handheld devices (such as an Apple® IPhone®) shall be available for personal lighting control.
5) Control software shall enable logging of system performance data and presenting useful information in a web-based graphical format and downloadable to .CSV files.
6) Control software shall enable integration with a BMS via BACnet IP.
7) System shall provide the option of having pre-terminated plenum rated CAT-5e cabling supplied with hardware.

1.4 SUBMITTALS
   A. Product Datasheets (general device descriptions, dimensions, wiring details, nomenclature)
   B. Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices)
   C. Other Diagrams – as needed for special operation or interaction with other system(s)
   D. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up
   E. Hardware and Software Operation Manuals
   F. Other operational descriptions as needed
   G. Owner Training Documentation
   H. Contractor Installation Training Documentation

1.5 QUALITY ASSURANCE
   A. NEMA Compliance: All system components shall comply with all applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
   B. UL Approval: All applicable equipment shall be tested to and listed under UL standard 508 and shall bear labels to indicate compliance. System listed by ETL or under other UL sections shall provide documentation proving compliance with UL standard 508 and/or 916 as applicable.
   C. NEC Compliance: All system components shall comply with all applicable sections of the National Electrical Code (NEC) as required.
   D. All steps in sensor manufacturing process shall occur in the USA; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.
   E. All components and the manufacturing facility where product was manufactured must be ROHS compliant.
   F. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.
   G. All applicable products must be UL / CUL Listed or other acceptable national testing organization.

1.6 COORDINATION
   A. Coordinate lighting control components to form an integrated interconnection of compatible components.
   B. Coordinate lighting controls with BAS (if necessary) either through IP based intercommunication of system or hardwired auxiliary relay outputs.
   C. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

1.7 WARRANTY
   A. All devices in lighting control system shall have a 5 year warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. APPROVED MANUFACTURERS are as the following:
1. The following manufacturers have been approved and will be allowed to bid, provided the
   submittal clearly indicates the design criteria and performance of specifications indicated in
   Lighting Control System Specification 26.00.00
2. nLight® Lighting Control System from Sensor Switch, an Acuity Brands Company
3. nLight Network Control System from Sensor Switch is the basis of design.
4. All other manufacturers not listed will require (2) sets of a side by side comparison noting any
   deviation from product specified in their submittal documentation submitted to the engineer
   (7) days prior to bid date. The specifying engineer must approve any proposed substitutions in
   writing by addendum. The document requirements may include, but are not limited to, the
   following:
   a. Full layout and design of each control area clearly mapping every individual device necessary
      for a complete working system.
   b. Submittal riser diagrams with specification sheets and instruction sheets for all devices in
      the system proposed

2.2 INDIVIDUAL DEVICE SPECIFICATION:
   A. Control Module (Gateway)
      1. Control module shall be a device that facilitates communication and time-based control of
         downstream network devices and linking into an Ethernet.
      2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage,
         and have a touch screen.
      3. Control device shall have three RJ-45 ports for connection to other backbone devices
         (bridges) or directly to lighting control devices.
      4. Device shall automatically detect all devices downstream of it.
      5. Device shall have a standard and astronomical internal time clock.
      6. Device shall have one RJ-45 10/100 Base T Ethernet connection.
      7. Device shall have a USB port
      8. Each control gateway device shall be capable of linking 1500 devices to the management
         software.
      9. Device shall be capable of using a dedicated or DHCP assigned IP address.
     10. Network Control Gateway device shall be the following Sensor Switch model Series: nGWY2
   B. System Occupancy Sensors
      1. Occupancy sensors system shall sense the presence of human activity within the desired
         space and fully control the on/off function of the lights.
      2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to
         initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic based
         sensing technologies shall not be accepted.
      3. For applications where a second method of sensing is necessary to adequately detect
         maintained occupancy (such as in rooms with obstructions), a sensor with an additional
         “dual” technology shall be used.
      4. Dual technology sensors shall have one of its two technologies not require motion to detect
         occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive
         Infrared/Automatic Gain Control Technology or PDT) which both looks for occupant motion
         and listens for sounds indicating occupants.
      5. All sensing technologies shall be acoustically passive meaning they do not transmit sounds
         waves of any frequency (for example in the Ultrasonic range), as these technologies have the
         potential for interference with other electronic devices within the space (such as electronic
         white board readers). Acceptable detection technologies include Passive Infrared (PIR),
         and/or Microphonics technology.
      6. Sensors shall be available with zero, one, or two integrated Class 1 switching relays, and up to
         one 0-10 VDC dimming output. Sensors shall be capable of switching 120 / 277 / 347 VAC.
         Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and 1/4 HP
         motor. Relays shall be dry contacts.
      7. Sensors shall be available with one or two occupancy “poles”, each of which provides a
         programmable time delay.
8. Sensors shall be available in multiple lens options which are customized for specific applications.
9. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5e low voltage cabling with RJ-45 connectors.
10. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5e connections) and blink its LED in a pattern to visually indicate of a potential wiring issue.
11. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
12. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5e cabling.
13. Sensors shall be equipped with an automatic override for 100 hour burn-in of fluorescent lamps. This feature must be available at any time for lamp replacements.
14. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
15. Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
16. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.
17. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray)
18. Wall switch sensors shall be available with optional raise/lower dimming adjustment controls
19. Wall switch sensors shall be the following Sensor Switch model numbers, with device color and optional features as specified:
20. LV (Dual Tech w/ Night Light, No Relay, Raise/Lower Dim Ctrl)

21. Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.
22. Fixture mount sensors shall be capable of powering themselves via a line power feed.
23. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
24. Sensors with dimming can control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).

C. System Daylight (Photocell and or Dimming) Sensors
1. Photocell shall provide for an on/off set-point, and a dead-band to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
2. Photocell and dimming sensor’s set-point and dead-band shall be automatically calibrated through the sensor’s microprocessor by initiating an “Automatic Set-point Programming” procedure. Min and max dim settings as well as set-point may be manually entered.
3. Dead-band setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
4. Dimming sensors shall control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more ballasts).
5. Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the “auto set-point” setting.)
6. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
7. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an “offset” from the primary zone.
8. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC, 277 VAC, and 347 VAC. Load ratings shall
be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and 1/4 HP motor load. Relays shall be dry contacts.

9. Sensor shall be the following Sensor Switch model numbers, with device options as specified: Refer to plans.

   Note: Recessed mount versions of the above ceiling (fixture) mount versions also shall be available (e.g. nCMR[B] PC => nRMR PC)

D. System Power (Relay) Packs

1. Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.

2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.

3. All devices shall have two RJ-45 ports.

4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.

5. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.

6. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.

7. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).

8. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.

9. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.

10. Specific Secondary Packs shall be available that require a manual switch signal (via a networked Wall Station) in order to close its relay.

11. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.

12. Specific Secondary Packs shall be available that control louver/damper motors for skylights.

13. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.

14. Power (Relay) Packs and Supplies shall be the following Sensor Switch model Series:

15. nPP16 (Power Pack w/ 16A relay)

16. nPP16 D (Power Pack w/ 16A relay and 0-10VDC dimming output)

17. nSP16 (Secondary Pack w/ 16A relay)

18. nPP16 ER (UL924 Listed Secondary Pack w/ 16A relay for switching emergency power circuits)

19. nSP5 PCD 2W (Secondary Pack w/ 5A relay and incandescent dimming or 2-wire line voltage fluorescent dimming output)

20. nSP5 PCD 3W (Secondary Pack w/ 5A relay and 3-wire line voltage fluorescent dimming output)

21. nSP5 PCD MLV (Secondary Pack w/ 5A relay and magnetic low voltage dimming output)

22. nSP5 PCD ELV 120 (Secondary Pack w/ 4A relay and electronic low voltage dimming output)

23. nPS 80 (Auxiliary Bus Power Supply)

E. System Relay & Dimming Panels
1. Panel shall incorporate up to 8 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.
2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
3. Panel shall provide one 0-10VDC dimming output paired with each relay.
4. Panel shall power itself from an integrated 120/277 VAC supply.
5. Panel shall be capable of operating as either two networked devices or as one.
6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5e.
7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection.
8. Power (Relay) Packs and Supplies shall be the following Sensor Switch model numbers:

```plaintext
9. nPANEL 8 (Panel w/ four 120/277 VAC relays and four 0-10 VDC dimming outputs)
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F. Networked Auxiliary Input / Output (I/O) Devices

1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½” knockout.
2. Devices shall have two RJ-45 ports.
3. Communication and low voltage power shall be delivered to each device via standard CAT-5e low voltage cabling with RJ-45 connectors.
4. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current (typically 40 or more ballasts).
5. Specific I/O devices shall have an input that read a 0-10 VDC signal from an external device.
6. Specific I/O devices shall interface with either a maintained or momentary switch and run a switch event, run a local/remote control profile, or raise/lower a dimming output.
7. Specific I/O devices shall sense state of low voltage outdoor photocells.
8. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
9. Specific I/O devices shall sense.
10. Auxiliary Input/Output Devices shall be the following Sensor Switch model numbers:

```plaintext
11. nI/O D (I/O device with 0-10 dimming output)
12. nI/O 1S or nI/O RLX (I/O device with contact closure or 0-10VDC dimming input)
13. nI/O NLI (Input device for detecting state of low voltage outdoor photocell; sold in nI/O PC KIT only)
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14. nI/O X (Interface device for communicating with RS-232 enabled AV Touch Screens)

G. System Wall Switches & Dimmers

1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Devices shall be available with zero or one integrated Class 1 switching relay.
3. Communication and low voltage power shall be delivered to each device via standard CAT-5e low voltage cabling with RJ-45 connectors.
4. All sensors shall have two RJ-45 ports.
5. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
6. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
7. Devices with dimming control outputs can control 0-10 VDC dimmable ballasts by syncing up to 20 mA of current (typically 40 or more ballasts).
8. Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.
9. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
10. Devices with mechanical push-buttons shall be made available with custom button labeling.
11. Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.
12. Wall switches and dimmers shall be the following Sensor Switch model numbers, with device options as specified:
13. nPODM (single on/off, push-buttons, LED user feedback)
14. nPODM DX (single on/off, single dimming raise/lower, push-buttons, LED user feedback)
15. nPODM 2P DX (dual on/off, dual dimming raise/lower, push-buttons, LED user feedback)
16. nPODM 4P DX (quad on/off, quad dimming raise-lower, push-buttons, LED user feedback)

H. Communication Bridges
1. Device shall surface mount to a standard 4” x 4” square junction box.
2. Device shall have 8 RJ-45 ports.
3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5e cabled connection.
5. Device shall be careful of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.
6. Communication Bridge devices shall be the following Sensor Switch model numbers:
7. nBRG 8 (8 Ports)

2.3 LIGHTING CONTROL PROFILES
A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.
D. Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.
E. All lighting control profiles shall be stored on the network control gateway device and on the software’s host server.
F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.
J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.4 MANAGEMENT SOFTWARE
A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software
B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).
C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.
D. A printable network inventory report shall be available via the software.
E. A printable report detailing all system profiles shall be available via the software.
F. Software shall require all users to login with a User Name and Password.
G. Software shall provide at least three permission levels for users.
H. All sensitive stored information and privileged communication by the software shall be encrypted.
I. All device firmware and system software updates must be available for automatic download and installation via the internet.
J. Software shall be capable of managing systems interconnected via a WAN (wide area network)

2.5 BMS COMPATIBILITY
A. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software. No additional hardware shall be required.
B. BACnet IP gateway software shall communicate information gathered by networked system to other building management systems.
C. BACnet IP gateway software shall translate and forward lighting relay and other select control commands from BMS system to networked control devices.

2.6 Pre-construction Jobsite Visit
A. Pre-construction On-site Services
B. Project electrical contractor/distributor shall contact Spectrum Lighting – San Antonio to schedule jobsite meeting prior to the beginning of the installation of the lighting control system. Purpose of the meeting is to review installation documentation provided by the system manufacturer and submittals. Discussion should include wiring conventions and specific wiring requirements. Installation of specific devices are also to be addressed.
C. Purpose is to review any questions regarding the installation of the lighting control system by the installing contractor.
D. Prior to commissioning Spectrum Lighting field service technical shall visit the jobsite to confirm progress and answer any additional questions. Commissioning date is to be confirmed at the time of this visit. Training agenda shall be provided to the contractor/distributor. Contractor/distributor shall confirm owner representative and specifying engineer attendance at lighting system demonstration and/or for training. Contractor/distributor shall provide to field service technician programming information as required for commissioning to include zone assignments, time schedules for operation, presets for all control stations, programming sequences for dynamic LED fixtures, emergency operation, blink warn, and system override. Programming information is required for system set-up and pre-commissioning.
E. Lighting Control System Commissioning and Training
F. Prior to energizing lighting control system the following must be completed:
G. No component of the lighting control system shall be energized prior to a factory certified field service engineer has approved the installation of the system by the project electrical contractor. Failure to have a factory certified field service technician approve the installation and commission the system will relieve the manufacturer of the lighting control equipment of all responsibility relating to damaged parts or warranty. The electrical contractor/distributor shall contact Spectrum Lighting at least 3 weeks prior to the requested commissioning date to schedule a field service engineer to be at the jobsite. Request shall be in writing and shall include filled out commissioning request form and dated jobsite photos of the dimmer and/or relay panels.
H. Lighting Control system is defined as the dimmer/relay panel(s) and all associated control stations and related accessories.
I. The electrical contractor is responsible to install the entire lighting control system, all power feeders, all load wiring, and control wiring. Equipment shall be installed according to the manufacturer’s instructions, contract documents, and national and local codes and regulations.
J. Equipment shall be plumb and level to the finished floor. All components of the lighting control system shall be clean, free of dust and paint spatters. Components shall be unmarred or
damaged. All cable shall be dressed, neatly routed, and labeled. All conduit shall be securely attached to the dimmer/relay panel.

K. Commissioning
Each dimmer/relay panels shall be individually tested with the connected load as designed. Each dimmer/relay should be tested with its connected load as specified.

L. Each dimmer/relay shall be tested by the electrical contractor (with a multi-meter) to confirm what voltage is being passed and to confirm that no voltage is being passed when the circuit is open.

M. A representative of the owner shall be present to observe the testing/demonstration of the dimmer/relay panels. Each individual dimmer/relay panel shall be load tested with all circuits on while under load for a minimum of 1 hour.

N. Where external devices are to be attached to the dimmer/relay panel including photocell, occupancy sensor, time clock, and/or control stations, operation of each device should be verified at the panel and specific circuits that are programmed to be controlled by the external device(s).

O. Where control signals originate from the dimmer/relay panel for control of lighting fixtures, the control signal shall be tested by the electrical contractor to confirm that it is being delivered to each lighting fixture. Proper operation of the lighting fixtures shall be confirmed as part of the system testing/demonstration.

P. Training:
Training shall be provided for the owner’s representative and contractor. Prior to commissioning owner’s representative and electrical contractor/distributor shall acknowledge receipt of training agenda. Electrical contractor/distributor shall confirm that specifying engineer has been contacted and been invited to attend the system demonstration and/or training. All product and lighting control system documentation and operation’s manuals shall be provided by electrical contractor/distributor at the time of training.

Q. Training is to include, but not be limited to: basic operation of lighting control system, set-up of system and control panels, operation of control stations, programming of system, basic debugging, and overall system testing. At completion of training session all in attendance shall sign the commissioning technician’s field service report to confirm participation in the training session.

R. Completed field service report shall be submitted to the electrical contractor/distributor and specifying engineer.

S. Follow-up Contact
Approximately 90 days following the commissioning of the lighting control system Spectrum Lighting shall contact the electrical contractor/distributor/owner to confirm that the system is operating correctly and answer any operational questions that have come-up since commissioning.

T. Warranty Review and Follow-up Visit
Approximately 300 days following commissioning of the lighting control system Spectrum Lighting shall contact the owner’s representative who attended the system demonstration and training and electrical contractor/distributor to schedule a visit to the jobsite. Visit shall be scheduled so that testing of the lighting control system and related equipment can be conducted without disturbing normal operation of the jobsite. In attendance should be owner’s representative and contractor.

U. The lighting control system shall be demonstrated to confirm operation. All system programming shall be confirmed and when necessary adjusted to meet the set-up or current requirements. When programming needs to be adjusted the new system configuration files shall be forwarded by the field service technician to the system manufacturer, as required. Copies can be provided to owner’s representative upon request. Any questions regarding operation of the system shall be addressed at this time.
V. Any lighting control equipment that is not operating as defined by the specification shall be repaired or replaced at the discretion of the field service technician. Projected dates for completion of all changes will be included in the follow-up report. All system changes and updates shall be documented by the field service technician and provided in a written report to the owner’s representative, contractor, and specifying engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to all recommendations set forth by the manufacturer

B. Preparation

1. Contractor shall provide a set of floor plan drawings, and shall coordinate with the manufacturer / manufacturer’s representative the necessary electronic documents necessary to lay out the drawings

C. It is the manufacturer’s responsibility to select the appropriate type of sensor for each room, under the following constraints:

1. Provide sensors in all spaces required by current IECC. Provide dual technology occupancy sensors in all bathrooms.
2. It will the contractor’s / manufacturer’s responsibility to provide the quantity of sensors required for complete and proper coverage in the control area. Sensors shall be able to detect single or multiple occupants in the room. The contractor shall decide the most effective way to run low voltage wiring, while adhering to manufacturer’s layout recommendations

3. Adjustments to sensors may be done at the room level, or remote via Sensor View software
4. Install low voltage lighting control devices only in electrical boxes that are clean, free from debris, excess building material, and similar matter.

D. Wiring

1. All branch circuit wiring shall be installed in approved raceway
2. Low voltage wiring shall be installed in approved raceway where concealed in inaccessible locations or exposed. Where the low voltage wiring is concealed in accessible ceiling plenums, it may, to the Contractor’s option, be routed without a raceway using air, plenum-rated multi-conductor cable. All control wiring shall be minimum 18 AWG stranded copper.
3. All low voltage wiring shall be color coded and identified or tagged at terminations to assist with future maintenance.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
   1. Edit panelboards below to suit Project.
   2. Lighting and appliance branch-circuit panelboards.
   3. Distribution panelboards.
B. Related Sections include the following:
   1. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.
   2. Retain subparagraph below if Project includes fusible panelboards.
   3. Section “Fuses.”

1.3 DEFINITIONS
A. Retain abbreviations that remain after this Section has been edited.
B. EMI: Electromagnetic interference.
C. GFIC: Ground-fault circuit interrupter.
D. RFI: Radio-frequency interference.
E. RMS: Root mean square.
F. SPDT: Single pole, double throw.
G. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS
A. Product Data: For each type of panelboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers’ technical data on features, performance, electrical characteristics, ratings, and finishes.
B. Shop Drawings: For each panelboard and related equipment.
   1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Enclosure types and details for types other than NEMA 250, Type 1.
      b. Bus configuration, current, and voltage ratings.
      c. Short-circuit current rating of panelboards and overcurrent protective devices.
      d. UL listing for series rating of installed devices.
      e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
C. Delete paragraph below if independent testing agency is not used.
D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in “Quality Assurance” Article.
E. Field Test Reports: Submit written test reports and include the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
G. Maintenance Data: For panelboards and components to include in maintenance manuals specified in other sections. In addition to requirements specified in Section "Contract Close-out," include the following:
   1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE
A. Retain paragraph and subparagraph below if Contractor or manufacturer selects testing agency.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with NEMA PB 1.
D. Comply with NFPA 70.

1.6 COORDINATION
A. Edit below to delete or add types of equipment that affect panelboard installation.
B. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.7 EXTRA MATERIALS
A. Extra materials may not be allowed for publicly funded projects. Revise quantity below to suit Project.
B. Keys: [SIX] 6 spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Lists below are examples only. Retain or insert only those manufacturers whose products correspond with other requirements and whose availability and suitability for the application have been verified.
   2. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
      a. Eaton
      b. Square D Co.
      c. General Electric
      d. Siemens

2.2 FABRICATION AND FEATURES
A. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
   1. Delete items below if not applicable. Add other Project-specific requirements.
   2. Outdoor Locations: NEMA 250, Type 3R.
   3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   4. Enclosures in hazardous locations must be carefully selected to meet the division and group listing of the environment.
   5. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.
B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
C. Retain paragraph above or below.
D. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
E. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
F. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
H. Main and Neutral Lugs: Copper mechanical type suitable for use with conductor material.
I. Ten paragraphs below are special features. Add other required features and coordinate with Drawings.
J. Equipment Ground Bus: Copper and adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
K. Delete paragraph below except for panelboards incorporating one or more main service disconnect switches. Edit to suit Project.
L. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
M. Delete paragraph below if future provisions are not required.
N. Isolated Equipment Ground Bus: Copper and adequate for branch-circuit equipment ground conductors; insulated from box.
O. Extra-Capacity Neutral Bus: Copper neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
P. Split Bus: Vertical buses divided into individual vertical sections.
Q. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
R. Gutter Barrier: Arrange to isolate individual panel sections.
S. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
T. Feed-through Lugs: Copper mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANELBOARD SHORT-CIRCUIT RATING
A. Select one of two paragraphs below for series-rated system or system that has panelboards and circuit breakers rated for full value of short-circuit current available at location of equipment. Edit to suit Project and coordinate with Drawings.
B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS
A. Branch Overcurrent Protective Devices: Plug-in or bolt on circuit breakers, replaceable without disturbing adjacent units.
B. Coordinate below with Drawings.
C. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISTRIBUTION PANELBOARDS
A. Edit three paragraphs and associated subparagraphs below to suit Project. Coordinate with Drawings.
B. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.
C. Main Overcurrent Protective Devices: Circuit breaker.
D. Branch overcurrent protective devices shall be one of the following:
   1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in or Bolt-on circuit breakers.
   2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.6 OVERCURRENT PROTECTIVE DEVICES
A. Edit three paragraphs and associated subparagraphs below to suit Project. Coordinate with schedules and Drawings.
B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
2. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments.
   d. Ground-fault pickup level, time delay, and I^2t response.
3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.

C. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
   2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install panelboards and accessories according to NEMA PB 1.1.
B. Mounting Heights: Top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
D. Revise paragraph below if "Balancing Loads" Paragraph is deleted from "Field Quality Control" Article below.
E. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
F. Install filler plates in unused spaces.
G. Revise below if "Balancing Loads" Paragraph is deleted from "Field Quality Control" Article below.
H. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION
A. Select Division 16 Section "Basic Electrical Materials and Methods" for projects with simple requirements and Division 16 Section "Electrical Identification" for projects with complex requirements.
B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section "Basic Electrical Materials and Methods] [Electrical Identification."
C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS
A. Coordinate paragraphs below with Drawings.
B. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL
A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
   1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
   1. Measure as directed during period of normal system loading.
   2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
   3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
   4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 ADJUSTING
   A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING
   A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes receptacles, connectors, switches, and finish plates.

1.3 DEFINITIONS
A. Retain abbreviations that remain after this Section has been edited for Project.
B. GFI: Ground-fault circuit interrupter.
C. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS
A. Product Data: For each product specified.
B. Shop Drawings: Legends for receptacles and switch plates.
C. Include sample review below if products may have critical features needing hands-on appraisal.
D. Samples: For devices and device plates for color selection and evaluation of technical features.
E. Maintenance Data: For materials and products to include in maintenance manuals specified in other sections.

1.5 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
B. Comply with NEMA WD 1.
C. Comply with NFPA 70.

1.6 COORDINATION
A. Delete paragraph below unless receptacles for Owner-Furnished equipment with plugs have unknown configurations.
B. Receptacles for Owner-Furnished Equipment: Match plug configurations.
C. Coordinate with pool contractor for special receptacles.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Wiring Devices:
      b. Or equal

2.2 RECEPTACLES
A. Select one of three paragraphs below to specify grade of receptacles. See Editing Instruction No. 3 in the Evaluations for wiring device grades.
B. Straight-Blade and Locking Receptacles: Heavy-Duty grade. The device shall be 20-ampere, 125-volts, Nema configuration 5-20R, back and side wired.
C. Special Receptacles for NEMA configuration refer to Manufacturer specs.
D. Termination-type GFCI unit may be substituted for feed-through type where no protection of downstream receptacles is required.
E. GFI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter. Device shall have an indicator light. Equal to Hubbell GF series. Feeding downstream more than one receptacle from a single GFI receptacle is not acceptable.
2.3 SWITCHES
A. General
   1. Switches shall be 20Amp heavy duty specification grade equal to Hubbell HBL series. The body of the switch shall be made of an arc-resistant thermoset material.
   2. Switches shall be SPST, DPST, 3-way or 4-way as indicated on the Drawings.
   3. Switch color shall be selected by owner. Coordinate with Architect.
B. Specification Grade
   1. Specification Grade switches shall be toggle type. The contact arms shall be made of one-piece copper alloy material. The switch shall include a green ground screw attached to the mounting strap. The switch shall be 20-ampere, 120/277-volts AC, horsepower rated, back and side-wired.
C. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters.
   1. Control: Continuously adjustable slide, toggle, or rotary knob. Single-pole or three-way switch to suit connections.
   2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable slide with "on/off" switch; single pole with soft tap or other quiet switch; electromagnetic filter to eliminate noise, RF, and TV interference; and 5-inch (130-mm) wire connecting leads. Dimmer to be sized per circuit load.

2.4 WALL PLATES (All wall plates)
A. For all single and combination types match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.

2.5 FLOOR SERVICE FITTINGS
A. Items in this Article are available for telephone and data cable service as well as power. Edit to suit Project.
B. Select one of three paragraphs below.
C. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.
D. Signal Outlet: Blank cover with bushed cable opening, unless otherwise indicated.

PART 3 - EXECUTION
3.1 INSTALLATION
A. Install devices and assemblies plumb and secure.
B. Install wall plates when painting is complete.
C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.
D. Do not share neutral conductor on load side of dimmers.
E. Coordinate two paragraphs below with Drawings.
F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
G. Protect devices and assemblies during painting.
H. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION
A. Comply with Section "Electrical Identification."
B. Select paragraph above or below.
C. Comply with Section "Basic Electrical Materials and Methods."
   1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
   2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS
   A. Select paragraph above or below. Coordinate with Division 16 Section "Grounding."
   B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
   C. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.
   D. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL
   A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
   B. Dparagraph below if GFCIs are not in Part 2.
   C. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
   D. Replace damaged or defective components.

3.5 CLEANING
   A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes the following:
   1. Fuses.

1.3 SUBMITTALS
A. Use this Article to convey basic design intent. Delete if Drawings show sufficient detail to clarify intent.
B. General: Submit each item in this Article according to the Conditions of the Contract and Specification Sections.
C. Product Data for each fuse type specified.
D. Select above or below. Data listed in paragraph below are appropriate where selective coordination is necessary.
E. Field test reports indicating and interpreting test results.
F. Maintenance data for tripping devices to include in the operation and maintenance manual specified in other sections.

1.4 QUALITY ASSURANCE
A. Source Limitations: Obtain fuses from one source and by a single manufacturer.
B. Comply with NFPA 70 for components and installation.
C. Listing and Labeling: Provide fuses specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
   2. Subparagraph below is required by some Federal agencies.
   3. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.5 EXTRA MATERIALS
A. Extra materials may not be allowed for publicly funded projects.
B. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
   1. Spare Fuses: Furnish quantity equal to 20 percent of each fuse type and size installed, but not less than 1 set of 3 of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fuses that may be incorporated into the Work include, but are not limited to, the following:
B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
C. Manufacturers: Subject to compliance with requirements, provide fuses by one of the following:
   1. See Editing Instruction No. 1 in the Evaluations for cautions about naming products and manufacturers.
   4. Ferraz Corp.

2.2 CARTRIDGE FUSES
A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class as specified or indicated; current rating as indicated; voltage rating consistent with circuit voltage.

2.3 SPARE FUSE CABINET
A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door with key-coded cam lock and pull.
   1. Size: Adequate for orderly storage of spare fuses specified with 15 percent spare capacity minimum.
   2. Finish: Gray, baked enamel.
   3. Identification: Stencil legend "SPARE FUSES" in 1-1/2-inch (40-mm) letters on door.
   4. Fuse Pullers: For each size fuse.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.
B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS
A. Select and edit paragraphs below. Add paragraphs as Project requires to specify fuse applications rather than show them on Drawings.
B. Motor Branch Circuits: Class RK1, time delay.
C. Other Branch Circuits: Class RK5, non-time delay.

3.3 INSTALLATION
A. Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.
B. Install spare fuse cabinet where indicated.

3.4 IDENTIFICATION
A. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

END OF SECTION
PART 1 GENERAL

1.1 RELATED REQUIREMENTS

1.2 SCOPE OF WORK
   A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of disconnect switches, including all related systems and accessories.

1.3 SUBMITTALS
   A. Submit product data and shop drawings in accordance with other Sections for products specified under PART 2 - PRODUCTS.
   B. Provide outline drawings with dimensions, and equipment ratings for voltage, amperage, horsepower and short circuit.
   C. Provide designations for each disconnect. RE: to section 16075.

1.4 REFERENCE STANDARDS
   A. Switches shall be manufactured in accordance with the following standards:
      1. UL 98 - Enclosed and Dead Front Switches
      2. NEMA KS1 - Enclosed Switches
      3. NEMA 250 - Enclosures for Electrical Equipment

PART 2 PRODUCTS

2.1 MANUFACTURER
   A. Eaton
   B. Square D Co.
   C. General Electric
   D. Siemens

2.2 GENERAL
   A. Switches shall be heavy duty type.

2.3 SWITCH INTERIOR
   A. Switches shall have switch blades which are visible when the switch is OFF and the cover is open.
   B. Lugsshall be copper and front removable and UL listed for 60°C or 75°C conductors 30-100 ampere, 75°C conductors 200 ampere and up.
   C. Current carrying parts shall be plated to resist corrosion.
   D. Switches shall have removable arc suppressor to facilitate easy access to line side lugs.
   E. Switches shall have provisions for a field installable electrical interlock.

2.4 SWITCH MECHANISM
   A. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
   B. The operating handle shall be an integral part of the box, not the cover.
   C. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
   D. The handle position shall travel at least 90° between OFF and ON positions to clearly distinguish and indicate handle position.
   E. Switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

2.5 SWITCH ENCLOSURES
A. Switch covers shall be attached with welded pin-type hinges (Type 1) or top-hinged, attached with removable screws and securable in the open position (Type 3R).
B. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel (Type 1) or gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated galvannealed steel (Type 3R).
C. The enclosure shall have ON and OFF markings stamped into the cover.
D. The operating handle shall be provided with a dual colored, red/black position indication.
E. Switches shall have provisions to accept up to three 3/8" hasp padlocks to lock the operating handle in the OFF position.
F. Tangential knockouts shall be provided to facilitate ease of conduit entry (Type 1).
G. Type 3R enclosure shall contain no knockouts. Supply watertight hubs.
H. Type 4x shall be stainless steel enclosure with no knockouts. Supply watertight hubs.

2.6 SWITCH RATINGS
A. Switches shall be horsepower rated.
B. The UL listed short circuit current rating of the switches shall be: 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses 30-600 ampere employing appropriate fuse rejection schemes.

PART 3 EXECUTION

3.1 INSTALLATION
A. Install disconnect switches where indicated shown or not shown.
B. Install fuses in fusible disconnect switches.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED REQUIREMENTS
A. The General Provisions, Supplemental General Provisions, Special Provisions, apply to work covered by this Section.
B. Comply with Electrical Sections, as applicable. Refer to other Sections for coordination of work.

1.2 SCOPE OF WORK
A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of a high-energy power conditioning surge protection device(s) at branch circuit panelboards where indicated on the Drawings. The device shall incorporate transient voltage surge suppression (TVSS) and high-frequency electrical line noise filtering. The device shall provide effective high energy transient voltage suppression, surge current diversion, high-frequency attenuation, and line stabilization in ANSI/IEEE C62.41-2002 environments connected downstream from the facility's main overcurrent protective device. The device shall be installed in parallel with the facility's wiring system.
B. The device shall be installed as an integral part or external of the panelboard, switchboard.

1.3 SUBMITTALS
A. Submit product data and shop drawings for products specified under PART 2 - PRODUCTS.
B. Manufacturers' Product Data: Submit material specifications and installation data for products specified under PART 2 - PRODUCTS.
C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract documents.
   1. Include electrical characteristics and ratings for the specified equipment.
   2. Include wiring diagrams indicating the internal connections of the specified equipment within its enclosure.
   3. Drawings shall be provided indicating device dimensions, weights, mounting provisions, connection details and wiring diagrams.
   4. Documentation of the specified device UL 1449 3rd Edition voltage protection rating (VPR) and per mode surge current rating shall be included. All submittals without this documentation will be rejected.
D. Record Drawings
   1. A complete set of manufacturers' product data and shop drawings indicating all post bid revisions and field changes.

1.4 QUALITY ASSURANCE
A. Industry Reference Standards and Publications: The device shall be designed, manufactured, tested and installed in compliance with the latest editions of:
   1. American National Standards Institute (ANSI) and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.41-2002 and C62.45-2002)
   2. Federal Information Processing Standards Publication 94 (FIPS PUB 94)
   3. National Electrical Manufacturers Association (NEMA LS-1)
   4. National Fire Protection Association (NFPA 70, National Electrical Code (NEC), 75 and 78)
   5. Underwriters Laboratories UL 1449 Standard for Transient Voltage Surge Suppressors Surge Protection Devices and UL 1283 Standard for Electromagnetic Interference Filters.
B. The device shall be UL listed under UL 1449 and UL 1283 complimentary listed.
C. The device shall be warranted against defects in material and/or workmanship and any failure or
end-of-life event including lighting for a minimum of TEN (10) years from the date of shipment.

D. The device shall be thoroughly factory-tested before shipment. Testing of the device shall include but not be limited to quality control checks, maximum continuous operating voltage (MCOV) check, and clamping voltage verification tests. The MCOV check shall consist of a minimum of one (1) hour burn-in at the applicable MCOV.

1.5 SYSTEM DESCRIPTION

A. Environmental Requirements
1. Storage Temperature: Storage temperature range shall be -40° to +85° C (-40° to +185° F).
2. Operating Temperature: Operating temperature range shall be -40° to +60° C (-40° to 140° F).
3. Relative Humidity: Operation shall be reliable in an environment with 5% to 95% non-condensing relative humidity.
4. Operating Altitude: The device shall be capable of operation in an altitude of 0 - 12,000 feet above sea level.
5. Audible Noise: The device shall not generate any audible noise.
6. Magnetic Fields: No appreciable magnetic fields shall be generated. The device shall be capable of use directly in computer rooms in any location without danger to data storage systems or devices.
7. Electrical Requirements
8. Device Operating Voltage: The nominal operating voltage and configuration shall be that of the switchgear, distribution panel, sub or branch panelboard. Maximum Continuous Operating Voltage (MCOV): The allowable maximum continuous operating voltage of all suppression components utilized in the unit shall not be less than 115% of the nominal operating voltage.
9. Operating Frequency: The operating frequency range of the device shall be 47 to 63 Hertz.
10. Protection Modes: The devices primary mode of protection shall be line-to-neutral. The secondary modes of protection shall be line-to-ground and neutral-to-ground.
11. Surge Current Capacity and Voltage Protection Rating: Unless specifically noted on the drawings and/or the schedules, the surge current capacity, and the voltage protection rating of the SPD shall be not less than listed on the following table.

<table>
<thead>
<tr>
<th>Location</th>
<th>Per Mode Surge Current Rating</th>
<th>120/208 vac 3 phase VPR</th>
<th>277/480 vac 3 phase VPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchgear</td>
<td>200,000 amps</td>
<td>900v</td>
<td>1200v</td>
</tr>
<tr>
<td>Distribution Panel</td>
<td>150,000 amps</td>
<td>900v</td>
<td>1200v</td>
</tr>
<tr>
<td>Sub or Branch Panel</td>
<td>100,000 amps</td>
<td>900v</td>
<td>1200v</td>
</tr>
</tbody>
</table>

12. The above text gives you the option to request a specific surge current rating on the riser or panel schedules.
13. Construction: SPD’s with a surge current rating of greater than 155,000 amps per mode shall be field serviceable modular devices. SPD’s with a surge current rating of less than 155,000 amps may be non-modular.

1.6 DOCUMENTATION

A. Equipment Manual. The manufacturer shall furnish an equipment manual with installation, operation, and maintenance instructions for the system.
PART 2 - PRODUCTS

2.1 MANUFACTURER
   A. Square D
   B. Eaton
   C. General Electric
   D. Siemens
   E. Current Technology
   F. THOR SYSTEMS

2.2 TRANSIENT VOLTAGE SURGE SUPPRESSION COMPONENTS
   A. The device shall include a solid-state suppression system which includes arrays of fused non-linear
      voltage dependent metal oxide varistors (MOV’s) with similar operating characteristics. The
      suppression system shall not utilize gas tubes, spark gaps, silicon avalanche diodes or other
      components which might short or crowbar the line, thus leading to interruption of normal power
      flow to or system upset of connected loads. The suppression system shall not incorporate any
      other components which may degrade performance or reliability of the

2.3 HIGH-FREQUENCY FILTER
   A. The device shall include a UL 1283 high frequency extended range tracking filter. The filter shall
      reduce fast rise-time, high-frequency, error-producing transients and electrical line noise
      eliminating disturbances which may lead to system upset. The filter shall provide minimum
      insertion loss of 45 dB at 100 kHz attenuation frequency utilizing the MIL-STD-E220A 50 ohm insertion
      loss methodology.

2.4 INTERNAL CONNECTIONS
   A. All internal wiring associated with the suppression/filter device and subject to surge currents shall
      utilize low-impedance copper bus bar and/or #4 AWG copper conductor or larger. All internal
      connections associated with the suppression/filter device and subject to surge currents shall be made
      with compression solderless-type lugs and shall be bolted to the bus bars in order to reduce overall
      system impedance.

2.5 FIELD CONNECTIONS
   A. The device shall include mechanical lugs for each phase, neutral and ground, or permanently
      connected conductors as applicable. The lugs shall accommodate up to #4 AWG copper
      conductor.

2.6 ENCLOSURE
   A. The device shall be provided in a surface mounted NEMA 1 type hinged enclosure, with a NEMA
      rating that matches or exceeds that of the switchgear, distribution panel, sub or branch
      panelboard that is being protected. of minimum 14 gauge steel, painted inside and out.
      Enclosure width shall not be greater than 24 inches.

2.7 MONITORING
   A. The device shall include solid-state, long-life externally mounted LED visual status indicators that
      indicate the on-line status of each phase of the unit.
   b. Dry Contacts
   c. Audible alarm with silence switch
   d. For Service Entrance or Switchgear SPD’s: LED visual status indicators, Audible alarm with silence
      switch, Dry Contacts plus Surge Event Counter.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. The installation and testing of the system shall be in full accordance with the manufacturer’s
      installation, operation and maintenance instructions, and all national and local codes.
B. The device shall be installed as close as practical to the facility’s wiring system in accordance with NEC Article 285, IEEE 1100-2005 section 8.4.2.5, plus applicable national/local electrical codes and the manufacturer’s recommended installation instructions. Connection shall be from a minimum 40A branch circuit breaker in the switchgear, distribution panel or panelboard with #4 AWG copper conductors not any longer than necessary, avoiding unnecessary bends. Advise the engineer if the installed in no case shall conductors will be longer than 3 feet in length. Verify circuit breaker size with manufacturer.

3.2 TESTING
A. The system shall be field tested in the presence of the Owner. At the same time operational procedures shall be reviewed with the Owner.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes interior lighting fixtures, lighting fixtures mounted on exterior building surfaces, emergency lighting units, and accessories.
   B. Related Sections include the following:

1.3 SUBMITTALS
   A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:
      1. Dimensions of fixtures.
      2. Select one of two subparagraphs below. With second subparagraph, photometric tests by manufacturer’s laboratory are acceptable.
      3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
      4. Emergency lighting unit battery and charger.
      5. LED lights
      6. Retain two subparagraphs below for projects with air-handling fixtures.
      7. Types of lamps.
   B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.
      1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.
   C. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.
   D. Maintenance Data: For lighting fixtures to include in maintenance manuals in the close out documents.

1.4 QUALITY ASSURANCE
   A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an acceptable to authorities having jurisdiction.
   B. Comply with NFPA 70.
   C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION
   A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

1.6 EXTRA MATERIALS
   A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Interior Lighting Fixture Schedule at the end of Part 3.
   B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Interior Lighting Fixture Schedule in the plans. Submit Manufacturers as is in the Lighting Fixture Schedule or Equal. Submit Equal Manufacturers 10 days prior to bidding.
day for approval. For Equal Manufacturers submit lighting calculation for each equal fixture submitted for approval.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs, sharp corners, and edges.
B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.
D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.
   4. Laminated Silver Metallized Film: 90 percent.
E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
   1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
   2. Lens Thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.

2.3 LED FIXTURES

A. Except as otherwise indicated, provide LED luminaires, of types and sizes indicated on fixture schedules.
B. Include the following features unless otherwise indicated:
   1. Each Luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).
   2. Each luminaire shall be rated for a minimum operational life of 50,000 hours utilizing a minimum ambient temperature of (25°C).
   3. Light Emitting Diodes tested under LM-80 Standards for a minimum of 12,000 hours.
   4. Color Rendering Index (CRI) of 82 at a minimum.
   5. Color temperature [3500] <Insert value> K, unless otherwise indicated.
   6. Rated lumen maintenance at 70% lumen output for 50,000 hours, unless otherwise indicated.
   7. Fixture efficacy of 60 Lumens/Watt, minimum.
   8. 5 year luminaire warranty, minimum.
   10. The individual LEDs shall be constructed such that a catastrophic loss of the failure of one LED will not result in the loss of the entire luminaire.
   11. Luminaire shall be constructed such that LED modules may be replaced or repaired without the replacement of the whole fixture.
C. Technical Requirements
   1. Luminaire shall have a minimum efficacy of 60 lumens per watt. The luminaire shall not consume power in the off state.
   2. Operation Voltage: The luminaire shall operate from a 50 Hz to 60 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
   3. Power Factor: The luminaire shall have a power factor of 0.9 or greater.
   4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 15 percent.
   5. Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.
D. Thermal Management
   1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
   2. The LED manufacturer’s maximum thermal pad temperature for the expected life shall not be exceeded.
3. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
4. The luminaire shall have a minimum heat sink surface such that LED manufacturer’s maximum junction temperature is not exceeded at maximum rated ambient temperature.

2.4 LED EXIT SIGNS
A. Exit light fixtures shall meet applicable requirements of NFPA and UL.
B. Housing and door shall be die-cast aluminum.
C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.
D. Finish shall be satin or fine-grain brushed aluminum.
E. There shall be no radioactive material used in the fixtures.
F. Fixtures:
   1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.
   2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
   3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the “chevron-type” of similar size and width as the letters and meet the requirements of NFPA 101.
G. Voltage: Multi-voltage (120 – 277V).

2.5 EMERGENCY LIGHTING UNITS
A. General Requirements: Self-contained units. Comply with UL 924. Units include the following features:
   1. Battery: Sealed, maintenance-free, lead-acid type with minimum 5-year nominal life and special warranty.
   2. Charger: Fully automatic, solid-state type with sealed transfer relay.
   3. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

2.6 LAMPS
A. ALL LED – NO LAMPS

2.7 FINISHES
A. Fixtures: Manufacturer’s standard, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer’s written instructions and approved submittal materials. Install lamps in each fixture.
B. NFPA 70 requires minimum support for fixtures. Retain paragraphs below for more specific support requirements and for requirements exceeding code minimums. Units in seismic zones must have additional supports and restraining devices beyond those specified here. See Editing Instruction No. 3 in the Evaluations.
C. Support for Fixtures in or on Grid-Type Suspended Ceilings: Do not use grid for support.
   1. Install a minimum of two ceiling support system wires for each fixture. Locate not more than 6 inches (150 mm) from fixture corners.
   2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.
   3. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
D. Suspended Fixture Support: As follows:
   1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.

3.2 CONNECTIONS
A. Ground equipment.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-
      tightening values. If manufacturer's torque values are not indicated, use those specified in
      UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL
A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
B. Advance Notice: Give dates and times for field tests.
C. Tests: As follows:
   1. Verify normal operation of each fixture after installation.
   2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
   3. Verify normal transfer to battery source and retransfer to normal.
   4. Report results in writing.
D. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until
   units operate properly.
E. Corrosive Fixtures: Replace during warranty period.

3.4 CLEANING AND ADJUSTING
A. Clean fixtures internally and externally after installation. Use methods and materials recom-
   mended by manufacturer.
B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes exterior lighting units with luminaries and lamps.
   B. Related Sections include the following:
      1. Section "Interior Lighting" for interior fixtures, lamps, ballasts, emergency lighting units, and accessories; and for exterior luminaires normally mounted on buildings.

1.3 DEFINITIONS
   A. Lighting Unit: A luminaire or an assembly of luminaires complete with a common support, including pole, post, or other structure, and mounting and support accessories.
   B. Luminaire (Light Fixture): A complete lighting device consisting of lamp(s) and ballast(s), when applicable, together with parts designed to distribute light, to position and protect lamps, and to connect lamps to power supply.

1.4 SUBMITTALS
   A. Product Data: For each type of lighting unit indicated, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
      1. Materials and dimensions of luminaries.
   B. Product Certificates: Signed by manufacturers of lighting units certifying that products comply with requirements.
   C. Maintenance Data: For lighting units to include in maintenance manuals specified in other sections.

1.5 QUALITY ASSURANCE
   A. Luminaires and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use, location, and installation conditions by acceptable to authorities having jurisdiction
   B. Comply with ANSI C2.
   C. Comply with NFPA 70.

1.6 WARRANTY
   A. General Warranty: LED fixture warranty is a five year limited warranty. Pole standard warranty is one year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Exterior Lighting Unit Schedule at the end of Part 3.
   B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Interior Lighting Fixture Schedule in the plans. Submit Manufacturers as is in the Lighting Fixture Schedule or Equal. Submit Equal Manufacturers 10 days prior to bidding day for approval. For Equal Manufacturers submit lighting calculation for each equal fixture submitted for approval.

2.2 LUMINAIRES
   A. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
   B. Metal Parts: Free from burrs, sharp corners, and edges.
   C. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
   D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
E. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position. Provide for door removal for cleaning or replacing lens. Arrange to disconnect ballast when door opens.

F. Exposed Hardware Material: Stainless steel.

G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.

H. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.

I. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor in luminaire doors.

J. Photoelectric Relays: As follows:
   1. Contact Relays: Single throw, arranged to fail in the on position and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay.
   2. Relay Mounting: In luminaire housing.

K. Lamps: Comply with the standard of the ANSI C78 series that is applicable to each type of lamp. Provide luminaires with indicated lamps of designated type, characteristics, and wattage. Where a lamp is not indicated for a luminaire, provide medium wattage lamp recommended by manufacturer for luminaire.

L. LED sources shall meet the following requirements:
   1. Operating temperature rating shall be between -40 degrees C (-40 degrees F) and 50 degrees C (120 degrees F).
   2. Correlated Color Temperature (CCT): 4000K
   4. The manufacturer shall have performed reliability tests on the LEDs luminaires complying with ILLuminating

2.3 LED DRIVERS

A. LED drivers shall meet the following requirements:
   1. Drivers shall have a minimum efficiency of 85%.
   2. Starting Temperature: -40 degrees C (-40 degrees F).
   3. Input Voltage: 120 to 480 (±10%) volt.
   4. Power Supplies: Class I or II output.
   5. Surge Protection: The system must survive 250 repetitive strikes of “C Low” (C Low: 6kV/1.2 x 50 μs, 10kA/8 x 20 μs) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. “C Low” waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
   6. Power Factor (PF): ≥ 0.90.
   7. Total Harmonic Distortion (THD): ≤ 20%.
   9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

PART 3 - EXECUTION

3.1 CONNECTIONS
A. Ground equipment.
1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Ground metal poles/support structures according to Section "Grounding and Bonding."
   1. Nonmetallic Poles: Ground metallic components of lighting units and foundations. Connect luminaires to grounding system with No. 6 AWG conductor.

3.2 FIELD QUALITY CONTROL
A. Inspect each installed unit for damage. Replace damaged units.
B. Advance Notice: Give dates and times for field tests.
C. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source, and as follows:

3.3 CLEANING AND ADJUSTING
A. Clean units after installation. Use methods and materials recommended by manufacturer.

END OF SECTION
DIVISION 27
COMMUNICATIONS

The Agreement, General Conditions Of The Contract For Construction, Supplementary Conditions Of The Contract For Construction, and all Addenda are a part of the Contract. The Contractor shall consult them in detail for instructions pertaining to the Work. The Contractor shall also consult all other divisions and sections of the Project Manual, and all Drawings in the execution of the work of the Contract.

The Contractor shall provide all labor, materials, systems, equipment, items, articles, operations, and/or methods listed, implied, mentioned, or scheduled in the Contract Documents and/or necessary and/or required for the satisfactory completion of the Work.

The listing of work, requirements, and products in this section is not intended to be conclusive. The Contractor shall check all other parts of the Contract Documents and shall provide all miscellaneous items of work and products necessary for the satisfactory completion of the Work described in the Contract Documents.
SECTION 27 0533
CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS
A. The General Provisions, Supplemental General Provisions, Special Provisions apply to work covered by this Section.
B. Comply with Sections 26 0000, as applicable. Refer to other Sections for coordination of work.
C. Refer to section 27 1300 for additional conduit requirements.

1.2 SCOPE OF WORK
A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of a telephone and data communications empty conduit system, including all related systems and accessories.

1.3 SUBMITTALS
A. Submit product data and shop drawings in accordance with the Architectural sections.

PART 2 - PRODUCTS

2.1 GENERAL
A. Conduit, conduit sleeves, outlet boxes, cover plates and pullwire as indicated.
B. Fireproofing material for telephone and data communication conduit and conduit sleeves through fire rated walls and floors.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install communication conduit sleeves for all fire rated and structured walls.
B. Install telephone and data communication raceways as indicated.
C. Install individual raceways from telephone and data communications outlets to above accessible ceiling. In areas without a ceiling, raceways shall be routed to the nearest ceiling space. In building without a ceiling, raceways shall be extended back to the main telephone/data communication board or to a location indicated on the Drawings.
1. Minimum size conduit: one inch, unless otherwise noted on the electrical plans.
2. Raceway installation shall be in accordance with Section 26 05 33.
3. Coordinate raceway installations in millwork and other fabricated architectural items with the other portions of the Work.
4. Provide pullwire in each raceway tagged on each end.
5. Raceways shall be terminated with an insulating bushing or a suitable connector with an insulated throat.
D. Provide telephone and data communications outlet boxes.
1. Provide a dual-gang outlet with one gang mud ring, unless noted otherwise. Box shall include 1" knock outs.
2. Install outlet box and device ring at each location.
3. Install telephone and data communications outlets at same height specified for convenience outlets unless noted otherwise. Group telephone and data communications outlets with related receptacle outlets unless noted otherwise.
4. Install a blank cover plate on all unused communications outlet boxes.

END OF SECTION
SECTION 271300
STRUCTURED CABLEING FOR VOICE AND DATA – INSIDE PLANT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Summary of Work:
   a. Provide a complete and tested cable distribution system for data interconnections. The data distribution system shall include fully terminated unshielded twisted pair cables, raceways, conduit, UTP termination devices, data communications outlets, patch panels, patch cables, and another incidental and miscellaneous premises wiring system hardware as required for a complete and usable system. The installation shall comply with all applicable codes and standards in effect at the job site and as indicated in the Drawings and Specifications.

1.2 QUALITY ASSURANCE

A. Acceptable manufacturers:
   a. The equipment/products described herein, and furnished per these specifications shall be the product of one manufacturer. No substitutions allowed. All references to model numbers and other detailed descriptive data are intended to establish standards of design performance, and quality, as required.

B. Installer Qualifications:
   a. The Data Cable System Installer shall be licensed and shall meet all applicable regulations of the State of Texas and Department of Labor insofar as they apply to this type of system. The proposer shall be firm normally employed in the low voltage and data cabling industry and shall provide a reference list of five (5) large-scale projections and contact names confirming successful category 6 premises wiring system installations.

   b. All Data Cable systems installation shall be performed by a (BICSI) Certified-Registered Telecommunications Technician or under the direct supervision of a (BICSI) Certified-Registered Communications Distribution Designer (RCDD).

   c. All data Cable Systems installation shall be performed by a factory/manufacturer certified installer, no exceptions.

C. Pre-Construction Meeting:
   a. The successful Contractor shall attend mandatory pre-construction meeting with individuals deemed necessary by the Owner’s representative prior to the start of the work.

D. Acceptance:
   a. The owner’s representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.

E. Warranty:
a. The selected system installer shall be a certified installing Contractor of product and hold current certification. Contractor shall provide and end-to-end performance warranty of not less than one (1) year on all products installed. The proposer shall provide current certification documentation. The performance warranty shall be issued by tested bi-directly (end to end) using Level 2 tester, per TSB-67, and that all test results conform to the most current TIA/EIA-526-14 Standard, method B.

b. The warranty will stipulate that all products used in this installation met the prescribed mechanical and transmission specifications for such products as described in ISO/IEC 11801, ANSI/TIA/EIA-568-A or EN 50173. Quality and workmanship evaluation shall be solely by the owner/designer and designated representatives.

1.3 REGULATORY REQUIREMENTS

A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
   a. Latest Local and Codes and Amendments
   b. 2020 National Electrical Code

B. Other References:
   a. TIA/EIA-568-A Commercial Building Telecommunications Wiring Standard
   b. EIA/TIA 569 Commercial Building Standard for Telecommunication Pathways and Spaces.
   c. TIA/EIA-606 The administration Standard for the Telecommunications Infrastructure of Commercial Buildings
   d. TIA/EIA-607 Commercial building Grounding and Bonding requirements for telecommunications.
   e. EIA/TIA 455-A Standard Test Procedure for fiber optic fibers, Cables, transducers, sensors, connecting and terminating devices and other fiber optic components.
   f. TIA/EIA TSB 67 Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling systems
   g. TIA/EIA TSB 72 Centralized Optical Fiber Cabling Guidelines
   h. ISO/IEC 11801 Generic Cabling Standard
   i. EN 50173 Generic Cabling Standards for Customer Premises
   j. ANSI/EIA/TIA 526-14 Optical power loss measurements of Installed Multimode Fiber Cable Plan

C. Governing Codes and Conflicts:
   a. If the requirements of these specifications or the project Drawings exceed those of governing codes and regulations, then the requirements of these specifications and the drawings shall govern. However, nothing in the drawings or specifications shall be construed to permit work not conforming to all governing codes and regulations.
1.4 ABBREVIATIONS

a. The following abbreviations are used in this document:
   
   CMP   Ceiling Mounted Projector
   TWS   Teacher Workstation
   PS    Presentation Station
   UTP   Unshielded Twisted Pair
   STP   Shielded Twisted Pair

1.6 SUBMITTALS

A. Project Initiation:

   a. Within fourteen (14) days of Notice to Proceed, the projection system installed shall furnish the following in a single consolidated submittal:

      i. Permits: the Contractor shall obtain all required permits and proved copies to the Owner/Architect/Engineer.

      ii. Product literature: Complete manufacture’s product literature for all Panduit wall mount, Panduit patch panel 48 ports, Panduit keystone wall plates, RJ-45 keystone, 2” j-hooks, Cable, cross-connect blocks, Cable supports, Cable labels and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Designer) and the manufacturer’s supporting documentation demonstrating compatibility with other related products shall be included.

      iii. Construction Schedule: a time-scaled construction schedule, using the installation of the Cable distribution system.

      iv. Testing: Proposed Contractor Enhanced Category 6 UTP Cable test result forms, and a list of instrumentation to be used for system testing.

B. Shop Drawings:

   a. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed.

      i. Proposed circuit routing and circuit grouping plan prepared by a BICSI certified RCDD (registered Communications Distribution Designer). The RCDD certification must be current.

      ii. Conformance: For items which are being provided exactly as specified, provide a letter stating the item description and model number, and that it is being provided as specified. For items which are not as specified, provide standard manufacture’s cut sheets or other descriptive information and a written description detailing the reason for the substitution.

C. Project Completion:
a. As a condition for project acceptance, the Contractor shall submit the following for review and approval:
   i. As Built Drawing: As built drawings will include Cable pathways, outlet locations with correct labeling and rack location. The as-built drawings will be prepared using latest AutoCAD version or revit.

PART 2 - PRODUCTS

2.1 GENERAL

A. Installation: The cabling shall be installed per requirements of the manufacturer and the Project Documents utilizing materials eating all applicable TIA/EIA standards. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system.

B. Materials: Materials shall be as listed or shall be approved equivalent products of other manufacturers meeting the intent and quality level of the TIA/EIA specifications. All approved equivalent products will be published by addendum ten days prior to proposal for Architect/Engineer to review.

C. Testing: all installed cabling shall be tested 100% good after installation by the Contractor.

D. Ratings: all products shall be new and brought to the job site in the original manufacturer’s packaging. Electrical components shall bear the Underwriters Laboratories label. All communications Cable shall bear flammability testing ratings as follows:
   a. CM Communications Cable
   b. CMP Plenum Rated Communications Cable
   c. CMR Riser-Rated Communications Cable

E. Initial Cable Inspection: The Contractor shall inspect all Cable prior to installation to verify that it is identified properly on the reel identification label, that it is of the proper gauge, containing the correct number of pairs, etc. Note any buckling of the jacket that would indicate possible problems. Damaged Cable or any other components failing to meet specifications shall not be used in the installation’s

F. Cable Lubricants: Lubricants specifically designed for installing communications Cable may be used to reduce pulling tension as necessary when pulling Cable into conduit.
   a. Approved Products
      i. Twisted-pair Cable: Dyna-Blue
         American Polywater

G. Fire Wall Sealant: Any penetration through firewalls (including those in sleeves) will be released with an Underwriter Laboratories (UL) approved sealant.
   a. Approved Products
      i. 3M or
      ii. Pre-approved equal
2.2 NETWORK DATA CLOSET CATEGORY 6 TERMINATION HARDWARE

A. Equipment: Provide the following equipment.

B. Contractor shall be Panduit certified.

C. All configurations shall be to meet 568B standards.

D. All systems shall be a turnkey solutions, include all required equipment for a complete 100% operable system.

E. All IDF ROOMS – (refer to plans for quantities)
   Note: Contractor shall install enough switches for 100% of all voice, data and WAP shown on the drawings.

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panduit #DP4868TGY</td>
<td>48-port, flat, 1RU, Category 6 RJ45 UTP data patch panel. Shall include 20% spare capacity.</td>
</tr>
<tr>
<td>Panduit #WMPSE</td>
<td>Horizontal cable manager, front and rear, 1RU</td>
</tr>
<tr>
<td>Panduit #PZCHSM2</td>
<td>Panzone Horizontal slack manager</td>
</tr>
<tr>
<td>Panduit #PZCFK</td>
<td>Fan kit</td>
</tr>
<tr>
<td>Panduit #PZC12W</td>
<td>12RU wall mount cabinet, windowed front door,</td>
</tr>
</tbody>
</table>

Note:
1. Vendor must provide a turnkey solution (Hardware, Installation, and Configuration) and adhere to all standards.
2. Contractor shall verify quantities with the plan and provide the higher number of devices.
3. Contractor is responsible for terminating all data cables to new rack.
4. Contractor shall provide Panduit patch panel with capacity of all circuit with additional 20% spare capacity.

F. Distribution Rack Grounding
a. All racks shall be grounded using stranded #6 AWG insulated copper conductor. Connect to service entrance grounding electrode. Provide all required bonding materials and hardware and bond to building grounding electrode subsystem at building at building electrical service entrance. Grounding shall meet NEC, ANSI/TIA-607-B-2011, ANSI/NECA/BICSI-607-2011

i. Approved products- Ground Terminal Block
   Chatsworth Products, Inc.- (CPI) #08009-001

ii. Approved Products- Wall mount Bus Bar (one per rack location)
   Panduit Products #GB0612TPI-1

• Contractor is responsible for terminating any phone cables to new racks.
• Network Hardware list will require the mounting of racks and UPSs. All racks must be grounded according to industry standards.

G. Category 6 equipment:

1. Category 6 Cable –
   A. Acceptable manufacturers: Panduit # PUPP6C04-U (provide jacket colors: blue for data and White for voice)
   B. Each voice/data outlet shall consist of (2) Panduit Category 6 Plenum cables from network rack to each outlet; number of cables described in accompanying documentation.
   • 3 meters service loop to be provided at each termination including rack location.

C. Unshielded Twisted Pair (UTP) Category 6 cable:
   1. All Category 6 cable will be tested with certified level tester that can provide a hard copy. Level 6 cables will be tested for according to industry standards.
   2. Vendor will provide hard copy of test results for all ports.
   3. Cable will be Category 6 4-pair plenum.
   4. Installation should follow the UTP Category 6 standards for distance
   5. All termination jacks, connectors, and patch cords will follow Category 6 UTP standards or higher.
   6. All wall faceplates and cables will be labeled in a scheme where switch ports can be identified. Contractor shall coordinate with owner/Architect.
   7. Cable must be labeled on both end with gap between label and cable end of 6 inches.
   8. Installation must meet or exceed all ANSI/TIA/EIA-568-B.2-1 for Category 6 cabling.
   9. Each equipment rack or wiring closet shall have adequate horizontal and vertical wire management hardware to ensure an organized and aesthetic installation to the owner’s satisfaction.
   10. All jacks and patch panels shall be configured to the 568B-wiring scheme.

2. Category 6 Patch Panels
   A. Adequate patch panel ports are to be supplied in the network rack to accommodate the number of cable drops in this. All patch panels shall meet or exceed EIA/TIA Category 6 standards. Terminate and
provide Category 6 RJ-45 jacks and wire management system. Label all patch panels with printed labels circuit ID. All jacks and patch panels shall be configured to the 568B-wiring scheme and both ends shall be tested to continuity is correct.

B. All Patch Panels must be of modular design.
   a. Panel shall be 48 ports only, Panduit # DP48688TGY.

3. Category 6 Accessories
A. Category 6 Inserts
   a. Panduit#NK688M-BU Category 6 U/UTP keystone jack module, blue (Data).
   b. Panduit#NK688M-WH Category 6 U/UTP keystone jack module, white (Voice)

B. Standard Faceplate 2 ports
   a. Panduit # CFPSL2S Stainless steel Flush Mounted Faceplate

C. Patch cables network work rack
   a. Use appropriate lengths to obtain a dressed appearance; Panduit#NK6PC3MBUY, 2 meters, blue for data and white for voice.

4. STATION WIRING
A. Wire: the data and voice wire provided for all outlets shall be Category 6 unshielded twisted pair, four-pair, 23 AWG solid cooper conductor, meeting the intent and quality level of the TIA/EIA-568-A Commercial building wiring standard. Refer to floor plan and data outlet legend for number of active data products to specified faceplates. Provide 2 cables per outlet.

B. Testing: The Enhanced Category 6 four-pair UTP Cable must be UL performance level tested. Each 1000 foot spool must be individually tested with test results affixed to the spool.

C. Rating: Cable installed in conduit shall be non-plenum rated. Cable not installed in conduit shall be plenum rated if installed in plenum ceiling spaces, non plenum rated otherwise.

5. STATION HARDWARE
A. Flush Mount Jacks: Flush mount jacks shall be high quality Category 6 RJ45 modular jacks, T568B terminations. Jacks shall meet EIA/TIA TSB40 recommendations for category 6 connecting hardware.

PART 3- EXECUTION
3.1 GENERAL
A. Fire wall penetrations: the Contractor shall avoid penetration of fire-rated walls and floors whenever possible. Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.
B. Allowable Cable Bend Radius and Pull tension: In general, communications Cable cannot tolerate sharp bends or excessive pull tension during installation. Refer to the Cable manufacturers allowable bend radius and pull tension data for the maximum allowable limits.

C. Cable Lubricants: After installation, exposed Cable and other surfaces must be cleaned free of lubricant residue.

D. Pull strings: Provide pull strings in all new conduits, including all conduits with Cable installed as part of this contract. Pull test is not to exceed 200 pounds. Data and video Cables can be pulled together with pull strings.

E. Conduit Fill: Conduit fill shall not exceed 40%.

F. Damage:
   a. The Contractor shall replace or rework Cables showing evidence of improper handling including stretches, kinks, short radius bends, over-tightened bindings, loosely twisted and over-twisted pairs at terminals and Cable sheath removed too far (over 1-1/2 inches).
   b. The Contractor shall replace any damaged ceiling tiles that broken during installation.

G. Clean up:
   a. All clean up activity related to work performed will be the responsibility of the Contractor and must be completed daily before leaving the facility.

3.2 DOCUMENTATION

A. Labels:
   a. The Contractor will label all outlets using permanent/legible typed or machine engraved labels approved by the Owner (no handwritten labels permitted). Label patch panels in the wiring closet to match those on the corresponding data outlets. The font shall be at least on-eight inch (1/8”) in height, block. All labels shall correspond to as-builds and to final test reports.
   b. The following nomenclature should be an example when labeling data/voice jacks:
   c. All Cables being served by the network rack shall begin with “NR”.
   d. Next identification letter shall refer to patch panel that is serving outlet (A, B, C…)
   e. Next identification shall note what # data port on patch panel (1 thru 48).
   f. Example:
      i. Outlet from 23rd port of the third patch panel from top of rack located at NR
      1. NR-C23

B. Floor Plan
   a. A floor plan clearly labeled with all outlet jack numbers shall be included in the as-built plans.

C. Cables: All Cables shall be labeled at both ends. This includes but not limited to horizontal voice and data cabling.

3.3 EQUIPMENT RACK CONFIGURATION

A. Equipment Racks: Equipment racks shall be assembled and mounted in locations shown on the Drawings and as detailed. Each Rack shall be securely mounted on the floor and braced to the
wall with Cable tray in accordance with the manufacturer’s instructions and recommendations. Racks shall be mounted such that the side rails are plumb with vertical Cable management panels. Racks to be located such that future expansion can occur without relocating existing racks. Racks shall be grounded in accordance with NEC requirements.

B. Wire management Components: Horizontal Cable management panels shall be installed directly above and below each patch panel, also 2 per each 48 port patch panel should be left at site to accommodate the switch gear when they are installed. Vertical Cable management panels shall be installed in each side of the rack. In instances where more than one rack is installed in a single location, vertical Cable management shall be installed between the racks and on either side.

C. Cable Placement: Cable installation in the wiring closet must conform to the project drawings, all cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance location. Avoid crossing area horizontally just above or below any riser conduit. Lay and dress Cables to allow other Cables to enter the conduit/riser without difficulty at a later time by maintaining a working distance from these openings.

D. Cable Routing: Cable shall be routed as close as possible to the ceiling, or corners to ensure that adequate wall or backboard space is available for current and future equipment. All Cable runs within the wiring closet shall be horizontal or vertical within the constraints of minimum Cable bending raii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.

E. Installation: all incoming Cables shall be routed on the Cable tray and neatly dressed down to the patch panels.

F. Hardware: provide rack and jack panel hardware as required for all data station wiring.

3.4 STATION WIRING INSTALLATION

A. General:
   a. Cabling between wiring closet and workstation locations shall be made as individual home runs. No intermediate punch down blocks or splices may be installed or utilized between the wiring closet and the communications outlet at the workstation location.
   b. All Cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connection points at both ends of the Cable. There shall never be more than one and one half inches of unsheathed enhanced category 6 UTP Cable at either the wiring closer or

B. Exposed Cable:
   a. All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed station Cable will only be run where indicated on the Drawings.
   b. Unless otherwise approved all cabling shall be concealed. All cabling ran in exposed ceiling areas shall be routed in conduit adequately sized and shall maintain fill ration per NEC and BICSI standards.

C. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner’s efficient use of their full capacity.
D. Cable Routes:
   a. All cabling placed in ceiling areas must be in conduit and J-Hooks. Cable supports shall be permanently anchored to building structure or substrates. Provide attachments hardware and anchors designed for the structure to which attached and that are suitably sized to carry the weight of the Cables to be supported. Do not route Cable through webbing of structural steel. Cabling must be supported in dedicated supports intended to support cabling as described in this section.
   b. Attaching Cable to pipes or other mechanical items is not permitted. Use J-Hooks for up to 15 Cables (Chatsworth hooks with appropriate brackets). All runs of sixteen (16) or more Cables provide Cable rings on 36 inch maximum centers to hang Cable. Communications Cable shall be rerouted so as to provide a minimum of 18 inches spacing shall not be attached to ceiling. Grid support wires. Cable runs shall be parallel or perpendicular to building structure. Multiple Cables to be bundled together every 6 feet.

3.5 STATION HARDWARE
A. Flush Mount Jacks: Flush mount jacks shall be mounted in a faceplate with back box.
B. Placement: Where possible, the PS outlet shall be located so that its centerline is 18 inches above floor level or 12 inches above permanent bench surfaces. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches. The CMP outlet shall be installed in the ceiling mounted projector plate.
C. RJ-45 Jack Pin Assignments:
   a. Pin connections for data station Cable outlets and patch panels shall match EIA/TIA 568 modular jack wiring recommendation T568B.
   b. Pin Connections at data jack panels shall match pin connections at outlets (straight through wiring).

3.6 CABLE TESTING REQUIREMENTS
A. Notification: The Owner shall be notified one week prior to any testing so that the testing may be witnessed.
B. Inspection: Before requesting a final inspection, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.
C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor’s use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors.
D. Errors: when errors are found, the source of each shall be determined, corrected and the Cable retested. All defective components shall be replaced and retested. Re-test results must be provided on Owner approved forms and witnessed by Owner.
E. Twisted Pair Cable Testing:
   a. At a minimum, the Contractor shall test all station drop Cable pairs from Data Closet termination patch panels to outlet device RJ45 jacks. Enhanced category
6 products shall be tested for compliance to ANSI/TIA/EIA 568A and ISO/IEEs 11801 for Enhanced Category 6 rated installation. Test equipment used shall meet TIA/EIA TSB-67, Level II accuracy. Further, the Contractor shall have a copy of TSB-67 in their possession and be familiar with its contents.

b. Each wire/pair shall be tested at both ends for the following:
   i. Wire map (pin to pin connectivity)
   ii. Length (in feet)
   iii. Attenuation
   iv. Near end cross talk (NEXT)
   v. Power Sum

c. Test results for each Enhanced Category 6 four pair UTO Cable must be submitted with identification to match labels on all patch panel ports and RJ45 jacks and must match as-builds associated with that Cable.

d. All testing of Category 6 twisted pair Cable testing shall be performed as described above and comply with all current Category 6 testing parameters and standards.

e. Test all cables to ensure 10/100/1000 megabit suitability using industry standards and equipment. Provide results to owner for review.

F. Testing: Once installed the cabling will be tested for continuity, shorts and grounds.

a. Cabling:
   i. Continuity-100% continuity testing is required and will be tested from the network rack location to each voice/data drop. A checklist of each Cable and test performed on that Cable will be submitted once the testing has been completed.
   ii. Shorts- No Cable shorts will be permitted on the system. If a short is detected, the connector or Cable will be repaired or replaced.
   iii. Grounds – no direct ground on the center conductor of the AVDN Cables are permitted.

b. System:
   i. Continuity- as tested in the above testing requirements.
   ii. Power readings- a power reading will be required at each drop of each of the cabling systems. A +3 dB to a +7 dB is required at each drop with a common feed signal of +15 dB into the head end amplifier. These measurements to be taken with an approved field strength meter of known calibration. These measurements to be performed at low channel, mid-band channel; and high channel to determine Cable slope.
   iii. Signal Quality- a standard receiver, typical of those used in the system, shall randomly be connected to 10% of the outlets across the system and tuned to a reference channel of known quality. No visible indication of co-
channel interference, noise, ghosting, or beat interference may be observed.

iv. Carrier to Noise- Carrier to Noise shall be measured at random outlets representing an average cross section of the drops with an approved field strength meter by the following process. With normal operating levels the field set shall be tuned to each channels visual carrier and the level recorded. The input signal to the head end amplifier shall be removed and the input of the amplifier terminated with a short. Each channel shall be re-measured and the noise levels recorded. The carrier to Noise measurement is the difference of the two figures.

v. Documentation of Results- all recorded measurements are to be tabulated and included in the system documentation manual for reference during maintenance of the system.

3.7 INSPECTION

A. General: Conformance to the installation practices covered above is to be verified when completed. In some cases, the Owner/Designer may inspect before acceptance.

END OF SECTION

THE CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS, SYSTEMS, EQUIPMENT, ITEMS, ARTICLES, OPERATIONS, AND/OR METHODS LISTED, IMPLIED, MENTIONED, OR SCHEDULED IN THE CONTRACT DOCUMENTS AND/OR NECESSARY AND/OR REQUIRED FOR THE SATISFACTORY COMPLETION OF THE WORK.

THE LISTING OF WORK, REQUIREMENTS, AND PRODUCTS IN THIS SECTION IS NOT INTENDED TO BE CONCLUSIVE. THE CONTRACTOR SHALL CHECK ALL OTHER PARTS OF THE CONTRACT DOCUMENTS AND SHALL PROVIDE ALL MISCELLANEOUS ITEMS OF WORK AND PRODUCTS NECESSARY FOR THE SATISFACTORY COMPLETION OF THE WORK DESCRIBED IN THE CONTRACT DOCUMENTS.
PART 1 - GENERAL

1.1 RELATED REQUIREMENTS
   B. Comply with applicable sections in division 26. Refer to other Sections for coordination of the Work.

1.2 SCOPE OF WORK
   A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing additional and new devices for new building.
      1. Fire alarm control panel
      2. Remote Annunciator
      3. Addressable or conventional manual fire alarm stations.
      4. Addressable analog and conventional area smoke detectors.
      5. Conventional beam detectors.
      6. Addressable analog and conventional duct smoke detectors.
      7. Addressable analog and conventional heat detectors.
      8. Sprinkler water flow alarm switches.
      9. Audible notification appliances; bells, horns, chimes.
      11. Central station alarm connection control.
      12. Air handling systems shutdown control.
      15. Sprinkler supervisory switches and tamper switch supervision.
      17. Battery standby.
      18. System shall activate the overhead gates. Provide all accessories for an active system.

1.3 SUBMITTALS
   A. Submit product data and shop drawings in accordance with other Sections for products specified under PART 2 - PRODUCTS. Shop drawings shall be generated by the Fire Alarm Contractor without the Engineers plans.
   B. The submittal data shall include, but not necessarily be limited to, the following:
      1. Complete bill of material indicating quantity, part numbers and brief description.
      2. Data sheets for all products. If multiple models are shown on the same data sheet, highlight the specific model used.
      3. Provide drawing with all devices.

1.4 REFERENCE STANDARDS
   A. The fire alarm system devices specified herein shall be designed, manufactured, installed and tested according to the latest version of the following standards:
   B. National Fire Protection Association Standards
      1. NFPA 70 - National Electric Code (NEC), Articles 725 & 760.
      2. NFPA 71 - Central Station Signaling Systems
      3. NFPA 72 - National Fire Alarm Code (NFAC)
      4. NFPA 92A - Smoke Control Systems
      6. Underwriters Laboratories, Inc.
      7. UL 38 - Manually Activated Signaling Boxes
      8. UL 228 - Door Holders for Fire Protective Signaling Systems
9. UL 268 - Smoke Detectors for Fire Protective Signaling Systems
10. UL268A - Smoke Detectors for Duct Applications
11. UL 346 - Waterflow Indicators for Fire Protective Signaling Systems
12. UL 464 - Audible Signaling Appliances
13. UL 864/UOJZ/APOU - Control Units for Fire Protective Signaling Systems
14. UL 1481 - Power Supplies for Fire Protective Signaling Systems
15. UL 1638 - Visual Signaling Appliances
16. UL 1711 - Amplifiers for Fire Protective Signaling Systems
17. UL 1971 - Standard for Fire Protective Signaling Systems
18. Americans with Disabilities Act (ADA)
19. Local and State Building Codes
20. Local Authorities Having Jurisdiction (LAHJ)

1.5 QUALITY ASSURANCE
A. The fire alarm system devices shall be listed and labeled by Underwriters Laboratories, Inc. for use in fire protective signaling system.
B. The Installing Contractor shall be factory authorized and trained and shall be NICET certified in the sub-field of Fire Alarm Systems, for the engineering and technical installation and supervision of the system. This certification shall be Level III for engineering and Level II for technical installation and supervision. Proof of certification shall be provided. All work shall be performed by skilled technicians, under the supervision and direction of the designated NICET engineering technician, all of whom shall be properly trained and qualified for the work.
C. The fire alarm contractor shall not sub out portion of the work. The fire alarm shall be responsible to complete the job.
D. Submission to Authority Having Jurisdiction: Submit copies of State Certificate as required by State Fire Marshall. Provide copy with operating and maintenance manual.

1.6 QUALIFICATIONS
A. The fire alarm contractor, as a business entity, shall be an authorized and designated representative of the equipment manufacturer and shall have been actively engaged in the business of selling, installation and servicing fire alarm systems for a period of at least (5) years prior to the bid date.
B. The fire alarm contractor shall have an office within the Rio Grande Valley with trained technicians who are qualified to manage the installation, to be responsible that the system is installed as submitted, to conduct system start-up, to instruct the project coordinators representatives and local authorities in the proper operation of the system, and to provide service throughout the warranty period. 3. The fire alarm contractor SHALL NOT HAVE any grievances or complaints on record regarding workmanship, code compliance, or service response with either the project coordinator, Architect, Engineer, Owner or the State Fire Marshals office. A contractor that has any prior finding(s) of a Fire Alarm license violation or has any litigation in process with the State Fire Marshal is unacceptable.

1.7 The fire alarm contractor shall be an active installer on the approved manufacturer for a minimum of 5 years.

1.8 WARRANTY
A. Warranty of all control equipment, sensors, I/O modules and all other peripherals and of materials, installation and workmanship shall be for one (1) year from date of acceptance.
B. The Contractor shall guarantee all wiring and raceways to be free from inherent mechanical or electrical defects for one (1) year from date of final acceptance.

PART 2 - PRODUCTS
2.1 MANUFACTURER
A. Notifier.

2.2 CIRCUITING GUIDELINES
A. Each addressable analog loop shall be circuited as shown on the drawings but device loading in not to exceed 80% of loop capacity in order to leave for space for future devices. The loop shall have Class A operation. When it is necessary to interface conventional initiating devices provide intelligent input modules to supervise Class A zone wiring. The audio system components shall be
B. Audio Amplifiers
   1. Each audio power amplifier shall have integral audio signal de-multiplexers, allowing the amplifier to select any digitized audio channels. The channel selection shall be directed by the system software. Multiple and different audio signals shall be able to be broadcast simultaneously from the same system network node.
   2. Each amplifier output shall include a dedicated, supervised speaker circuit which is suitable for connection of emergency speaker appliances. Each amplifier shall also include a notification appliance circuit for connection of visual (strobe) appliances. This circuit shall be fully programmable and it shall be possible to define the circuit for the support of audible, visible, or ancillary devices.
   3. Standby audio amplifiers shall be provided that automatically sense the failure of a primary amplifier, and automatically program themselves to select and de-multiplex the same audio information channel of the failed primary amplifier, and fully replace the function of the failed amplifier.
   4. In the event of a total loss of audio data communications, all amplifiers will default to the local "EVAC" tone generator channel. If the local panel has an alarm condition, then all amplifiers will sound the EVAC signal on their connected speaker circuits.
   5. In the event of a loss of the fully digitized, multiplexed audio riser, the audio amplifiers shall automatically default to an internally generated alarm tone.
   6. Audio amplifiers shall automatically detect a short circuit condition on the connected speaker circuit wiring, and shall inhibit itself from driving into that short circuit condition.

2.3 DETECTORS
A. General
   1. Detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters.
   2. Detectors shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and loop controller. Detectors not capable of making independent alarm decisions shall not be acceptable. Maximum total loop response time for detectors shall be 0.5 seconds.
   3. Detectors shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. Both LEDs on steady shall indicate alarm-standalone mode status. Both LEDs shall be visible through a full 360 degree viewing angle.
   4. Detectors shall be capable of identifying diagnostic codes to be used for system maintenance. The diagnostic codes shall be stored at the detector.
   5. Detectors shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each detector shall be individually programmable to operate at various sensibility settings.
   6. The detector microprocessor shall contain an environmental compensation algorithm which identifies and sets ambient "environmental thresholds." The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminates as well as detector aging. The process shall employ digital compensation to adapt the detector to both long term and short term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the "learned" base line sensitivity. The base line sensitivity information shall be permanently stored at the detector.
7. The detector and loop controller shall provide increased reliability and inherent survivability through intelligent conventional operation. The device shall automatically change to standalone, conventional device operation in the event of a loop controller polling communications failure. In the standalone detector mode, the detector shall continue to operate using sensitivity and environmental compensation information, stored in its microprocessor at the time of communications failure. The loop controller shall monitor the loop and activate a loop alarm if a detector reaches its alarm sensitivity threshold.

8. Detectors shall be capable of automatic electronic addressing and/or custom addressing. Devices using DIP or rotary switches for addressing, either in the base or on the detector shall not be acceptable.

9. Detectors shall be suitable for operation in the following environment:
   a. Temperature: 32°F to 120°F
   b. Humidity: 0-93% RH, non-condensing
   c. Elevation: Up to 6,000 ft.
   d. Intelligent Photoelectric Smoke Detectors

B. Addressable photoelectric smoke detectors
   1. Addressable intelligent photoelectric smoke detectors shall be provided as indicated on the Drawings. The detector shall use a light scattering type photo electric smoke sensor to sense changes in air samples from its surroundings. An integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. The detector shall utilize digital filters to remove signal patterns that are not typical of fires. Each detector shall have twin red/green status LEDs. The red LED shall indicate alarm condition and green LED shall indicate normal.
      a. The detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature and humidity. The information shall be stored in the integral processor and transferred to the loop controller.
      b. Detector shall be programmable for different sensitivity during day and night periods.
      c. The detector shall be suitable for direct insertion into air ducts up to 3 ft. high and 3 ft. wide with air velocities up to 5,000 ft/min.
      d. The detector shall be rated for ceiling installation at a minimum of 30 foot centers.
      e. The percent smoke obscuration per foot alarm setpoint for the detector shall be field selectable to various sensitive settings ranging from 1.0% to 3.5%.
      f. Detector Mounting Bases
         1) Detector mounting bases shall be suitable for mounting on a standard 4” square electrical outlet box. The base shall contain no electronics, support all detector types and have the following minimum requirements:
         2) Removal of the respective detector shall not affect communications with other detectors.
         3) Terminal connections shall be made on the room side of the base. Bases which must be removed to gain access to the terminals shall not be acceptable.
         4) Capable of supporting a remote LED indicator and test station. Provide remote LED indicators and test stations as indicated on the Drawings.
      g. Detector Mounting Plates
         1) Provide detector mounting plate assemblies to facilitate mounting detectors for direct insertion into low velocity ductwork. The mounting plate shall be code gauge steel with corrosion resistant red enamel finish.
      h. Duct Smoke Detectors
         1) Air duct mounted smoke detectors shall be provided in the air supply stream of all central air handling equipment above 2000 cfm, i.e. Provide all necessary interface wiring for proper system operation.
         2) The duct smoke detector shall be UL listed per UL 268A specifically for use in air handling systems. The detector shall operate at velocities of 300-4000 ft./min. The detector housing shall be equipped with an integral mounting base. It shall be capable of local testing via magnetic switch or remote testing using a remote test station. The duct detector housing shall incorporate an airtight smoke chamber in
compliance with UL 268A. The housing shall be capable of mounting to either rectangular or round ducts without adaptor brackets. An integral filter system shall be included to reduce dust and residue effects on detector housing, thereby reducing maintenance and servicing. Sampling tubes shall be easily installed after the housing is mounted to the duct by passing through the duct housing. The housing shall have a red enamel finish.

3) For each duct smoke detector provide a remote LED indicator and test station to be mounted in a location indicated on the Drawings and approved by the local authority having jurisdiction.

4) Beam Type Smoke Detectors

Provide projected beam type smoke detectors. Then beam detectors shall be four wire 24 Vdc and powered from the control panel 4 wire smoke power source. This unit shall consist of a separate transmitter and receiver capable of being powered separately or together. This unit shall operate in either a short range of 30 to 100 ft. (9.14 to 30.4m) or a long range of 100 to 300 ft. (30.4 to 91.4m). The detector shall feature a bank of four alignment LEDs on both the receiver and transmitter that are used to ensure proper alignment without the use of special tools. The beam detector shall feature automatic gain control which will compensate for gradual signal deterioration from dirt accumulation on lenses. Ceiling or mount as shown on the plans. Testing shall be carried out using calibrated test filters. Provide an activated remote test station.

2.3 SYSTEM MODULES

A. Addressable intelligent modules shall support supervised Class A circuits. The modules shall be multi-function capable of field programming. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing diagnostic codes which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:
   1. Addressable intelligent modules shall support supervised Class A circuits. The modules shall be multi-function capable of field programming. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing diagnostic codes which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:
   2. Temperature: 32°F to 120°F (0°C to 49°C)
   3. Humidity: 0-93% RH, non-condensing
   4. Single Input Module
   5. Addressable intelligent single input modules shall be provided as required for the system configuration. The single input module shall provide one (1) supervised Class A input circuit. The module shall be suitable for mounting on 4” square electrical box. The single input module shall support the following input circuit types:
      a. Normally-Open Alarm Latching (Manual Stations, Smoke Detectors, etc.)
      b. Normally-Open Alarm Delayed Latching (Waterflow Switches)
      c. Normally-Open Active Non-Latching (Monitors, Fans, Dampers, Doors, etc.)
      d. Normally-Open Active Latching (Supervisory, Tamper Switches)

B. Dual Input Module
   1. Addressable intelligent dual input modules shall be provided as required for the system configuration. The dual input module shall provide two (2) supervisedCLASS A input circuits. The module shall be suitable for mounting on a standard 4” square electrical box. The dual input module shall support the following input circuit types:
      a. Normally-Open Alarm Latching (Manual Stations, Smoke Detectors, etc.)
      b. Normally-Open Alarm Delayed Latching (Waterflow Switches)
      c. Normally-Open Active Non-Latching (Monitors, Fans, Dampers, Doors, etc.)
      d. Normally-Open Active Latching (Supervisory, Tamper Switches)

C. Monitor Module
   1. Addressable intelligent monitor modules shall be provided as required for the system
configuration. The monitor module shall support one (1) supervised Class A normally-open active non-latching monitor circuit. The monitor module shall be suitable for mounting on a standard 4” square electrical box.

D. Waterflow/Tamper Module

1. Addressable intelligent waterflow/tamper modules shall be provided as required for the system configuration. The waterflow/tamper module shall support two (2) supervised Class A input circuits. Channel A shall support a normally-open alarm delayed latching waterflow switch circuit. Channel B shall support a normally-open active latching tamper switch. The waterflow/tamper module shall be suitable for mounting on a standard 4” square electrical box.

E. Single Input Signal Module

1. Addressable intelligent single input signal modules shall be provided as required for the system configuration. The single input signal module shall provide one (1) supervised Class A output circuit capable of supporting the operation of an audible/visual signal power selector and a telephone power selector with ring tone for fire fighter’s telephone. The module shall be suitable for mounting on a standard 4” square electrical box.

F. Dual Input Signal Module

1. Addressable intelligent dual input signal modules shall be provided as required for the system configuration. The dual input signal module shall provide a means to selectively connect one of two (2) signaling circuits to one (1) supervised output circuit. The dual input signal modules shall be capable of supporting the operation of an audible/visual signal power selector. The module shall be suitable for mounting on a standard 4” square electrical box.

G. Control Relay Module

1. Addressable intelligent control relay modules shall be provided as required for the system configuration. The control relay module shall provide one form “C” dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware. The control relay module shall be suitable for mounting on a standard 4” square electrical box.

H. Universal Class A Module

1. Addressable intelligent class A modules shall be provided as required for the system configuration. The universal class A module shall be capable of numerous operations. The module shall be suitable for mounting on a standard 4” square electrical box. The universal class A module shall support the following circuit types:
   a. Two (2) supervised Class A Normally-Open Alarm Latching.
   b. Two (2) supervised Class A Normally-Open Alarm Delayed Latching.
   c. Two (2) supervised Class A Normally-Open Active Non-Latching.
   d. Two (2) supervised Class A Normally-Open Active Latching.
   e. One (1) form “C” dry relay contact rated at 2 amps @ 24 Vdc.
   f. One (1) supervised Class A Normally-Open Alarm Latching.
   g. One (1) supervised Class A Normally-Open Alarm Delayed Latching.
   h. One (1) supervised Class A Normally-Open Active Non-Latching.
   i. One (1) supervised Class A Normally-Open Active Latching.
   j. One (1) supervised Class A 2-wire Smoke Alarm Non-Verified.
   k. One (1) supervised Class A 2-wire Smoke Alarm Non-Verified.
   l. One (1) supervised Class A 2-wire Smoke Alarm Verified
   m. One (1) supervised Class A 2-wire Smoke Alarm Verified
   n. One (1) supervised Class A Signal Circuit, 24Vdc @ 2A.
   o. One (1) supervised Class A Signal Circuit, 24Vdc @ 2A.

2.4 MANUAL PULL STATIONS

A. Addressable intelligent dual action, non-break glass type, key reset, semi-flush mounted manual pull stations shall be provided as indicated on the Drawings. The stations shall be of Lexan construction, finished in red with white molded raised letters “PULL IN CASE OF FIRE”. The station shall be suitable for mounting on a standard 4” square electrical box. The station shall have a
2.5 NOTIFICATION APPLIANCES

A. General
1. All appliances shall be UL listed for Fire Protective Service. All audible appliances, visual appliances and combination audible/visual appliances shall be capable of providing the equivalent facilitation which is allowed under the Americans with Disabilities Act Accessibility Guidelines (ADA/AG), and shall be UL 1971, and ULC S526 listed.
2. Audible Only Notification Appliances
3. Audible appliances shall be a mylar cone type speaker. Paper type cones are not acceptable. The rear of the speaker shall be completely sealed protecting the cone during and after installation. Speakers shall provide power taps at 1/4w, 1/2w, 1w, and 2w. Speakers shall provide UL confirmed 90 dBA sound output at 2w.
4. Audible appliances shall be provided with in/out wiring terminals.
5. Audible appliances shall be flush for ceiling mounted and flush/semi-flush for wall mounted as indicated on the Drawings. They shall have a white faceplate for ceiling mounting and red faceplate for wall mounting. They shall mount to a standard 4” square electrical outlet box.

B. Visual Only Notification Appliances
1. Visual appliances shall be a self-synchronized strobe. The strobe flashtube shall be enclosed in a rugged lexan lens with solid state circuitry. The strobe shall provide 15, 15/75, 30, 60 and 110 candela synchronized flash outputs. The strobe intensity selection shall be based on the installed location within the building.
2. Visual appliances shall be provided with in/out field wiring terminals.
3. Visual appliances shall have lens markings oriented for wall mounting where indicated on the Drawings. They shall have a red faceplate for flush/semi-flush wall mounting. They shall mount to a standard 4” square electrical outlet box.

C. Combination Audible/Visual Notification Appliances
1. Combination appliances shall be a combination of the audible and visual appliances specified previously. They shall have a red faceplate for flush/semi-flush wall mounting.
2. The majority, if not all, of the notification appliances shall be combination devices such that the visual and audible requirements of ADA shall be complied with. Visual notification appliances shall be located in all areas of common use, i.e. lobbies, hallways, restrooms, meeting/conference/assembly areas, break rooms, copy/fax/mail rooms, etc. Audible notification appliances shall produce a sound that exceeds the prevailing equivalent sound level in the room or space by at least 15dBA or exceeds any maximum sound level with a duration of 60 seconds by 5dBA, whichever is louder. Sound levels for alarm signals shall not exceed 120 dBA. It is the intent of the Drawings to show all devices that are required. The fire alarm system vendor/bidder shall provide all appliances shown and/or required by these specifications but it others are anticipated to be required the vendor/bidder shall qualify the provisions for the system making note of the additional cost for the anticipated additional requirements.

2.6 ANCILLARY DEVICES

A. Remote Relays
1. Multi-Voltage Control Relays
   a. Remote control relays shall be provided as required for the system configuration for connection to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be SPDT or DPDT, as required, and rated for 10 amperes at 115
Vac. A single relay may be energized from a voltage source of 12 Vdc, 12 Vac, 24 Vdc, 24 Vac, 115 Vac, or 230 Vac, as required. A red LED shall indicate the relay is energized. A metal enclosure shall be provided.

B. Manual Override Control Relays
   1. Remote control relays with a manual override shall be provided as required for the system configuration for connection to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be SPDT and rated for 10 amperes at 115 Vac or 24 Vdc. A single relay may be energized from a voltage source of 24 Vdc or 24 Vac. A red LED shall indicate the relay is energized.

C. Heavy Duty Power Relays
   1. Remote control relays shall be provided as required for the system configuration for connection to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be DPDT and rated for 30 amperes at 300 Vac or 2 HP motor load. A single relay may be energized from a voltage source of 24 Vac, 115 Vac, as required. A metal enclosure shall be provided.

2.7 ELECTROMAGNETIC DOOR HOLDERS
   A. Provide single or double door, floor or wall mounted electromagnetic door holder/release devices as indicated on the Drawings. The devices shall be rated for 24V ac/dc input. The devices shall be brushed zinc finished.

2.8 FIRE ALARM CABLE
   A. The fire alarm cable shall plenum rated and be UL listed and suitable for use as power limited fire protective signaling circuit cable in accordance with National Electric Code Article 760 (Fire Alarm Systems) and Article 725 (Class 1, Class 2 and Class 3 - Remote Control, Signaling and Power-Limited Circuits).
      1. Cable Construction
      2. Conductors shall be solid, soft annealed, uncoated copper.
      3. Insulation shall be 300 volt, 105°C polyvinylchloride.
      4. Two conductor, non-shielded cables shall be parallel; shielded and three or more conductors shall be cabled round.
      5. Shielding shall be mylar backed aluminum foil, helically wrapped to provide 100% coverage. A suitable copper drain wire shall be provided with shielded cables.
      6. Jacket shall be red, 105°C polyvinylchloride, rated 300 volt.
      7. Cable shall be plenum rated when installed in air handling plenums.
         a. In general, non-shielded cable is acceptable for use throughout except on voice circuits. All voice circuits shall utilize shielded, twisted pair cable.

PART 3 - EXECUTION
3.1 APPROVALS
   A. Complete fire alarm system drawings shall be issued to the Local Authority Having Jurisdiction for approval prior to the installation of the fire alarm system.

3.2 INSTALLATION
   A. Installation of the Fire Alarm System shall be in strict compliance with manufacturers recommendations. The entire system shall be installed in accordance with approved manufacturers manuals and wiring diagrams and as approved by the Local Authority Having Jurisdiction.
      1. Fire alarm cable shall be installed in conduit in areas of exposed structure and within inaccessible ceilings. Conduit shall also be provided from outlet boxes within walls stubbed up to accessible ceilings. Provide end bushings on conduit stub-ups. Cable only is acceptable in accessible ceilings.
      2. All conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation shall be included as part of the system. All junction box blank coverplates shall be labeled with a red “F.A.” for identification purposes.
      3. All wiring shall be color coded throughout.
4. The system shall be installed and fully tested under the supervision of trained manufacturer's representatives. The system shall be demonstrated to perform all the functions as specified.

END OF SECTION

THE CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS, SYSTEMS, EQUIPMENT, ITEMS, ARTICLES, OPERATIONS, AND/OR METHODS LISTED, IMPLIED, MENTIONED, OR SCHEDULED IN THE CONTRACT DOCUMENTS AND/OR NECESSARY AND/OR REQUIRED FOR THE SATISFACTORY COMPLETION OF THE WORK.

THE LISTING OF WORK, REQUIREMENTS, AND PRODUCTS IN THIS SECTION IS NOT INTENDED TO BE CONCLUSIVE. THE CONTRACTOR SHALL CHECK ALL OTHER PARTS OF THE CONTRACT DOCUMENTS AND SHALL PROVIDE ALL MISCELLANEOUS ITEMS OF WORK AND PRODUCTS NECESSARY FOR THE SATISFACTORY COMPLETION OF THE WORK DESCRIBED IN THE CONTRACT DOCUMENTS.
PART 1 - GENERAL

1.1 WORK INCLUDED
   A. Site excavation
   B. Shoring excavation

1.2 RELATED WORK
   A. Section 31 2321 – Backfilling

1.3 PROTECTION
   A. Protect trees, shrubs, lawns, rock outcropping and other features remaining as a portion of final landscaping.
   B. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from equipment and vehicular traffic.
   C. Protect above and below grade utilities which are to remain.
   D. In accordance with the Laws of the State of Texas and the U.S. Occupational Safety and Health Administration regulations, all trenches over five (5) feet in depth in either hard and compact or soft and unstable soil shall be sloped, shored, sheeted, braced or otherwise supported. Furthermore, all trenches less than five (5) feet in depth shall also be effectively protected when hazardous ground movement may be expected. An engineered trench safety plan shall be submitted prior to any excavation.
   E. In accordance with the U.S. Occupational Safety and Health Administration regulations, when employees are required to be in trenches four (4) feet deep or more, adequate means of exit, such as a ladder or steps, must be provided and located so as to require no more than 25 feet of lateral travel.
   F. If trench safety system details were not provided in the plans because trenches were anticipated to be less than five (5) feet in depth are in an area where hazardous ground movement is expected, all construction shall cease, the trenched area shall be barricaded and the Engineer notified immediately. Construction shall not resume until appropriate trench safety system details, as designed by a professional engineer, are submitted to and accepted by the City of Killeen, and, a bid item for implementation of trench safety systems is added to the contract by change order.
   G. Underpin adjacent structures which may be damaged by excavation work, including service utilities and pipe chases.
   H. Notify Architect/Engineer of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.
   I. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.
   J. Grade excavation top perimeter to prevent surface water run-off into excavation.

1.4 SHOP DRAWINGS
   A. The Contractor shall submit shop drawings for retention systems under provisions of Section 01 3300 and prepared under the direction of an Engineer registered in the State of Texas. No excavations deeper than 5'-0' will be permitted prior to approval of the retention system drawings.

PART 2 - PRODUCTS

2.1 MATERIALS
   A. Subsoil: Excavated material, graded free of lumps larger than 6 inches, rocks larger than 3 inches, and debris.

PART 3 - EXECUTION

3.1 PREPARATION
   A. Identify required lines, levels, contours and datum.
   B. Identify known underground utilities. Stake and flag locations.
C. Identify and flag surface and aerial utilities.
D. Notify utility company to remove and relocate utilities.
E. Maintain and protect existing utilities remaining which pass through work area.

3.2 EXCAVATION
A. Excavate subsoil required to completely remove the surficial soil layer from beneath the building. Refer to the structural plans for required depth if soil removal.
B. Excavation shall not interfere with normal 45 degree bearing splay of any foundation.
C. Hand trim excavation and leave free of loose matter.
D. Remove lumped subsoil, boulders, and rock.
E. Correct unauthorized excavation at no cost to Owner.
F. Fill over-excavated areas under structure bearing surfaces by filling with concrete in accordance with direction by Architect/Engineer.

3.3 FIELD QUALITY CONTROL
A. Provide for visual inspection of bearing surfaces.

3.4 PROTECTION
A. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.
B. Protect bottom of excavations and soil adjacent to and beneath foundation, from freezing.

3.5 SCHEDULE
A. Excavate to subgrade and limits of site improvements as indicated on drawings.

END OF SECTION 31 2316
PART 1 - GENERAL

1.1 WORK INCLUDED
A. Building perimeter backfilling to subgrade elevations.
B. Fill under slabs-on-grade.
C. Compaction requirements.
D. Site filling to subgrade elevation for parking and landscaping areas.

1.2 RELATED WORK
A. Testing Laboratory Services: Compaction requirements of backfill. Uniform General Conditions of the Contract, especially article 8.2
B. Section 31 2316 - Excavation.

1.3 REFERENCES
B. TSDHPT TEX-113-E Compaction Test.

1.4 TESTS
A. Tests and analysis of fill materials will be performed in accordance with ASTM D-698.

1.5 SAMPLES
A. Submit samples under provisions of the Uniform General Conditions of the Contract. Fill to testing laboratory, in air-tight containers.

PART 2 - PRODUCTS

2.1 SELECT FILL MATERIALS
A. Type A - Structural Fill: Crushed natural stone; with a maximum particle size of 2 inches in nominal diameter equal to TXDOT 2014 Specification Item 247, Type A, Grades 1 through 3.

2.2 COMMON FILL MATERIALS
A. Subsoil: Imported or reused from site; free of rocks larger than 3-inch size, and debris, P.I. < 15. GC, SC, CL, & combination soils (clayey gravels), as classified according to the Unified Soil Classification System (USCS), may be considered satisfactory for use as select fill materials at this site. Alternative select fill materials shall have a maximum liquid limit not exceeding 40, a plasticity index between 7 and 20, and a maximum particle size not exceeding 4 inch or one-half the loose lift thickness, whichever is smaller. In addition, if these materials are utilized, grain size analyses and Atterberg Limits must be performed during placement at a rate of one test each per 5,000 cubic yards of material due to the high degree of variability associated with pit-run materials.

PART 3 - EXECUTION

3.1 INSPECTION
A. Verify stockpiled fill to be reused is approved.
B. Verify foundation or basement walls are braced to support surcharge forces imposed by backfilling operations.
C. Verify areas to be backfilled are free of debris, snow, ice, or water, and ground surfaces are not frozen.

3.2 PREPARATION
A. When necessary, compact subgrade surfaces to density requirements for backfill material.
B. Cut out soft areas of subgrade not readily capable of in-situ compaction.
C. Exposed subgrades should be thoroughly proof rolled in order to locate and densify any weak, compressible zones. A minimum of 5 passes of a fully-loaded dump truck or a similar heavily-loaded piece of construction equipment should be used for planning purposes. The Geotechnical Engineer or his representative to document subgrade condition and preparation should observe Proof-rolling operations. Weak or soft areas identified during proof-rolling should
be removed and replaced with suitable, compacted on-site clays, free of organics, oversized materials, and degradable or deleterious materials.

### 3.3 BACKFILLING

A. Upon completion of the proof-rolling operations and just prior to fill placement of slab construction, the exposed subgrade should be moisture conditioned by scarifying to a minimum depth of 6 in. and recompacting to a minimum of 95 percent of the maximum density determined from TxDOT, Tex-114-E, Compaction Test. The moisture content of the subgrade should be maintained within the range of optimum moisture content to 3 percentage points above optimum moisture content until permanently covered.

B. Backfill areas to contours and elevations. Use unfrozen materials.

C. Backfill systematically, as early as possible, to allow maximum time for natural settlement. Do not backfill over porous, wet, or spongy subgrade surfaces.

D. Place and compact fill materials in continuous layers not exceeding 8 inches loose depth.

E. Employ a placement method so not to disturb or damage foundation damp-proofing.

F. Maintain optimum moisture content of backfill materials, within 2% to attain required compaction density.

G. Backfill against supported foundation walls. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.

H. Slope grade away from building minimum 2 inches in 10 feet unless noted otherwise.

I. Make changes in grade gradual. Blend slopes into level areas.

J. Remove surplus backfill materials from site.

K. Leave stockpile areas completely free of excess fill materials.

### 3.4 TOLERANCES

A. Top Surface of Backfilling: Plus or minus one inch.

### 3.5 FIELD QUALITY CONTROL

A. Compaction testing will be performed in accordance with ASTM D698 and under provisions of article 8.2 of the Uniform General Conditions of the Contract.

B. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.

### 3.6 SCHEDULE OF LOCATIONS

A. The paragraphs below identify location, fill material to be used (identified from lower to upper fill type), compacted thickness of each level, and compaction expressed as a percentage of maximum density and optimum moisture in comparison with ANSI/ASTM D698.

B. Interior Slab-On-Grade:

   1) Common fill up to 24 inches below the bottom of the slab, compacted to 95 percent.
   2) Type A Structural fill, 24 inches thick minimum compacted to 95 percent.

C. Exterior Side of Foundation Walls and Retaining Walls: common fill, to subgrade elevation, each lift compacted to 95 percent.

END OF SECTION
PART 1 - GENERAL

1.1 WORK INCLUDED
A. Materials, labor, and equipment necessary to provide compaction of existing or imported soils.
B. Areas included: building foundations, slabs, sidewalks and paving.

1.2 REFERENCES
A. Texas State Department of Highways and Public Transportation (TSDHPT) Test Method TEX-113-E
B. TSDHPT Test Method TEX-114-E
C. ANSI/ASTM D698

1.3 SUBMITTALS
A. Testing Laboratory shall submit 3 copies of Moisture/Density Curves for each soil type, one to the owner, and one to the architect and other to the contractor.
B. Testing Laboratory shall submit 3 copies of Field Density Reports for each test performed, one to the owner, and one to the architect and other to the contractor.

1.4 QUALITY CONTROL
A. Testing Laboratory shall be allowed to secure necessary samples of proposed soil types for testing to insure conformance to specification requirements.

PART 2 - PRODUCTS
NOT USED

PART 3 - EXECUTION
A. Control soil and fill compaction, Provide minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by Architect if soil density tests indicate inadequate compaction.
B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density, in accordance with applicable procedures.
C. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.
D. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
E. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.
F. Quality Control Testing During Construction: Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.
G. Perform field density tests in accordance with ASTM D698 and TDH TEX-113-E, as applicable.
H. If field tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect.
I. Pavements: Perform at least one field density test of subgrade for every 2,000 sq. ft. of paved area or building slab, but in no case fewer than three tests. In each compacted fill layer, perform one field density test for every 2,000 sq. ft. of overlaying paved area, but in no case fewer than three tests.
J. If in opinion of Architect, based on testing service reports and inspection, subgrade or fills that have been placed are below specified density, perform additional compaction and testing until specified density is obtained, at no expense to owner.

END OF SECTION 31 2323
APPENDICES

GEO-TECHNICAL REPORT
ON SITE SEWAGE FACILITIES REPORT
LEAD PAINT ABATEMENT PROTOCOL
MOLD REMEDIATION PROTOCOL
MEG GEOTECHNICAL ENGINEERING REPORT

PROPOSED
MONAHANS SANDHILLS STATE PARK RENOVATIONS

MONAHANS, WARD COUNTY, TEXAS
GEOTECHNICAL ENGINEERING REPORT
FOUNDATION RECOMMENDATIONS
PROPOSED MONAHANS SANDHILLS STATE PARK RENOVATIONS
MONAHANS, WARD COUNTY, TEXAS

Prepared For
David Negrete, AIA
Principal and Partner
Negrete & Kolar Architects LLP

MEG Report No. 04-20-29110

August 21, 2020
August 21, 2020

David Negrete, AIA
Principal and Partner
Negrete & Kolar Architects LLP
11820 N. IH 78753
Austin, Texas 78753
(512)474-6526
dnegrete@nekoarch.com

Subject: Geotechnical Engineering Report
MEG Report No. 04-20-29110
Foundation Recommendations
Proposed Monahans Sandhills State Park Renovations
Monahans, Ward County, Texas

Dear Mr. Negrete (CLIENT):

Millennium Engineers Group, Inc. is pleased to submit the enclosed geotechnical engineering report that was prepared for the above subject project. This report addresses the procedures and findings of our geotechnical engineering study. Our recommendations should be incorporated into the design and construction documents for the proposed development.

We want to emphasize the importance that all our recommendations presented in this report and/or addendums to this report be followed. We look forward to continuing our involvement in the project by providing construction monitoring in accordance with the report recommendations and materials testing services during construction. We strongly recommend that we be a part of the preconstruction meeting to address any specific issues that are pertinent to this project.

Thank you for the opportunity to be of service to you in this phase of the project and we would like the opportunity to assist you in the upcoming phases of the project. If you have any questions, please contact our office at the address, telephone, fax or electronic address listed below.

Cordially,

Millennium Engineers Group, Inc.
TBPE Firm No. F-3913

Raul Palma, P.E.
President

Amos Emerson, EIT

Dr. Thang Pham, Ph.D., P.E.

The seal appearing on this document was authorized by Raul Palma, P.E. 65656 on August 21, 2020. Alteration of a sealed document without proper notification to the responsible engineer is an offence under the Texas Engineering Practice Act

Cc: 1 Original and PDF Document

MEG Project No.: 04-20-19110
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APPENDIX C - BORING LOGS AND PROFILE .................................................................
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APPENDIX G - AXIAL CAPACITY & ALLOWABLE UPLIFT RESISTANCE CHARTS ....
APPENDIX H - LABORATORY AND FIELD PROCEDURES .........................................
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1.0 INTRODUCTION

Millennium Engineers Group, Inc. (MEG) has completed and is pleased to submit this document that presents our findings as a result of a geotechnical engineering study of this project to our client. The project site is located approximately 800 feet to the northwest on State Highway and Interstate 20 Frontage Road Intersection Park Road 41 located near the Monahans State Park Visitor Section in Monahans, Ward County, Texas. The project location is shown on the Project Location Map, found in the Appendix section of this report. This report briefly describes the procedures utilized during this study and presents our findings along with our recommendation, for foundation design and construction considerations.

Our scope of services for the project was outlined in MEG proposal No. 04-20-112G, dated July 7, 2020 and approved by David Negrete, AIA on July 7, 2020.

2.0 PROJECT DESCRIPTION

It is our understanding that the proposed site will accommodate the construction of a new restroom facility along with a pavilion area. It is also our understanding that the proposed State Park development will consist of a one (1) story structure. The site construction for the proposed restroom facility is anticipated to be on concrete pier foundation and the proposed pavilion structure is anticipated to be on a spread footing provided expansive soil related movements will not impair the performance of the structure.

3.0 SCOPE AND LIMITATIONS OF STUDY

This engineering report has been prepared in accordance with accepted geotechnical engineering practices currently exercised by geotechnical engineers in this area. No warranty, expressed or implied, is made or intended. This report is intended for the exclusive use by the client and client’s authorized project team for use in preparing design and construction documents for this project only. This report may only be reproduced in its entirety for inclusion in construction documents. This report in its entirety shall not be reproduced or used for any other purposes without the written consent of our firm. This report may not contain sufficient information for purposes of other parties or other uses and is not intended for use in determining construction means and methods.

The recommendations presented in this report are based on data obtained from the soil borings drilled at this site and our understanding of the project information provided to us by our client and other project team members, and the assumption that site grading will result in only minor changes in the existing topography. Subsurface soil conditions have been observed and interpreted at the boring locations only.

This report may not reflect the actual variations of the subsurface conditions across the subject site. It is important to understand that variations may occur due to real geologic conditions or previous uses of the site. The nature and extent of variations across the subject site may not become evident until specific design locations are identified and/or construction commences. The construction process itself may also alter subsurface
conditions. If variations appear evident at the time during the design phase and/or construction phase, we should be notified immediately to determine if our opinions, conclusions and recommendations need to be reevaluated. It may be necessary to perform additional field and laboratory tests and engineering analyses to establish the engineering impact of such variations. These services are additional and are not a part of our project scope.

The engineering report was conducted for the proposed project site described in this report. The conclusions and recommendations contained in this report are not valid for any other project sites. If the project information described in this report is incorrect, is altered, or if new information becomes available, we should be retained to review and modify our recommendations. These services are additional and are not a part of our project scope.

Our scope of services was limited to the proposed work described in this report, and did not address other items or areas. The scope of our geotechnical engineering study does not include environmental assessment of the air, soil, rock or water conditions on or adjacent to the site. No environmental opinions are presented in this report. If the client is concerned with environmental risk at this project site, the client should perform an environmental site assessment.

If final grade elevations are significantly different from existing grades at the time of our field activities (more than plus or minus one (1) foot), our office should be informed about these changes. If desired, we will reexamine our analyses and make supplemental recommendations.

4.0 FIELD EXPLORATION PROCEDURES

Subsurface conditions at the subject site were evaluated by two (2) 40-foot soil borings and one (1) 20-foot soil borings. The Borings were drilled at the locations shown on the Borings Location Map, found in the Appendix section of this report. This location is approximate and distances were measured using a measuring wheel, tape, angles, and/or pacing from existing references. The structural soil borings were drilled in general accordance with American Society of Testing Materials (ASTM) D 420 procedures.

As part of our sampling procedures, the samples were collected in general conformance with ASTM D 1586 procedures. Representative portions of the samples were sealed in containers to reduce moisture loss, identified, packaged, and transported to our laboratory for subsequent testing. In the laboratory, each sample was evaluated and visually classified by a member of our Geotechnical Engineering staff. The geotechnical engineering properties of the strata were evaluated by a series of laboratory tests. The results of the laboratory and field-testing are tabulated on the boring logs and Summary of Soil Sample Analyses which are found in the Attachments section of this report.

Standard penetration test results are noted on the boring logs as blows per 12 inches of penetration. Three 6 inch increments are performed for each standard penetration test. The sum of the blows for the final two 6 inch increments is considered the "standard
penetration resistance value” or “N-value.” Where hard or very dense materials were encountered, the tests are terminated as follows: (1) when a total of 50 blows have been applied in any of the 6 inch increments, or (2) when a total of 100 blows have been applied, or (3) when there is no observed advance of the sampler in the application of 10 successive blows. The boring logs in the case of hard or very dense materials will be noted as follows: 50/3”, where 50 is the number of blows applied in 3 inches of penetration, or 100/7½” where 100 is the number of blows applied in a total of 7 ½ inches of penetration, or 10/0”, where 10 is the number of blows applied in 0 inches of penetration.

Samples will be retained in our laboratory for 30 days after submittal of this report. Other arrangements may be provided at the request of the Client.

5.0 GENERAL SITE CONDITIONS

5.1 Site Description

The project site is located approximately 800 feet to the north west on State Highway and Interstate 20 Frontage Road Intersection Park Road 41 located near the Monahans State Park Visitor Section in Monahans, Ward County, Texas. The project location is shown on the Project Location Map, found in the Appendix section of this report. At the time of our field operations, the subject site can be described as a developed tract of land. The general topography of the site is rolling hills consisting of sand with a visually estimated vertical relief of more than 5 feet. Surface drainage is visually estimated to be fair.

5.2 Site Geology

According to the Soil Survey of Ward County, Texas, published by the United States Department of Agriculture – Soil Conservation Service, the project site appears to be located within the Kermit soil association.

- The Kermit series consists of very deep, excessively drained soils formed in eolian sands. Kermit soils are on sandy plains with slopes of 0 to 12 percent. Mean annual precipitation is about 12 inches and mean annual temperature is about 63 degrees F. The corresponding soil symbol is KD, Kermit-Dune land association hummocky.

5.3 Subsurface Conditions

On the basis of our borings, three (3) generalized strata that possess similar physical and engineering characteristics can describe the subsurface stratigraphy at this site. Table 5.1 summarizes the approximate strata range in our boring logs. These were prepared by visual classification and were aided by laboratory analyses of selected soil samples. The lines designating the interfaces between strata on the boring logs represent approximate boundaries. Transitions between strata may be gradual details for each of the borings can be found on the boring logs in the appendix of this report.
Table 5.1. Approximate Subsurface Stratigraphy Depths.

<table>
<thead>
<tr>
<th>Stratum</th>
<th>Range in Depth, ft(^1)</th>
<th>Stratum Description(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0 – 10</td>
<td>SAND, tan, dry, very loose to medium dense</td>
</tr>
<tr>
<td>II</td>
<td>10 – 20</td>
<td>SAND, tan to white, dry, medium dense</td>
</tr>
<tr>
<td>III</td>
<td>20 – 40</td>
<td>SAND, tan to white, dry, very dense</td>
</tr>
</tbody>
</table>

Note 1: The stratum thickness and depths to strata interfaces are approximate. Our measurements are rounded off to the nearest foot increment and are referenced from ground surface at the time of our drilling activities. Subsurface conditions may vary between the boring locations.

5.4 Groundwater Conditions

The dry auger drilling technique was used to complete the soil borings in an attempt to observe the presence of subsurface water. During our drilling operations we did not encounter the groundwater table below natural ground elevation for short term conditions. Moisture content test did not exhibit high moisture content below natural ground elevation and were classified as relatively dry. It should be noted that the groundwater level measurements recorded are accurate only for the specific dates on which measurement were obtained and does not show fluctuations throughout the year.

Fluctuations in Groundwater levels are influenced by variations in rainfall and surface water run-off from season to season. The construction process itself may also cause variations in the groundwater level. If the subsurface water elevation is critical to the construction process the contractor should check the subsurface water conditions just prior to construction excavation activities.

Based on the findings in our borings and on our experience in this region, we believe that groundwater seepage may not be encountered during site earthwork activities. If groundwater seepage is encountered during site earthwork activities, it may be controlled using temporary earthen berms and/or conventional sump-and-pump dewatering methods.

6.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS

6.1 General

The analysis and recommendations presented in this report are applicable specifically to the proposed foundation structure. The data gathered from both the field and laboratory testing programs on soil samples obtained from the borings was utilized to establish geotechnical engineering parameters to develop recommendations for the proposed structure. The foundation system(s) considered in this report to provide support for the proposed structure must meet two independent criteria. One of the criteria is that the movement below the foundation structure due to compression (consolidation) or expansion (swell) of the underlying soils must be within tolerable limits. This criterion is
addressed in the Soil Related Movements section of this report. The other criterion is that the dead and live loads must be distributed appropriately and the foundation structure designed with an acceptable factor of safety to minimize the potential for bearing capacity failure of the underlying soils.

Geotechnical and structural engineers in this general area consider soil movements or Potential Vertical Rise (PVR) of approximately one (1) inch or less to be within acceptable structural design tolerances for most structures but may be different depending on structure use and the desired performance of the foundation. Therefore, movements of the underlying soils are not eliminated and thus one should expect a slab foundation structure to exhibit differential vertical movements. However, structural engineers design slab foundations for the expected magnitude of soil movements without failure of the structure. More stringent soil movement criteria may be established but the owner should consider the exponential increase in cost required to design and construct a structure for such soil movements. Data obtained in this study indicate that the soils at this site have strength characteristics capable of supporting the foundation and structure if designed appropriately. Stratum I, II, and III are composed of SAND and they have no potential to exhibit volumetric changes (contraction and expansion). The potential for soil volumetric changes is dependent on variations in moisture contents of the underlying soils. Based on this data, this site is suitable for a slab foundation provided the subgrade is modified in accordance with the recommendations established in this report to reduce the potential for these soil volumetric changes.

6.2 Soil-Related Movements

The anticipated ground movements due to swelling of the underlying soils at this site were estimated for slab foundation construction using the Texas Department of Transportation (TxDOT) procedures of test method TEX-124-E for determining Potential Vertical Rise (PVR). A PVR value of less than one (1) inch was estimated for the stratigraphic conditions encountered in our subsurface borings. A surcharge of 1 pound per square inch for the concrete slab, an active zone of 15 feet, and dry subsurface moisture conditions were assumed in estimating the above PVR values.

The following methods are generally acceptable for use in modifying the subgrade to reduce the potential for soil movements, volumetric changes, and to provide a stable platform below the foundation structure.

- Excavate expansive clay soils and replace with select fill.
- Chemical injection of expansive clay soils.
- A combination of methods 1 and 2.

The method to be used is dependent on specific site conditions. As of the date of this report the CLIENT/OWNER has not provided the proposed FFE. We recommend that the project civil engineer evaluate the proposed FFE with our recommendations to ensure that the subgrade modifications presented in the report are not diminished or compromised. Adding select fill is generally the most cost effective method for reducing the potential for soil related movements and to provide a stable platform. Therefore, we
only discuss this method in this report but we can provide details for the other methods if requested.

Based on the data obtained, the assumed FFE of natural ground elevation, information provided by our client and our analysis of the site, we recommend the following modification (Table 6.1. Subgrade Modifications) of the subgrade at this area to accomplished finish floor elevation of the subgrade at this site. This method will maintain the potential for soil related movements to an approximate PVR value of less than one (1) inch, which is generally desired for projects of this type.

Table 6.1.a  Subgrade Modifications (Restroom Building)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>See and adhere to the Site Preparation Recommendations section of this report.</td>
</tr>
<tr>
<td>2</td>
<td>Excavate existing soils to a depth of four (4) feet below natural ground elevation in accordance with the Site Preparation Recommendations section of this report.</td>
</tr>
<tr>
<td>3</td>
<td>Condition and compact twelve (12) inches of subgrade below excavated soils in accordance with the Site Preparation Recommendations section of this report.</td>
</tr>
<tr>
<td>4</td>
<td>Place select fill, (for a total of four (4) feet select fill) condition and compact up to the proposed FFE in accordance with the Select Fill Recommendations section of this report.</td>
</tr>
</tbody>
</table>

Table 6.1.b  Subgrade Modifications (Pavilion Area)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>See and adhere to the Site Preparation Recommendations section of this report.</td>
</tr>
<tr>
<td>2</td>
<td>Excavate existing soils to a depth of two (2) feet below footing bearing elevation in accordance with the Site Preparation Recommendations section of this report.</td>
</tr>
<tr>
<td>3</td>
<td>Condition and compact twelve (12) inches of subgrade below excavated soils in accordance with the Site Preparation Recommendations section of this report.</td>
</tr>
<tr>
<td>4</td>
<td>Place select fill, (for a total of two (2) feet select fill) condition and compact up to the proposed footing bearing elevation in accordance with the Select Fill Recommendations section of this report.</td>
</tr>
</tbody>
</table>
The PVR method of estimating expansive, soil-related movements is based on empirical correlations utilizing the measured plasticity indices and assuming typical seasonal fluctuations in moisture content. If desired, other methods of estimating expansive, soil-related movements are available, such as estimations based on swell tests and/or soil-suction analyses. However, the performance of these tests and the detailed analyses of expansive, soil-related movements were beyond the scope of the current study. It should also be noted that actual movements can exceed the calculated PVR values as a result of isolated changes in moisture content (such as leaks, landscape watering, etc.) or if water seeps into the soils to greater depths than the assumed active zone depth due to deep trenching and/or excavations.

6.3 Flatwork Recommendations

The ground exposed near the proposed Restroom Building should be sloped away for at least 10 feet beyond the perimeter. As part of the structure’s maintenance program, the grading around the building should be inspected, adjusted and verified for accuracy and effective drainage. Flatworks will be subjected to post construction movement. Maximum grades shall be utilized to avoid ponding of water. Concrete sidewalks and driveways thicknesses and reinforcement shall be completed as shown on the plans as prepared by others.

Table 6.2. Subgrade Modifications (Flatwork)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>See and adhere to the Site Preparation Recommendations section of this report.</td>
</tr>
<tr>
<td>2</td>
<td>Flatwork placed shall be bedded with at least six (6) inches of select fill condition and compact up to the proposed FFE in accordance with the Select Fill Recommendations section of this report. The subgrade shall be excavated and shaped to the lines and grades shown on the plans as prepared by others.</td>
</tr>
</tbody>
</table>

6.4 Conventional Spread Footing Foundation Design Criteria

We recommend the following soil bearing pressures, and dimensional criteria for the pavilion. These recommendations ensure proper utilization of soil bearing capacity of continuous beam sections in the spread footing foundation and reduce the potential of water migration from the outside to beneath the foundation. For structural considerations foundation may need to be greater and should be evaluated and designed by the structural engineer. Where concentrated load areas are present the grade beams or slab may be thickened and widened to serve as spread footings. Soil bearing pressures dimensional criteria are as follows:
Table 6.3. Bearing Criteria (Pavilion Area)

<table>
<thead>
<tr>
<th>Spread Footings (square)</th>
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</thead>
<tbody>
<tr>
<td>Minimum depth below finished grade:</td>
<td>24 inches</td>
</tr>
<tr>
<td>Maximum depth below finished grade:</td>
<td>36 inches</td>
</tr>
<tr>
<td>Maximum width:</td>
<td>60 inches</td>
</tr>
<tr>
<td>Maximum allowable bearing pressure:</td>
<td>2,400 psf</td>
</tr>
</tbody>
</table>

The above-presented maximum allowable bearing pressures will provide a factor of safety of 3 with respect to the design soil strengths. For a foundation structure designed and constructed in accordance with the recommendations of this report, it is anticipated that total settlements will be in the order of one (1) inch or less. If lower anticipated total settlements are required for this project further mitigation may be required and MEG must be consulted for further recommendations.

Furthermore, the above design parameters are contingent upon the fill materials (if utilized) being selected and placed in accordance with the recommendations presented in the Select Fill Recommendations section of this report. Should select fill selection and placement differ from the recommendations presented herein, MEG should be informed of the deviations in order to reevaluate our recommendations and design criteria.

Excavations for spread footing foundations should be performed relatively clean and with an undisturbed bearing area. The bottom 6 inches of the excavation should be performed using a flat plate excavation bucket. The excavations should be neatly excavated. No foreign debris or undisturbed soil should be left in the footing bottom. Should there be any abundance of foreign debris or disturbed soil found, it may be necessary to re-assess the fill site of its bearing capacity suitability. If the bearing area is found to be disturbed, the bearing area will require preparation and compaction for the entire depth of the disturbance in accordance with the Site Preparation and/or the Select Fill sections of this report.

The bearing surface of the spread footings should be evaluated after excavation and immediately prior to concrete placement. We recommend that footing inspections be performed by a representative of MEG. The required inspections shall include inspecting for clean, dry (the moisture content should be within limits specified by the appropriate section in this report,) and undisturbed footing bottom, depth of footing, clearances from sides and size and spacing of reinforcing steel. Test results shall comply with the recommendations of this geotechnical report and shall be verified by an on-site representative of MEG.

Over excavation, if necessary, for compacted backfill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of over excavation depth below footing base elevation. The over excavation should then be backfilled up to the footing base elevation select fill placed in lifts of 8 inches or less in loose thickness and prepared and compacted in accordance with the Site Preparation
and/or the Select Fill sections of this report. Equipment should not be operated and materials should not be placed or stockpiled within a horizontal distance equal to the excavation depth from the edge of the excavation. Excavations should not be placed next to existing structures or buried utilities/structures closer than a horizontal distance equal to the excavation depth unless some form of protection for the facilities is provided.

Water should not be allowed to accumulate at the bottom of the foundation excavation. Proper barriers such as berms or swales should be placed to divert any surface runoff away from excavations. To reduce the potential for groundwater seepage into the excavations and to minimize disturbance to the bearing area, we recommend that steel and concrete be placed as soon as possible after the excavations are completed, properly prepared and cleaned. Excavations should not be left open overnight.

### 6.5 Soil Properties

Lateral loads on the retaining wall structure may be resisted by passive earth pressure developed against the embedded portion of the foundation and by frictional resistance between the bottom of the wall and the supporting subgrade soils. For footings bearing on the sandy soils, a frictional coefficient of 0.35 may be used to evaluate sliding resistance developed between the gabion wall and the subgrade soil.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Soil Friction Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retaining Wall Structure</td>
<td>0.35</td>
</tr>
</tbody>
</table>

### 6.6 Lateral Earth Pressures

Presented below are at-rest, active and passive earth pressure coefficients for various backfill types adjacent to below-grade walls or site retaining walls. At-rest earth pressures are recommended in cases where little wall yield is expected (such as structural below-grade walls). Active earth pressures may be utilized in cases where the walls can exhibit a certain degree of horizontal movements (such as cantilevered retaining walls).
Table 6.5. Lateral Earth Pressures

<table>
<thead>
<tr>
<th>Backfill Type</th>
<th>Estimated Total Unit Weight (pcf)</th>
<th>Angle of Internal Friction $\phi$, deg</th>
<th>Active Condition</th>
<th>Passive Condition</th>
<th>At rest Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washed Gravel</td>
<td>135</td>
<td>33</td>
<td>0.29</td>
<td>3.39</td>
<td>0.45</td>
</tr>
<tr>
<td>Crushed Limestone</td>
<td>145</td>
<td>38</td>
<td>0.24</td>
<td>4.20</td>
<td>0.38</td>
</tr>
<tr>
<td>Clean Sand</td>
<td>120</td>
<td>30</td>
<td>0.33</td>
<td>3.00</td>
<td>0.50</td>
</tr>
</tbody>
</table>

The above values do not include a hydrostatic or ground-level surcharge component. To prevent hydrostatic pressure build-up, retaining walls should incorporate functional drainage (via free-draining aggregate or manufactured drainage mats) within the backfill zone. The effect of surcharge loads, where applicable, should be incorporated into wall pressure diagrams by adding a uniform horizontal pressure component equal to the applicable lateral earth pressure coefficient times the surcharge load, applied to the full height of the wall. The structure walls should be designed for hydrostatic pressures if drainage cannot be provided. Ports/weepholes for release of hydrostatic pressure need to be provided during construction. The ports/weepholes should be filled with filter cloth to reduce the loss of soil fines.

The compactive effort should be controlled during backfill operations adjacent to walls. Over compaction can produce lateral earth pressures in excess of at-rest magnitudes. Compaction levels adjacent to walls should be maintained between 95 and 100 percent of standard proctor (ASTM D 698) maximum dry density.

All retaining walls shall be provided with a subdrain system in order to minimize the potential for hydrostatic pressure buildup behind the proposed retaining walls. A wall drain system (consisting of freely-drained aggregate or manufactured drainage mat, along with outlet piping) is recommended for collection and removal of surface water percolation behind the walls. Proper control of surface water percolation will help to prevent buildup of higher wall pressures. In unpaved areas, the final 12 inches of backfill should preferably consist of clayey soils to help reduced percolation of subsurface water in to the backfill.

The lateral earth pressures recommended above for retaining wall assume that a permanent drainage system will be installed so that external water pressure will not be developed against the walls. If a drainage system is not provided, the walls should be designed to resist an external hydrostatic pressure due to water in addition to the lateral earth pressure. We do not recommend that retaining walls be designed allowing hydrostatic pressure to build up because other factors such as bearing capacity and shear strength of the soils may be significantly impacted and slope stability compromised. It is also important that behind the retaining wall there exist no barriers to the free flow of moisture into and through the wall drain system.
6.7 Soil Erosion Factors

The analysis of soil erosion factors is crucial and to be considered along degraded hill slopes. Having a better understanding of the erosion of the soil will help mitigate the natural interventions of the project site. Better erosion control methods by shaping will minimize soil movement and unnecessary reshaping. The soil erosion factors that are considered are as follows: the K Factor (Rock Free) indicates erodibility of the fine-earth fraction, the K Factor (Whole Soil) indicates erodibility of the whole soil, the T Factor indicated the maximum average annual rate of soil erosion by wind and/or water, the Wind Erodibility Group rating that are the most susceptible to wind erosion, and the Wind Erodibility Index is a value of tons per acre per year that identifies the soil's susceptibility to wind erosion. **The soils at this site are considered low erodible by sheet or rill water erosion.** On the other hand, the Wind Erodibility Group rating of 1 indicates that they surface soils are very susceptible to wind erosion as presented in the Erosion Factor Maps that are found in the Appendix section of this report.

7.0 PIER FOUNDATION RECOMMENDATIONS

7.1 Straight Sided Concrete Piers

Items influencing the type of foundation selected for the proposed Monahans Sandhills State Park include the design axial and lateral foundation loads, the presence of poorly graded sand. More specifically, the final pier dimensions, particularly to include the required length of pier, will be determined based on the foundation design loads, the depth of the active zone, the potential uplift force imposed by the soils within the active zone and the available side friction capacity and end bearing capacity allotted to the subsurface stratigraphy. Straight-sided piers bearing at a minimum elevation of 15 feet below natural ground may support vertical loads for the proposed structure. **The poorly graded sand at this site may require that the concrete piers to be placed with steel casing to prevent collapse of the shaft boring walls.** Based on our depth of exploration at an elevation of approximately 40 feet below natural ground and the type of structures, pier depths should not exceed a depth of 35 feet below natural ground. The allowable capacities are provided in an attachment in the Appendix section of this report, titled *Allowable Axial Capacity.* For straight sided piers, the contribution of the soils for the top 5 feet of soil embedment and for a length equal to at least 1 pier diameter from the bottom of the shaft should be neglected in the determination of friction capacity. The recommended design parameters include a factor of safety of 2 for skin friction and of 3 for end bearing. The minimum embedment depth was selected to locate the pier base within a specified desired bearing stratum. If the piers are subject to water action, scour may occur. If this is the case, the pier length should be referenced from the level of the maximum scour depth. Likewise, the LPILE analysis should neglect the contribution of soils down to the maximum scour depth.
7.2 Uplift Forces

Within the active zone the concrete piers may be subjected to potential uplift forces. Alternate drying and wetting conditions of the expansive soils surrounding the concrete pier create these uplift forces. The uplift force acting on the piers may be estimated by the following relationship:

\[
\text{Uplift force (tons)} = 0.0 \times \text{shaft diameter (feet)} \text{ (with subgrade modifications)}
\]

Other uplift forces due to other factors may need to be taken into consideration.

7.3 Allowable Uplift Resistance

The potential uplift forces that may be created by the swelling soils may be resisted by the dead load of the concrete pier plus the allowable uplift resistance provided by the friction between the soil and pier interface. The allowable uplift resistance are provided in an attachment in the Appendix section of this report, titled Allowable Uplift Resistance. These values have been estimated with a factor of safety of two (2). Design requirements for reinforcing and for pier penetration derived from compression or uplift loading for the structure is usually sufficient to overcome any effects of expansive soils. However, we recommend that the cross sectional area of the reinforcing steel should not be less than one (1) percent of the gross cross sectional area of the drilled pier shaft. The reinforcing steel should extend from the top to the bottom of the shaft to resist axial tension forces. The final reinforcing requirements should be determined by the project structural engineer.

7.4 Pier Lateral Criteria

Lateral pile analysis including capacity, maximum shear, and maximum bending moment should be evaluated by the project structural engineer using LPILE or similar software. In the following table, MEG presents geotechnical input parameters for the encountered soils. Please note that the depths to the top and bottom of each layer were interpreted using the data at the explored boring locations and layer boundaries as shown on the boring logs:
Table 7.1. Drilled Pier Geotechnical Input Parameters for LPILE Analysis

<table>
<thead>
<tr>
<th>Depth</th>
<th>Material</th>
<th>$Y_e$</th>
<th>$C_u$</th>
<th>$\phi$</th>
<th>$K$</th>
<th>$\theta_{50}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 5</td>
<td>SAND</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Neglect contribution</td>
</tr>
<tr>
<td>5 to 10</td>
<td>SAND</td>
<td>115</td>
<td>-</td>
<td>29</td>
<td>K=25</td>
<td>-</td>
</tr>
<tr>
<td>10 to 20</td>
<td>SAND</td>
<td>120</td>
<td>-</td>
<td>31</td>
<td>K=90</td>
<td>-</td>
</tr>
<tr>
<td>20 to 35</td>
<td>SAND</td>
<td>125</td>
<td>-</td>
<td>37</td>
<td>K=225</td>
<td>-</td>
</tr>
</tbody>
</table>

Where: $Y_e =$ Effective Soil Unit Weight,pcf  
$C_u =$ Undrained Soil Shear Strength, psf  
$\phi =$ Undrained angle of internal friction, degrees  
$\theta_{50} =$ 50% strain value  
$K =$ Modulus of subgrade reaction, pci  
$K_s =$ Modulus of subgrade reaction (static loading), pci  
$K_c =$ Modulus of subgrade reaction (cyclic loading), pci

7.5 Spacing for Concrete Piers

Concrete pier spacing should be at least three (3) shaft diameters from edge to edge to eliminate any reduction in load carrying capacity of the individual piers.

When utilizing a pier group and the pier spacing is less than three (3) times the pier diameter from edge to edge, the following reduction factors for bearing capacity and skink friction shall apply:

- The minimum recommended pier spacing shall be one and a half (1.5) times the pier diameter from edge to edge. The reduction factor for this spacing is 0.5.
- The reduction factor for pier spacing less than three (3) times the pier diameter but more than one and a half (1.5) times the pier diameter from edge to edge shall be linearly interpolated from the reduction factor values provided herein.

For straight-sided concrete piers, the total settlements based on the bearing pressures are estimated to generally be in the order of one (1) inch or less for properly designed and constructed drilled piers. At this site, the underlain soils exhibit low shear strengths and potential settlements can best be estimated when site grading, foundation dimensions and loads have been established. Most of the settlement beneath each individual pier should occur during the construction phase. Differential settlement between piers can be expected and should be in the order of 50 to 75 percent of the total pier settlement. For properly designed and constructed piers we estimate the differential settlement between adjacent piers to be in the order of three-fourths ($\frac{3}{4}$) of an inch. A detailed estimate of settlement is outside the scope of this service report. The quality of construction will affect the settlement process of drilled piers more than the soil-structure interaction. Poor drilled pier construction could result in settlements significantly higher than what we have estimated in this report. Utilizing soil-bearing pressures higher than
the allowable values presented in this report can also produce significantly higher settlements at individual piers and differential settlement between adjacent piers.

7.6 IBC Site Classification and Seismic Design Coefficients

Section 1613 of the International Building Code (2012) requires that every structure be designed and constructed to resist the effects of earthquake motions, with the seismic design category to be determined in accordance with Minimum Design Loads for Buildings and Other Structures / ASCE 7. Site classification according to the ASCE 7 is based on the soil profile encountered to 100-foot depth. The stratigraphy at the site location was explored to a maximum of 40-foot depth as per Client scope of services for this study. Site classification is based on the available information from this study.

On the basis of the site class definitions included in ASCE 7, Table 20.3-1 and the encountered generalized stratigraphy, we characterize the site as Site Class D.

Seismic design coefficients were determined using the on-line software, OSHPD Seismic Design Maps accessed at (http://seismicmaps.org). Analyses were performed considering the 2012 International Building Code. Input included zip code 79756 and Site Class C. Seismic design parameters for the site are summarized in the following table:

<table>
<thead>
<tr>
<th>Site Classification</th>
<th>F_a</th>
<th>F_v</th>
<th>S_s</th>
<th>S_1</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>1.6</td>
<td>2.4</td>
<td>0.167g</td>
<td>0.041g</td>
</tr>
</tbody>
</table>

Where:

F_a = Site coefficient  
F_v = Site coefficient  
S_s = Mapped spectral response acceleration for short periods  
S_1 = Mapped spectral response acceleration for a 1-second period

7.7 Global Slope Stability Analysis

Global slope stability analysis was completed for the Monahan State Park Renovations proposed restroom facility that is anticipated to be on concrete pier foundation. The basis of this analysis is to determine the factor of safety such that the soil mass must be safe against slope failure on any surface across the slope. The global stability of the slope in this project was performed using Plaxis 2D software through the finite element method (FEM). Soil strength parameters used for the evaluation of the global stability were through the soil characteristics where correlations were made. In accordance with TxDOT 2020 Geotechnical Manual Section 2 for global stability of a slope, a minimum factor of safety of 1.3 is required for both the long-term drained condition and the short term undrained condition, for slope or walls that support abutment, buildings, critical utilities, or for other low tolerance failure, a minimum factor of safety of 1.5 is to be utilized. The factor of safety for the slope was determined to be 2.7. Slope stability analysis
figures representing the configuration of the project site slope, the total
defformation, soil movement direction, and factor of safety for critical condition of
a slope are found in the Appendix section of this report.

8.0 CONSIDERATIONS DURING CONSTRUCTION

8.1 Site Grading Recommendations

Site grading plans can result in changes in almost all aspects of foundation
recommendations. We have prepared the foundation recommendations based on the
existing ground surface; there is no surcharge addition for the stratigraphic conditions
encountered at the time of our study. If site grading plans differ from existing grades by
more than plus or minus 1 foot, we must be retained to review the site grading plans prior
to bidding the project for construction. This will enable us to provide input for any changes
in our original recommendations that may be required as a result of site grading
operations or other considerations.

8.2 Site Drainage Recommendations

Drainage is one of the most important aspects to be addressed to ensure the successful
performance of any foundation. Positive surface drainage should be implemented prior
to, during and maintained after construction to prevent water ponding at or adjacent to
the building facilities. It is recommended that the building and site design include rain
gutters, downspouts and concrete gutters to channel runoff to paving or storm drains.

8.3 Site Preparation Recommendations

Building areas and all area to support select fill should be stripped of all vegetation and
organic topsoil up to a minimum of 5 ft. beyond the building perimeters. After stripping,
remove at least six (6) inches of on-site soil as measured from existing grade when
excavation of existing subgrade is not recommended in other sections of this report. The
excavated material, if free of organic and/or deleterious material, may be stockpiled for
use in the non-structural areas of the site. Where excavation of the subgrade is
recommended in this report, the bottom of the excavation will extend at least five (5) feet
beyond the limits of the planned building perimeter including canopies and sidewalks.
Exposed subgrades should be thoroughly proof rolled in order to locate and compact any
weak, compressible and soft spots. Proof rolling shall be in accordance with TxDOT 2014
Specification Item 216. Proof rolling operations should be observed by the Geotechnical
Engineer or his representative to document subgrade condition and preparation. Weak
or soft areas identified during proof rolling or areas where large tree roots have been
removed within the limits of excavation should be removed and replaced with a suitable,
compacted select fill in accordance with the recommendations presented under the Select
Fill Recommendations section of this report. Proof rolling operations and any
excavation/backfill activities should be observed by MEG representatives to document
subgrade preparation.
Prior to fill placement, the exposed subgrade shall be prepared based on what option is selected from the foundation and pavement recommendations. The exposed subgrade should be prepared, moisture-conditioned by scarifying to a minimum depth as recommended in the foundation and pavement recommendations and recompacting to a minimum 98 percent of the maximum dry density as determined in accordance with ASTM D 698, moisture-density relationship. The moisture content of the subgrade should be maintained within the range of minus two (-2) percentage points below optimum to plus two (+2) percentage points above the optimum moisture content until the fill is permanently covered. The soil should be properly compacted in accordance with these recommendations and tested by MEG personnel for compaction as specified.

8.4 Select Fill Recommendations

Materials used for select fill shall meet the following requirements:

1. Material shall conform to TxDOT 2014 Specification Item 247, Flexible Base; Type A, Grades 1 through 3.

Select fill shall be placed in loose lifts not to exceed 8 inches (6 inches compacted) and compacted to a minimum 98 percent of the maximum dry density as determined in accordance with ASTM D 1557. The moisture content of the fill shall be maintained within the range of minus two (-2) percentage points below optimum to plus two (+2) percentage points above the optimum moisture content until the fill is permanently covered. The select fill should be properly compacted in accordance with these recommendations and tested by MEG personnel for compaction as specified.

8.5 Drainage Rock Backfill Recommendations

Materials used for rock backfill shall meet the following requirements:

2. Material shall conform to TxDOT 2014 Specification Item 423, Retaining Walls Backfill; Type DS.

Backfill shall be placed in loose lifts not to exceed 10 inches (8 inches compacted) and compacted to a minimum 98 percent of the maximum dry density as determined in accordance with ASTM D 698. The moisture content of the fill shall be maintained within the range of minus two (-2) percentage points below optimum to plus two (+2) percentage points above the optimum moisture content until the fill is permanently covered. The select fill should be properly compacted in accordance with these recommendations and tested by MEG personnel for compaction as specified.

8.6 Site Fill Recommendations

Site fill shall be placed in loose lifts not to exceed 8 inches (6 inches compacted) and compacted to a minimum 95 percent of the maximum dry density as determined in accordance with ASTM D 698. The moisture content of the fill shall be maintained within the range of minus two (-2) percentage points below optimum to plus two (+2) percentage
points above the optimum moisture content until the fill is permanently covered. The site fill should be properly compacted in accordance with these recommendations and tested by MEG personnel for compaction as specified.

8.7 Back Fill Recommendations

Back fill shall be placed in loose lifts not to exceed 8 inches (6 inches compacted) and compacted to a minimum 98 percent of the maximum dry density as determined in accordance with ASTM D 698. The moisture content of the fill shall be maintained within the range of minus two (-2) percentage points below optimum to plus two (+2) percentage points above the optimum moisture content until the fill is permanently covered. The back fill should be properly compacted in accordance with these recommendations and tested by MEG personnel for compaction as specified.

8.8 Utility Considerations

Utilities that project through the slab-on-grade, slab-on-fill, floating floor slabs, or any other rigid unit should be designed with some degree of flexibility or with sleeves. Such features will help reduce the risk of damage to utility facilities from soil movements related to shrinkage and expansion.

8.9 Utility Trench Recommendations

Bedding and initial backfill are buried around utility lines to support and protect the utility. The secondary backfill above the initial backfill also helps protect and support the foundation and/or pavement above. To ensure that settlement is not excessive in this secondary backfill we recommend the following:

1) If possible, trench and install utilities prior to work such as lime treatment and/or compaction of subgrade or placement of other fills or bases.
2) Place, moisture condition and compact the secondary backfill in accordance with the pertinent project requirements. Within the footprint of a building pad the secondary backfill should meet the same compaction requirements for select fill. Within the footprint of a pavement structure the secondary backfill should meet the same compaction requirements for the subgrade. When compaction of the subgrade is not specified it should meet the same compaction level of the adjacent natural ground. An alternative to compaction of secondary backfill is the use of flowable fill where secondary backfill is to be placed. If properly designed, the flowable fill can be excavated easily at a later date if necessary. No compaction and no testing is required when properly designed flowable fill is used.

8.10 Excavation, Sloping and Benching Considerations

The soils encountered in the borings can easily be excavated using conventional earthwork equipment. No major hard soil and/or rock units were encountered in the borings through completion depth. In the case that excavations occur through granular
soil or submerged soils it will be necessary to either slope the excavation sidewalls or provide temporary bracing to control excavation wall instability.

The side slopes of excavations through the overburden soils should be made in such a manner to provide for their stability during construction. Pipe lines or other facilities which are constructed prior to or during the currently proposed construction and which require excavation should be protected from loss of end bearing or lateral support.

Temporary construction slopes and/or permanent embankment slopes should be protected from surface runoff water. Site grading should be designed to allow drainage at planned areas where erosion protection is provided instead of allowing surface water to flow down unprotected slopes.

Permanent slopes at the site should be as flat as practical to reduce creep and occurrence of shallow slides. The following slope angles are recommended as maximums. The presented angles refer to the total height of a slope. Site improvement should be maintained away from the top of the slope to reduce the possibility of damage due to creep or shallow slides.

Table 8-1. Slopes Angles Requirements

<table>
<thead>
<tr>
<th>Height (ft.)</th>
<th>Horizontal to vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 3</td>
<td>1:1</td>
</tr>
<tr>
<td>3 – 6</td>
<td>2:1</td>
</tr>
<tr>
<td>6 – 9</td>
<td>3:1</td>
</tr>
<tr>
<td>&gt;9</td>
<td>4:1</td>
</tr>
</tbody>
</table>

The contractor or persons doing the trenching should adhere to the current Occupational Health and Safety Administration (OSHA) guidelines on trench excavation safety and protection measures. Other industry standards may be applicable. The collection of specific geotechnical data and development of a plan for trench safety, sloping, benching or various types of temporary shoring, is beyond the scope of this study.

Benching

Benches shall be excavated per Figure 9.1 into the existing slope to allow for proper compaction. Bench widths shall be a minimum of 5 feet in width. Proposed slopes shall be no greater than 1 unit vertical in 5 units horizontal (20% slope). Benches shall be spaced consecutively. Bench heights shall not exceed the lesser of one-half the bench width, or 10 feet. Placement of the soils shall be conditioned and compacted in accordance with the select fill recommendations of the report.
Keying

Benches shall have a key at the toe of the slope where the slope height exceeds 5 feet or the slope is greater than 1-unit vertical in 5 units horizontal (20% slope). The key shall be a minimum depth of 2 feet and a length not less than 10 feet.

Setbacks

General: Excavation and fill slopes shall be set back from the site boundary in accordance with this section. Setback dimensions shall be measured horizontally, and shall be perpendicular to the site boundary.

Top of excavation slope: The top of excavation slopes shall be set back from the site boundary not less than one-fifth the vertical height of the slope, but not less than 2 feet and need not to exceed 10 feet.

Toe of fill slope: The toe of fill slopes shall be set back from the site boundary not less than one-half the vertical height of the slope, but not less than 2 feet but need not exceed 20 feet.

8.11 Shallow Foundation Excavation Considerations

The Geotechnical Engineer or his representative prior to the placement of reinforcing steel and concrete should observe shallow foundation excavations. This is necessary to verify that the bearing soils at the bottom of the excavations are similar to those encountered during the subsurface soil exploration phase and that excessive loose materials and water are not present in the excavations. If soft pockets of soil are
encountered in the foundation excavations, they should be removed and replaced with a compacted non-expansive fill material or lean concrete up to the design foundation bearing elevation.

8.12 Pier Excavation Considerations

The following general considerations are important to ensure that the drilled piers are properly constructed. Pier excavations should be augured and constructed in a continuous process from beginning to end. Steel and concrete are to be placed in the pier excavation immediately after drilling and evaluation for proper bearing, embedment and cleanliness. Under no circumstances should a pier excavation remain open overnight. We recommend monitoring of installation by a representative of MEG.

We recommend that the foundation contractor verify the subsurface water level prior to beginning pier excavation. We recommend that he be prepared to control water intrusion and sloughing of soils into the pier excavation should these conditions occur. Typically the methods available to control these conditions are the casing method, slurry displacement method or a combination of the two. We recommend that the foundation contractor submit a plan for approval by the designer for the construction of concrete piers outlining and including proposed methods of excavation, preparations for dealing with ground water and sloughing, slurry methods and type (mineral or polymer), methods of cleaning excavation, methods for concrete placement and other procedures or materials important to the successful construction and performance of a drilled pier.

If water is encountered during the drilling operations in excess of 6 inches it should be pumped out prior to steel and concrete placement. If the water is left, a closed end tremie should be used to place the concrete completely to the bottom of the pier excavation in a controlled manner to properly displace the water. If water is not present, the concrete should be placed with a tremie if the free fall distance exceeds five (5) feet. The concrete should not be placed in a manner that causes the concrete to hit the excavated pier walls or reinforcing steel. Removal of casing should be done with extreme care and with proper supervision. Rapid removal of the casing can cause mixing of surrounding soil with the fresh concrete and/or develop a suction that will cause soil to intrude into the concrete pier and thus reduce its effective diameter and/or expose its reinforcement. An insufficient head of concrete in the casing during withdrawal could also cause the same conditions.

For this project we recommend that the concrete should be designed to achieve a minimum 28-day compressive strength of 3600 psi when placed at a seven (7) inch slump with a plus or minus one (1) inch tolerance. The concrete should be designed to meet the requirements of Texas Department of Transportation 2014 Standard Specification Item 421, Class C or SS concrete or American Concrete Institute (ACI) 318-11 – Building Code Requirements for Structural Concrete. If a high range water-reducing admixture is used to achieve the slump requirements, a span of slump retention should be thoroughly investigated for the concrete design to be used. Compatibility with other concrete admixtures should also be considered. We
recommend that a technical representative of the admixture supplier be consulted with the use of these admixtures.

The concrete pier design and construction should be performed as discussed in this report and as described in the publications entitled: ACI 336.1 – 98 Standard Specification for the Construction of Drilled Piers, ACI 336.3R-93 Suggested Design and Construction Procedures for Pier Foundations, Drilled Shafts: Construction Procedures and Design Methods by Michael W. O’Neill and Lymon C. Reese, Publication No. FHWA-IF-99-025, August 1999 and Texas Department of Transportation 2014 Standard Specification Item 416 for Dilled Shaft Foundations. Concrete pier construction should be carefully monitored to ensure that the construction activities comply with the project specifications. The following items in particular among others need to be considered during the concrete pier construction process.

1. Proper drilling rig with proper equipment (including augers, casing, slurry holding tanks with appurtenances);
2. Pier locations, vertical alignment, competent bearing;
3. Reinforcing steel cages tied to meet project specifications;
4. Proper scheduling and ordering of concrete;
5. Concrete properties and placement, steel placement;
6. Proper casing seal for subsurface water control, proper slurry properties and proper casing removal; and
7. Monitoring of installation by a representative of MEG.

8.13 Landscaping Considerations

Even though landscaping is a vital aesthetic component of any project, the owner, client and design team should be aware that placing trees or large bushes adjacent to any structure may distress the structure in the future. It is recommended that if any landscaping is to be placed adjacent to the structure in this project, it should be limited to small plants and shrubs. Trees and large bushes should be placed at a distance such that at their mature height, their canopy or “drip line” does not extend over the structures. The owner, client and design team should also be aware that if any watering is to be done in connection with the landscaping for this project it should be controlled, consistent and timely. Excessive or prolonged watering is not recommended. If watering is part of the landscaping plan, termination of watering for any extended period of time may also be detrimental to the structure. It is important that the moisture level in the subsurface soils remain constant so that shrinking and swelling of soils may be mitigated.

8.14 Perimeter Foundation Cap

We recommend that a cap of impervious fill be placed around the perimeter of the foundation to mitigate the intrusion of moisture into the soils surrounding the foundation. The top eighteen inches of fill around the foundation structure should be a low permeance clay cap to keep surface water away from the foundation. The low permeance clay cap should be sloped away from the foundation at a minimum slope of 2% and the surrounding areas should have positive drainage. The low permeance clay shall meet the USCS classification of CL and meeting the requirements in Tables 7.2 Gradation Requirements
and Table 7.3 Atterberg Limits Requirements. The low permeance clay shall be compacted to minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D 698. The moisture content of the subgrade should be maintained within the range of optimum to four (4) percentage points above the optimum moisture. If plantings are intended, add 4 to 6 inches of loam on top of the clay cap.

Table 8.2. Gradation Requirements

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing (by dry weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 inch</td>
<td>100</td>
</tr>
<tr>
<td>No 4</td>
<td>70-100</td>
</tr>
<tr>
<td>No. 200</td>
<td>50 – 100</td>
</tr>
</tbody>
</table>

Table 8.3. Atterberg Limits Requirements

<table>
<thead>
<tr>
<th>Test / ASTM</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atterberg Limits</td>
<td>LL ≤ 45</td>
</tr>
<tr>
<td>D4318</td>
<td>20 ≤ PI ≤ 30</td>
</tr>
</tbody>
</table>

9.0 PROJECT REVIEW AND QUALITY CONTROL

Each project site is unique and it is important that the appropriate design data, construction drawings, specifications, change orders and related documents be reviewed by the respective design and construction professionals participating in this project. The performance of foundations, construction building pads and/or parking areas for this project will depend on correct interpretation of our geotechnical engineering report and proper compliance of and adherence to our geotechnical recommendations and to the construction drawings and specifications.

It is important that MEG be provided the opportunity to review the final design and construction documents to check that our geotechnical recommendations are properly interpreted and incorporated in the design and construction documents. We cannot be responsible for misinterpretations of our geotechnical recommendations if we have not had the opportunity to review these documents. This review is an additional service and not part of our project scope.

MEG should be retained to provide construction materials testing and observation services during all phases of the construction process of this project. As the Geotechnical Engineer of Record, it is important to let our technical personnel provide these services to make certain that our recommendations are interpreted properly and to ensure that actual field conditions are those described in our geotechnical report. Since our personnel are familiar with this project, MEG’s participation during the construction phase of this project would help mitigate any problems resulting from variations or anomalies in subsurface conditions, which are among the most prevalent on construction projects and
often lead to delays, changes, costs overruns, and disputes. If the client does not follow all of our recommendations presented in this report and/or addendums to this report, the client assumes the responsibility and liability of such actions and will hold our firm harmless and without responsibility and liability for client’s actions.

A construction testing frequency plan and budget needs to be developed for the required construction materials engineering and testing services for this project. Before construction, we recommend that MEG, the project design team members and the project general contractor meet and jointly develop the testing plan and budget, as well as review the testing specifications as it pertains to this project. **A failure to implement a complete testing plan will negate the recommendations provided in this report.**

MEG looks forward to the opportunity to provide continued support on this project.
# Map Unit Legend

<table>
<thead>
<tr>
<th>Map Unit Symbol</th>
<th>Map Unit Name</th>
<th>Acres in AOI</th>
<th>Percent of AOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>KD</td>
<td>Kermit-Dune land association, hummocky</td>
<td>1.3</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>Totals for Area of Interest</strong></td>
<td></td>
<td><strong>1.3</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>
APPENDIX C
PROJECT BORING LOGS AND PROFILE

MEG ENGINEERS
Strong Leaders!

Geotechnical | Environmental | Testing

1601 Rutherford Lane, Ste A100 ■ Austin, Texas 78754 ■ 956-702-8500
**Project:** Proposed Monahans Sandhills State Park  
**Project Location:** Monahans, Ward County, Texas  
**Project Number:** 04-20-29110

### Log of Boring B-1

**Sheet 1 of 1**

<table>
<thead>
<tr>
<th>Date(s) Drilled</th>
<th>Logged By</th>
<th>Checked By</th>
<th>Drilling Method</th>
<th>Drill Bit Size/Type</th>
<th>Total Depth of Borehole</th>
<th>Groundwater Level and Date Measured</th>
<th>Borehole Backfill</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Juan Palma</td>
<td>Raul Palma</td>
<td>SFA</td>
<td>4&quot; soil bit</td>
<td>40 feet bgs</td>
<td>Star Com. Tech</td>
<td>See Boring Location Map</td>
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</tbody>
</table>

### Boring Log

<table>
<thead>
<tr>
<th>Elevation (feet)</th>
<th>Depth (feet)</th>
<th>Sample Type</th>
<th>Sample Number</th>
<th>Sampling Resistance, Blowert</th>
<th>Material Type</th>
<th>Graphic Log</th>
<th>MATERIAL DESCRIPTION</th>
<th>Water Content, %</th>
<th>LL, %</th>
<th>PI, %</th>
<th>Percent Fines</th>
<th>REMARKS AND OTHER TESTS</th>
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<td>3</td>
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<td>SP</td>
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## Log of Boring B-2

**Sheet 1 of 1**

**Project:** Proposed Monahans Sandhills State Park  
**Project Location:** Monahans, Ward County, Texas  
**Project Number:** 04-20-29110

<table>
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<tr>
<th>Date(s) Drilled</th>
<th>Logged By</th>
<th>Checked By</th>
<th>Drilling Method</th>
<th>Drill Bit Size/Type</th>
<th>Total Depth of Borehole</th>
<th>Drill Rig Type</th>
<th>Drilling Contractor</th>
<th>Approximate Surface Elevation</th>
<th>Groundwater Level and Date Measured</th>
<th>Sampling Method(s)</th>
<th>Hammer Data</th>
<th>Subgrade Cuttings Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Juan Palma</td>
<td>Raul Palma</td>
<td>SFA</td>
<td>4&quot; soil bit</td>
<td>40 feet bgs</td>
<td></td>
<td>Star Com. Tech</td>
<td></td>
<td></td>
<td>SPT</td>
<td>140 lb., 30 in. drop, auto trip</td>
<td></td>
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</tbody>
</table>

**Backfill:** Subgrade Cuttings  
**Location:** See Boring Location Map

<table>
<thead>
<tr>
<th>Elevation (feet)</th>
<th>Depth (feet)</th>
<th>Sample Type</th>
<th>Sample Number</th>
<th>Sampling Resistance, blowes/ft</th>
<th>Material Type</th>
<th>Graphic Log</th>
<th>MATERIAL DESCRIPTION</th>
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<td></td>
<td></td>
<td><strong>Bore Termination</strong></td>
</tr>
</tbody>
</table>

**REMARKS AND OTHER TESTS**

- Water Content: %
- LL,%: %
- PI,%: %
- Percent Fines: %

**Sample Log:**

- Sample Type: SP
- Material Type: SAND
- Sample Resistance: blowes/ft
- Material Description: tan to white, dry, very loose to very dense
# Log of Boring B-3

**Sheet 1 of 1**

**Project:** Proposed Monahans Sandhills State Park  
**Project Location:** Monahans, Ward County, Texas  
**Project Number:** 04-20-29110

<table>
<thead>
<tr>
<th>Date(s) Drilled</th>
<th>Logged By</th>
<th>Checked By</th>
<th>Drilling Method</th>
<th>Drill Bit Size/Type</th>
<th>Total Depth of Borehole</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Juan Palma</td>
<td>Raul Palma</td>
<td>SFA</td>
<td>4&quot; soil bit</td>
<td>20 feet bgs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drill Rig Type</th>
<th>Drilling Contractor</th>
<th>Approximate Surface Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Star Com. Tech</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Groundwater Level and Date Measured</th>
<th>Sampling Method(s)</th>
<th>Hammer Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SPT</td>
<td>140 lb., 30 in. drop, auto trip</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Borehole Backfill</th>
<th>Subgrade Cuttings</th>
<th>Location</th>
<th>See Boring Location Map</th>
</tr>
</thead>
</table>

## MATERIAL DESCRIPTION

<table>
<thead>
<tr>
<th>Elevation (feet)</th>
<th>Depth (feet)</th>
<th>Sample Type</th>
<th>Sample Number</th>
<th>Sampling Resistance, Blowen</th>
<th>Material Type</th>
<th>Water Content, %</th>
<th>LL, %</th>
<th>PI, %</th>
<th>Percent Fires</th>
<th>REMARKS AND OTHER TESTS</th>
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</tbody>
</table>

Bore Termination
### COLUMN DESCRIPTIONS

<table>
<thead>
<tr>
<th>Column Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Elevation (feet): Elevation (MSL, feet).</td>
</tr>
<tr>
<td>2</td>
<td>Depth (feet): Depth in feet below the ground surface.</td>
</tr>
<tr>
<td>3</td>
<td>Sample Type: Type of soil sample collected at the depth interval shown.</td>
</tr>
<tr>
<td>4</td>
<td>Sample Number: Sample identification number.</td>
</tr>
<tr>
<td>5</td>
<td>Sampling Resistance, blow/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.</td>
</tr>
<tr>
<td>6</td>
<td>Material Type: Type of material encountered.</td>
</tr>
<tr>
<td>7</td>
<td>Graphic Log: Graphic depiction of the subsurface material encountered.</td>
</tr>
<tr>
<td>8</td>
<td>MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.</td>
</tr>
<tr>
<td>9</td>
<td>Water Content, %: Water content of the soil sample, expressed as percentage of dry weight of sample.</td>
</tr>
<tr>
<td>10</td>
<td>LL, %: Liquid Limit, expressed as a water content.</td>
</tr>
<tr>
<td>11</td>
<td>PI, %: Plasticity Index, expressed as a water content.</td>
</tr>
<tr>
<td>12</td>
<td>Percent Fines: The percent fines (soil passing the No. 200 Sieve) in the sample. WA indicates a Wash Sieve, SA indicates a Sieve Analysis.</td>
</tr>
<tr>
<td>13</td>
<td>REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.</td>
</tr>
</tbody>
</table>

### FIELD AND LABORATORY TEST ABBREVIATIONS

- CHEM: Chemical tests to assess corrosivity
- COMP: Compaction test
- CONS: One-dimensional consolidation test
- LL: Liquid Limit, percent
- PL: Plasticity Index, percent
- SA: Sieve analysis (percent passing No. 200 Sieve)
- UC: Unconfined compressive strength test, Qu, in ksf
- WA: Wash sieve (percent passing No. 200 Sieve)

### MATERIAL GRAPHIC SYMBOLS

- Poorly graded SAND (SP)

### TYPICAL SAMPLER GRAPHIC SYMBOLS

- Auger sampler
- CME Sampler
- Grab Sample
- 2-inch-OD Modified California w/ brass liners
- 2.5-inch-OD Modified California w/ brass liners
- Pitcher Sample
- 2-inch-OD unlined split spoon (SPT)
- Shelby Tube (Thin-walled, fixed head)
- 3-inch-OD California w/ brass rings

### OTHER GRAPHIC SYMBOLS

- Water level (at time of drilling, ATD)
- Water level (after waiting)
- Minor change in material properties within a stratum
- Interbed/gradational contact between strata
- Queried contact between strata

### GENERAL NOTES

1. Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.
APPENDIX D
SUMMARY OF SOIL SAMPLE ANALYSIS
## Summary of Soil Sample Analyses

**Project Name:** Proposed Monahans Sandhills State Park

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Sample Depth (ft)</th>
<th>Blows Per (ft)</th>
<th>Moisture Content</th>
<th>Liquid Limit</th>
<th>Plastic Limit</th>
<th>Plasticity Index</th>
<th>-200% Sieve</th>
<th>Shear Strength (tsf)</th>
<th>Dry Unit Weight (pcf)</th>
<th>USCS</th>
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### Sieve Analysis Data Sheet

ASTM D-2487

**Project Name:** Monahans Sandhills State Park  
**Project No.:** 04-20-29110  
**Location:** Monahans, Ward County, Texas  
**Borehole No.:** B-1  
**Tested By:** J. Uriostegui  
**Date:** 8/13/2020  
**Depth:** 2.5 - 4

**Weight of Container (g):** 3736.6  
**Weight of Dry Sample (g):** 192.2  
**Weight of Container & Soil (g):** 3929.0

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<th>Diameter (mm)</th>
<th>Mass of Empty Sieve (g)</th>
<th>Mass of Sieve &amp; Soil (g)</th>
<th>Soil Retained (g)</th>
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**TOTAL:** 192.4  100.1

---

**Grain Size Distribution Curve Results:**

- % Gravel: 5.7
- % Sand: 94.1
- % Fines: 0.4
- $D_{10}:$ 0.163
- $D_{30}:$ 0.206
- $D_{50}:$ 0.262
- $C_u: 1.60$
- $C_c: 1.00$
### Sieve Analysis Data Sheet

**ASTM D-2487**

**Project Name:** Monahans Sandhills State Park  
**Project No.:** 04-20-29110  
**Location:** Monahans, Ward County, Texas  
**Borehole No.:** B-1  
**Tested By:** J. Uriostegui  
**Date:** 8/13/2020  
**Depth:** 8.5 - 10

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**TOTAL:** 167.2 100.2

#### Grain Size Distribution Curve Results:

- **% Gravel:** 0.0  
- **% Sand:** 99.9  
- **% Fines:** 0.3  
- **D_{16}:** 0.161  
- **D_{50}:** 0.202  
- **C_{u}:** 1.58  
- **C_{c}:** 0.99
# Sieve Analysis Data Sheet

**ASTM D-2487**

**Project Name:** Monahans Sandhills State Park  
**Project No.:** 04-20-29110  
**Location:** Monahans, Ward County, Texas  
**Borehole No.:** B-1  
**Depth:** 23.5 - 25  
**Tested By:** J. Uriostegui  
**Date:** 8/13/2020

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**TOTAL:** 152.5  
**Soil Passing:** 100.2

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**Grain Size Distribution Curve Results:**

- **% Gravel:** 0.0
- **D_{10}:** 0.159
- **C_u:** 1.65
- **% Sand:** 99.9
- **D_{50}:** 0.203
- **C_c:** 0.99
- **% Fines:** 0.2
- **D_{60}:** 0.263

---

**Diagram:**

- GRAVEL
- #4 Coarse SAND
- Medium SAND
- #40 Fine SAND
- #200 SILT/CLAY

---

**Particle Diameter (mm)**

- **% Passing**
  - 100
  - 90
  - 80
  - 70
  - 60
  - 50
  - 40
  - 30
  - 20
  - 10
  - 0

- **10,000**
  - 1,000
  - 100
  - 10
  - 1
  - 0.1
  - 0.01
  - 0.001

---

**Note:**

- The data sheet provides detailed information about the sieving analysis of a soil sample from the Monahans Sandhills State Park, including the size distribution, mass retained, and soil passing percentages. The grain size distribution curve results are also included, providing key parameters such as D_{10}, D_{50}, and C_u, C_c values.
Sieve Analysis Data Sheet
ASTM D-2487

Project Name: Monahans Sandhills State Park
Project No.: 04-20-29110
Location: Monahans, Ward County, Texas
Borehole No.: B-1

Weight of Container (g): 3736.6
Weight of Dry Sample (g): 204.7

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<th>Soil Retained (g)</th>
<th>Soil Retained (%)</th>
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TOTAL: 205.1

Grain Size Distribution Curve Results:

- % Gravel: 0.0
- % Sand: 99.8
- % Fines: 0.3

D_{10}: 0.164
D_{30}: 0.210
D_{60}: 0.275

C_u: 1.68
C_c: 0.98
Sieve Analysis Data Sheet  
ASTM D-2487  

Project Name: Monahans Sandhills State Park  
Project No.: 04-20-29110  
Location: Monahans, Ward County, Texas  
Borehole No.: B-2  
Depth: 0.5 - 2  

Weight of Container (g): 3736.6  
Weight of Dry Sample (g): 169.4  
Weight of Container & Soil (g): 3905.9

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TOTAL: 169.3 99.9

Grain Size Distribution Curve Results:

- % Gravel: 0.5
- % Sand: 99.0
- % Fines: 0.4
- D_{10}: 0.155
- D_{30}: 0.197
- D_{60}: 0.251
- C_u: 1.62
- C_c: 1.00
### Sieve Analysis Data Sheet

**ASTM D-2487**

**Project Name:** Monahans Sandhills State Park  
**Project No.:** 04-20-29110  
**Location:** Monahans, Ward County, Texas  
**Borehole No.:** B-2  
**Depth:** 6.5 - 8

**Weight of Container (g):** 3736.6  
**Weight of Dry Sample (g):** 205.8  
**Weight of Container & Soil (g):** 3943.3

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**TOTAL:** 206.7 100.4

---

**Grain Size Distribution Curve Results:**

- **% Gravel:** 6.0
- **% Sand:** 94.3
- **% Fines:** 0.2

**D_{10}:** 0.164  
**D_{30}:** 0.206  
**D_{60}:** 0.262  
**C_u:** 1.60  
**C_c:** 0.99
Sieve Analysis Data Sheet
ASTM D-2487

Project Name: Monahans Sandhills State Park
Project No.: 04-20-29110
Location: Monahans, Ward County, Texas
Borehole No.: B-2

Tested By: J. Uriostegui  Date: 8/13/2020

Depth 12.5 - 14

Weight of Container (g): 3736.6
Weight of Dry Sample (g): 262.6
Weight of Container & Soil (g): 3999.1

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<th>Soil Retained (g)</th>
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TOTAL: 262.5 100.0

Grain Size Distribution Curve Results:

- % Gravel: 3.3
- % Sand: 96.4
- % Fines: 0.3
- \( D_{10} \): 0.158
- \( D_{30} \): 0.204
- \( D_{60} \): 0.266
- \( C_u \): 1.68
- \( C_c \): 0.99
Sieve Analysis Data Sheet
ASTM D-2487

Project Name: Monahans Sandhills State Park
Project No.: 04-20-29110
Location: Monahans, Ward County, Texas
Borehole No.: B-2

Weight of Container (g): 3736.6
Weight of Dry Sample (g): 165.2

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TOTAL: 165.2 100.3

Grain Size Distribution Curve Results:

% Gravel: 0.0  D_{10}: 0.164  C_u: 1.69
% Sand: 100.0  D_{30}: 0.211  C_c: 0.98
% Fines: 0.3  D_{50}: 0.278
Sieve Analysis Data Sheet
ASTM D-2487

Project Name: Monahans Sandhills State Park
Project No.: 04-20-29110
Location: Monahans, Ward County, Texas
Borehole No.: B-3

Tested By: J. Uriostegui Date: 8/13/2020

Depth 4.5 - 6

Weight of Container (g): 3736.6
Weight of Dry Sample (g): 145.8
Weight of Container & Soil (g): 3881.8

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Total: 145.2 99.6

Grain Size Distribution Curve Results:

% Gravel: 0.0  D_{10}: 0.154  C_u: 1.64
% Sand: 99.1  D_{50}: 0.197  C_c: 1.00
% Fines: 0.5  D_{90}: 0.252
# Sieve Analysis Data Sheet

**ASTM D-2487**

**Project Name:** Monahans Sandhills State Park  
**Tested By:** J. Uriostegui  
**Project No.:** 04-20-29110  
**Location:** Monahans, Ward County, Texas  
**Borehole No.:** B-3  
**Date:** 8/13/2020  
**Depth:** 12.5 - 14

**Weight of Container (g):** 3736.6  
**Weight of Container & Soil (g):** 3903.6  
**Weight of Dry Sample (g):** 166.6

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**TOTAL:** 167.0 100.2

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### Grain Size Distribution Curve Results:

- **% Gravel:** 0.0  
- **% Sand:** 99.8  
- **% Fines:** 0.5

- **D_{10}:** 0.157  
- **D_{30}:** 0.199  
- **D_{50}:** 0.253

- **C_{u}:** 1.62  
- **C_{c}:** 1.00
Sieve Analysis Data Sheet
ASTM D-2487

Project Name: Monahans Sandhills State Park
Project No.: 04-20-29110
Location: Monahans, Ward County, Texas
Borehole No.: B-3

Weight of Container (g): 3736.6
Weight of Dry Sample (g): 173.2

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<td>0.8</td>
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TOTAL: 173.4 100.1

Grain Size Distribution Curve Results:

| % Gravel: 0.0 | D_{10}: 0.164 | C_u: 1.61 |
| % Sand: 99.6 | D_{30}: 0.207 | C_c: 0.99 |
| % Fines: 0.5 | D_{50}: 0.263 |           |
Slope Stability Analysis

A finite element method was used for analyzing global stability of the slope in this project. The factor of safety of 2.7 was determined for the critical condition of the slope.

Figure 1: Configuration of the slope considering the restroom located on the top of the hill

Figure 2: Total deformation
Figure 3: Soil movement direction

Figure 4: Factor of safety for critical condition of the slope is about 2.7
Laboratory and Field Test Procedures

Soil Classification Per ASTM D2487-93:
This soil-testing standard was used for classifying soils according to the Unified Soil Classification System. The soil classifications of the earth materials encountered are as noted in the attached boring logs.

Soil Water Content Per ASTM D2216-92:
This test determines the water content of soil or rock expressed as a percentage of the solid mass of the soil. The test results are listed under MC in the attached boring logs.

Soil Liquid Limit Per ASTM D4318-93:
The soil Liquid Limit identifies the upper limit soil water content at which the soil changes from a moldable (plastic) physical state to a liquid state. The Liquid Limit water content is expressed as a percentage of the solid mass of the soil. The test results are listed under LL in the attached boring logs.

Soil Plastic Limit Per ASTM D4318-93:
The soil Plastic Limit identifies lower limit soil water content at which the soil changes from a moldable (plastic) physical state to a non-moldable (semi-solid) physical state. The Plastic Limit water content is expressed as a percentage of the solid mass of the soil. The test results are listed under PL in the attached boring logs.

Plasticity Index Per ASTM D4318-93:
This is the numeric difference between the Liquid Limit and Plastic Limit. This index also defines the range of water content over which the soil-water system acts as a moldable (plastic) material. Higher Plasticity Index (PI) values indicate that the soil has a greater ability to change in soil volume or shrink and swell with lower or higher water contents, respectively. The test results are listed under PI in the attached boring logs.

Standard Penetration Test (SPT) and Split Spoon Sampler (SS) per ASTM D 1586:
This is the standard test method for both the penetration test and split-barrel (spoon) sampling of soils. This sampling method is used for soils or rock too hard for sampling using Shelby Tubes. The method involves penetration of a split spoon sampler into the soil or rock through successive blows of a 140-pound hammer in a prescribed manner.

Blow Counts (N) per ASTM D 1586:
This is the number of blows required to drive a Split Spoon Sampler by means of a 140 pound hammer for a distance of 12 inches in accordance with the variables stated in the test procedures.
Shelby Tube (ST) per ASTM D 1587:
This procedure is for using a thin-walled metal tube to recover relatively undisturbed soil samples suitable for laboratory tests of physical properties.

Dry Density (DD) per ASTM D 2937:
This procedure is for the determination of in-place density of soil. The test results are measured in pounds per cubic foot, pcf.

Unconfined Compression Test (Uc) per ASTM D 2166:
This test method covers the determination of the unconfined compressive strength of cohesive soil in the undisturbed, remolded, or compacted condition, using strain-controlled application of the axial load.

Minus No. 200 Sieve per ASTM D 1140:
This test method covers determination of the amount of material finer than a Number 200 sieve by washing. The results are stated as a percent of the total dry weight of the sample.

Pocket Penetrometer (PP):
This test method is an accepted modification of ASTM D 1558 test method for establishing the moisture-penetration resistance relationships of fine-grained soils. The test results are measured in tons per square foot, tsf. The strength values provided by this method should be considered qualitatively.

Rock Quality Designation (RQD):
The measure of the quality of a rock mass defined by adding intact rock core pieces greater than four inches in length by the total length of core advance.

Recovery Ratio (REC):
The Recovery Ratio is equal to the total length of core recovered divided by the total length of core advance.

Boring Logs:
This is a summary of the above-described information at each boring location.
### MAP LEGEND

<table>
<thead>
<tr>
<th>Area of Interest (AOI)</th>
<th>.20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soils</td>
<td></td>
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<tr>
<td>Soil Survey Areas</td>
<td></td>
</tr>
<tr>
<td>Soil Rating Polygons</td>
<td>.02</td>
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<tr>
<td></td>
<td>.05</td>
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<tr>
<td></td>
<td>.10</td>
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<td></td>
<td>.64</td>
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<tr>
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</tr>
</tbody>
</table>

### MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Ward County, Texas
Survey Area Date: Version 19, Jun 11, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 21, 2016—Sep 17, 2017

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K Factor, Rock Free

<table>
<thead>
<tr>
<th>Map unit symbol</th>
<th>Map unit name</th>
<th>Rating</th>
<th>Acres in AOI</th>
<th>Percent of AOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>KD</td>
<td>Kermit-Dune land association, hummocky</td>
<td>.02</td>
<td>1.4</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>Totals for Area of Interest</strong></td>
<td></td>
<td></td>
<td><strong>1.4</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

**Description**

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kf (rock free)" indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

**Rating Options**

*Aggregation Method: Dominant Component*

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.
The aggregation method "Dominant Component" returns the attribute value associated with the component with the highest percent composition in the map unit. If more than one component shares the highest percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher attribute value should be returned in the case of a percent composition tie. The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.
K Factor, Whole Soil—Ward County, Texas
(04-20-29110 proposed Monahans Sandhills State Park)

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Survey Areas

Soil Rating Polygons

- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Soil Rating Points

- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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Soil Survey Area: Ward County, Texas
Survey Area Date: Version 19, Jun 11, 2020

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Date(s) aerial images were photographed: Oct 21, 2016—Sep 17, 2017

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K Factor, Whole Soil

<table>
<thead>
<tr>
<th>Map unit symbol</th>
<th>Map unit name</th>
<th>Rating</th>
<th>Acres in AOI</th>
<th>Percent of AOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>KD</td>
<td>Kermit-Dune land association, hummocky</td>
<td>.02</td>
<td>1.4</td>
<td>100.0%</td>
</tr>
<tr>
<td>Totals for Area of Interest</td>
<td></td>
<td></td>
<td>1.4</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Rating Options

Aggregation Method: Dominant Condition
Component Percent Cutoff: None Specified
Tie-break Rule: Higher
Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)
### MAP LEGEND

<table>
<thead>
<tr>
<th>Area of Interest (AOI)</th>
<th>Streams and Canals</th>
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</thead>
<tbody>
<tr>
<td>Soils</td>
<td>Transportation</td>
</tr>
<tr>
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<td>Rails</td>
</tr>
<tr>
<td></td>
<td>Interstate Highways</td>
</tr>
<tr>
<td></td>
<td>US Routes</td>
</tr>
<tr>
<td></td>
<td>Major Roads</td>
</tr>
<tr>
<td></td>
<td>Local Roads</td>
</tr>
<tr>
<td>Background</td>
<td>Aerial Photography</td>
</tr>
</tbody>
</table>

### MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

**Warning:** Soil Map may not be valid at this scale.

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**Source of Map:** Natural Resources Conservation Service

**Web Soil Survey URL:**

**Coordinate System:** Web Mercator (EPSG:3857)

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**Survey Area Data:** Version 19, Jun 11, 2020

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T Factor

<table>
<thead>
<tr>
<th>Map unit symbol</th>
<th>Map unit name</th>
<th>Rating (tons per acre per year)</th>
<th>Acres in AOI</th>
<th>Percent of AOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>KD</td>
<td>Kermit-Dune land association, hummocky</td>
<td>5</td>
<td>1.4</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Totals for Area of Interest: 1.4 acres, 100.0%

Description

The T factor is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Rating Options

Units of Measure: tons per acre per year
Aggregation Method: Dominant Condition
Component Percent Cutoff: None Specified
Tie-break Rule: Lower
Interpret Nulls as Zero: No
MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Survey Areas

Soil Rating Polygons
- 1
- 2
- 3
- 4
- 4L
- 5
- 6
- 7
- 8
- Not rated or not available

Soil Rating Lines
- 1
- 2
- 3
- 4
- 4L
- 5
- 6
- 7
- 8
- Not rated or not available

Soil Rating Points
- 1
- 2
- 3
- 4
- 4L
- 5
- 6
- 7
- 8

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

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Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: Web Mercator (EPSG:3857)
Coordinate System: Web Mercator

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Wind Erodibility Group

<table>
<thead>
<tr>
<th>Map unit symbol</th>
<th>Map unit name</th>
<th>Rating</th>
<th>Acres in AOI</th>
<th>Percent of AOI</th>
</tr>
</thead>
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<tr>
<td>KD</td>
<td>Kermit-Dune land association, hummocky</td>
<td>1</td>
<td>1.4</td>
<td>100.0%</td>
</tr>
<tr>
<td>Totals for Area of Interest</td>
<td></td>
<td></td>
<td>1.4</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Description

A wind erodibility group (WEG) consists of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible.

Rating Options

Aggregation Method: Dominant Condition
Component Percent Cutoff: None Specified
Tie-break Rule: Lower
The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

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Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: 
Coordinate System: Web Mercator (EPSG:3857)
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Wind Erodibility Index

<table>
<thead>
<tr>
<th>Map unit symbol</th>
<th>Map unit name</th>
<th>Rating (tons per acre per year)</th>
<th>Acres in AOI</th>
<th>Percent of AOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>KD</td>
<td>Kermit-Dune land association, hummocky</td>
<td>250</td>
<td>1.4</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Totals for Area of Interest: 1.4 acres, 100.0%

Description

The wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Rating Options

Units of Measure: tons per acre per year
Aggregation Method: Dominant Condition
Component Percent Cutoff: None Specified
Tie-break Rule: Higher
ON-SITE SEWAGE FACILITIES REPORT
MONAHANS STATE PARK OSSF
MONAHANS, WARD COUNTY, TEXAS

Prepared For
David Negrete, AIA
Principal and Partner
Negrete & Kolar Architects, LLP.

MEG Report No. 04-20-29108

September 2, 2020

TBPE FIRM NO. F-3913
1601 RUTHERFORD LANE, STE A100
AUSTIN, TEXAS 78754
TEL: 512-729-0400
September 2, 2020

David Negrete, AIA
Principal and Partner
NEGRETE & KOLAR ARCHITECTS LLP
11720 N. IH 35
Austin, Texas 78753
512.474.6526
dnegrete@nekoarch.com

Subject: On-Site Sewage Facilities Report
M.E.G. Report No. 04-20-29108
Monahans State Park OSSF
Monahans, Ward County, Texas

Dear Mr. Negrete:

Millennium Engineers Group, Inc. is pleased to submit the enclosed On-Site Sewage Facilities Report that was prepared for Monahans State Park located in Monahans, Ward County, Texas. This study addresses the findings of our On-Site sewage facilities. Our recommendations should be incorporated into the design and construction documents for the proposed development.

Thank you for the opportunity to be of service to you in this phase of the project and we would like the opportunity to assist you in the upcoming phases of the project. We look forward to continuing our involvement in the project by providing construction monitoring and materials testing services during construction.

If you have any questions, please contact our office at the address, telephone, fax or electronic address listed below.

Cordially,
Millennium Engineers Group, Inc.
TBPE Firm No. F-3913

Raul Palma, P.E.
President
## Table of Contents

APPLICATION INFORMATION ....................................................................................................................1
ON-SITE SANITARY SEWERAGE FACILITY EVALUATION .................................................................2
  Field Boring 1 ........................................................................................................................................2

## APPENDIX

APPENDIX A – PROJECT LOCATION, TOPOGRAPHIC AND BOREHOLE MAPS...........
Application Information:
Name: David Negrete, AIA
Address: 11720 N. IH 35
City/State/Zip Code: Austin, Texas 78753
Phone: (512) 474-6526

Site Evaluator Information:
Name: Raul Palma
Company: Millennium Engineers Group, Inc.
Address: 1601 Rutherford Lane
City/State/Zip Code: Austin, Texas 78754
Phone: 512-729-0400

Property Location Information:
Street/Road Address: 2500 East Interstate 20 Exit 86, Monahans, Texas
County: Ward
Unincorporated Area? Yes
Additional Information:

Schematic of Lot or Tract
Show:
- Compass, adjacent streets, property lines, property dimensions, locations of buildings, easements, swimming pools, water lines, and other surface improvements where known (drainage, patios, sidewalks).
- Locations of existing or proposed water wells within 150 feet of property.
- Indicate slope or provide contour lines from the structure to the farthest location of the proposed soil absorption or irrigation area.
- Location of soil borings or dug pits (show location with respect to a known reference point.).
- Location of natural, constructed, or proposed drainage ways, (streams, ponds, lakes, rivers, high tide of salt water bodies) water impoundment areas, cut or fill bank, sharp slopes and breaks.
- Note type of vegetation on lot.

For Site Drawing see “Attached Drawings”.

Features of Site Area
Presence of 100 year flood zone. Flood zone designation: _  Yes: _  No: X
Presence of adjacent ponds, streams, water impoundments. Yes: _  No: X
Existing or proposed water well in nearby area. Yes: _  No: X
Organized sewage service available to lot or tract. Yes: _  No: X

I certify that the findings of this report are based on my field observations and are accurate to the best of my ability.

Site Evaluator:
Name: Raul Palma, P.E.  Signature: ____________________________  License No. 65656
(Circle One: RS PE DR, Installer II)
ON-SITE SEWERAGE FACILITY
SOIL EVALUATION REPORT INFORMATION

Date Soil Survey Performed: **August 31, 2020**
Site Location: **Monahans State Park**

**County:** Ward  
**Name of Site Evaluator:** Raul Palma, P.E.  
**Proposed Excavation Depth:** 5 feet  
**Registration Number:** 65656

**Requirements:**
- At least two soil excavations must be performed on the site at opposite ends of the proposed disposal area. Locations of soil borings or dug pits must be shown on the site drawing.
- For subsurface disposal, soil evaluations must be performed to a depth of at least two feet below the proposed excavation depth. For surface disposal, the surface horizon must be evaluated.

### Soil Boring Number (B-1)

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Classification</th>
<th>Soil Texture</th>
<th>Structure (for CL III-blocky, platy or massive)</th>
<th>Drainage (Mottless water table)</th>
<th>Restrictive Horizon</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1b – Sand</td>
<td>Grittiness</td>
<td>Blocky</td>
<td>None</td>
<td>None</td>
<td>Brown color</td>
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<tr>
<td>1</td>
<td>1b – Sand</td>
<td>Grittiness</td>
<td>Blocky</td>
<td>None</td>
<td>None</td>
<td>Brown color</td>
</tr>
<tr>
<td>2</td>
<td>1b – Sand</td>
<td>Grittiness</td>
<td>Blocky</td>
<td>None</td>
<td>None</td>
<td>Brown color</td>
</tr>
<tr>
<td>3</td>
<td>1b – Sand</td>
<td>Grittiness</td>
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<td>None</td>
<td>Brown color</td>
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<td>4</td>
<td>1b – Sand</td>
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<td>None</td>
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<tr>
<td>5</td>
<td>1b – Sand</td>
<td>Grittiness</td>
<td>Blocky</td>
<td>None</td>
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<td>Brown color</td>
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### Soil Boring Number (B-2)

<table>
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<th>Depth (Feet)</th>
<th>Classification</th>
<th>Soil Texture</th>
<th>Structure (for CL III-blocky, platy or massive)</th>
<th>Drainage (Mottless water table)</th>
<th>Restrictive Horizon</th>
<th>Observation</th>
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<td>Brown color</td>
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<td>1b – Sand</td>
<td>Grittiness</td>
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</tr>
<tr>
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<td>Blocky</td>
<td>None</td>
<td>None</td>
<td>Brown color</td>
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<td>None</td>
<td>Brown color</td>
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<tr>
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<td>Grittiness</td>
<td>Blocky</td>
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</tr>
</tbody>
</table>
APPENDIX A
PROJECT LOCATION, TOPOGRAPHIC AND BOREHOLE LOCATION MAPS
PROPOSED MONAHANS STATE PARK OSSF
MONAHANS, WARD COUNTY, TEXAS
MEG PROJECT: 04-20-29108   /   DATE: 9/2/2020   /   APPROVED BY: A. PALMA   /   DRAWN BY: S. MARTINEZ

APPROXIMATE PROJECT LOCATION

PROJECT TOPOGRAPHY MAP
PROPOSED MONAHANS STATE PARK OSSF
MONAHANS, WARD COUNTY, TEXAS

MILLENNIUM ENGINEERS GROUP, INC.
1604 RUTHEFORD LANE
AUSTIN, TEXAS 78754
WWW.MEGENGINEERS.COM
TEL.: 512-729-0400
ABATEMENT SPECIFICATION FOR REMOVAL/REPAINTING OF COMPONENTS PREVIOUSLY PAINTED WITH LEAD BASED PAINT (COATINGS)

Sandhills State Park
Section House
2500 E. Interstate 20, Exit 86
Monahans, Texas, 79756

Prepared for:
Negrete & Kolar Architects LLP
11720 North IH 35
Austin, Texas, 79753

Prepared by:
Etech Environmental & Safety Solutions, Inc.
13000 W. County Road 100
Midland, Texas 79711

8 January 2021

Jimmy W. McNeil, Jr.
DSHS Lead Risk Assessor
Certification # 2070395
Expires 5/26/2022
SECTION ONE: SCOPE OF WORK

1.0 Description of the Work

1.1 The work specified herein shall be the paint removal or paint stabilization or component replacement of approximately 12,500 square feet of Lead-based Paint from the Section House at the Sandhills State Park located approximately five miles east of Monahans, Texas. The lead-based paint is on all the painted surfaces of the structure including, but not limited to the siding, windows, doors and trim. The GPS coordinates for the Section House are 31.634833 N, 102.815132 W. The removal shall be performed in accordance with OSHA 1926.62 by a “competent” contractor employing properly trained personnel. A lead inspection was performed on the exterior of the Section House on August 25, 2020 and can be found in Section Ten of this specification.

1.2 Before submitting a bid for this work, it is highly recommended that the Bidder visit the site and familiarize themselves of existing conditions under which he will operate, and/or any conditions which could affect the work under this Contract. No allowance will be made to the Contractor for error or negligence on his part.

1.3 Discrepancies between conditions at the site and requirements of the contract documents shall be reported to the Architect, in writing, before any bids are opened. The Architect will issue necessary instructions to Bidders.

2.0 Project Schedule

2.1 The work schedule for this project has not yet been determined.

2.2 Completion time is to include all prep work, removal or paint stabilization or component replacement of specified Lead-based Paint, clean-up, final visual clearance, removal of containments or regulated areas, and vacating the work site.

2.3 For the purposes of this specification, a “workday” is defined as Monday through Friday, from 0800 to 1700.

3.0 Consultant

3.1 The consulting firm representing the owner for this project is E-Tech Environmental and Safety Solutions, Inc. Jimmy W. McNeil, Jr is the Project Designer. Email address for the consultant is wally@etechenv.com and cell number is 432-559-3566.
SECTION TWO: CONDITIONS & COORDINATION

1.0 General

1.1 The Owner, Architect, and Contractor shall coordinate with one another throughout the project to ensure that the project is completed to the Owner’s satisfaction within the allotted timeframe and according to this specification and all applicable regulatory requirements.

2.0 Facilities

2.1 The Owner extends the use of his facility to the Contractor in the good faith that the contractor will use care and all precaution to prevent damage to the facility. The Owner is unaware of any existing damage to his facility. Before the Contractor begins work in the facility, the Contractor will inspect the area and furnish to the Consultant a list of any existing damage discovered. Damage discovered after work has begun will be assumed to have been caused by the Contractor.

2.2 The Contractor shall remain solely responsible for the safety of workers and sub-contractors and shall take all precautions regarding their safety.

2.3 The General Contractor shall provide water, electricity, and toilet facilities for the duration of the project.

2.4 The Contractor shall provide ground fault circuit interrupters (GFCIs), wiring, lighting switches, outlets, etc., and shall be in accordance with all Federal, State, and Local Underwriters Laboratories (UL) requirements. Installation shall be the responsibility of the Contractor.

2.5 The Contractor shall be responsible for any damages to the Owner's electrical system.

2.6 The Contractor shall comply with all local fire safety regulations, rules and standards.

2.7 The Contractor shall maintain adequate fire extinguishers (Class A, B, or C) ready for immediate use and distributed throughout the work area for the duration of the project. A minimum of one (1) such approved fire extinguisher must be available at the work area and others added at the rate of one (1) for every additional 100 linear feet of work area.

3.0 Personnel Qualifications

All personnel who will enter containment or regulated area or handle lead-based paint materials – loose or bagged shall:

a. Be trained in safe work practices and engineering controls for the removal of lead-based paint and possess a valid certificate of accreditation indicating completion of training or training refresher course within the past 12 months.

b. Possess proof of medical surveillance physical within the past 12 months.

c. Possess valid current (within the past 12 months) respirator fit tests for each specific respirator model which will be used on the project.

4.0 Responsibilities of the Air Monitoring Technician

4.1 The Lead Risk Assessor shall be hired by the Owner(s) and be independent of the Abatement Contractor on the job.

4.2 The Lead Risk Assessor shall be onsite periodically throughout the project.

4.3 The Lead Risk Assessor shall conduct visual inspections.

a. Prior to the start of removal activities to ensure that the regulated area is properly constructed or the containment is properly sealed and encloses all the lead-based paint to be removed,

b. Periodically throughout the removal work, to ensure that Contractor personnel are complying with all applicable regulations and this specification and that
there is no contamination of areas outside of regulated area or containment; and

c. After fine cleaning is completed to ensure that all specified lead-based paint has been removed from the work site.

4.4 The Lead Risk Assessor shall have the authority to stop work due to lack of cooperation by Contractor personnel, contamination of areas outside the work area, or any violations of the Specifications, or Federal, State and Local regulations.

a. Work stoppage shall continue until conditions have been corrected to the satisfaction of the Consultant or Architect.

b. Any standby time shall be at the expense of the Contractor.

4.5 The Lead Risk Assessor shall provide an Air Monitoring Technician (AMT) to be onsite throughout the project.

4.6 At the Lead Risk Assessor’s discretion, he/she may act as the AMT if he has the appropriate training and license.

4.7 The AMT shall be responsible for collecting area and personal air samples.

5.0 Responsibilities of the Abatement Contractor

5.1 The Contractor shall provide labor, materials and equipment to complete the work as described in this specification, including but not limited to the following:

a. Work area preparation
b. Preparation of regulated area or containment
c. Removal, paint stabilization or component replacement of all specified lead-based paint containing materials
d. Cleaning of all surfaces inside of the regulated area or containment
e. Transportation and disposal of lead-based paint waste
f. Re-establisment of all building systems disrupted by the work
g. Repair or replacement of any existing finishes, construction, or other building components damaged during the work to the Owner’s satisfaction.

5.2 All waste generated by the Contractor shall be disposed of as lead-contaminated waste at a licensed landfill.

5.3 The Contractor shall be responsible for ensuring that his Abatement Supervisor and all Abatement Workers are familiar with the Contractor’s emergency response plan, fall protection plan, and respiratory protection plan.

5.4 The Contractor agrees to defend and hold harmless the Owner and the Lead Risk Assessor from any and all fines, levies or penalties including the cost to defend against penalties issued regulatory agencies as a result of actions or work procedures used by the Contractor or his sub-Contractors or any persons or organizations assisting or employed directly or indirectly by the Contractor.

5.5 The Contractor shall adhere to the following sequence of work:

a. Disabling Ventilation Systems, where necessary
b. Cleaning of Work Area
c. Construction of Critical Barriers
d. Construction of Containment
e. Construction of Decontamination Chamber/s
f. Removal of Lead-based Paint
g. Fine Cleaning
h. Visual Inspection
i. Encapsulation
j. Final Visual Clearance
k. Removal of Regulated Area or Containment
l. Disposal of Waste

6.0 Abatement Supervisor

6.1 The Contractor shall provide a “competent” Abatement Supervisor to be on site throughout the project. "Competent person" means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

6.2 The Abatement Supervisor shall:

a. Be fluent in English and any languages spoken by the abatement workers on the project.

6.3 The Abatement Supervisor shall be responsible for:

a. Coordinating with the Owner, the Architect and the Consultant to complete the project within the allotted time and in compliance with all applicable Federal, State, and Local regulations and with this specification;

b. Maintaining a project logbook to include a detailed daily summary of the Contractor’s activities, regulated area or containment entry log with entry and exit times for each person who enters the regulated area or containment, and dates and times and pass/fail for all visual inspections;

c. Assuring that decontamination chambers are kept clean;

d. Surveying the regulated area and containment to ensure proper housekeeping, safety precautions, containment integrity, and clear paths of egress from the containment and regulated area, and

e. Ensuring all workers meet the qualifications listed in paragraph 3.0 above.

7.0 Progress Meetings

7.1 Progress meetings will be held when/if requested by the Owner and will be attended by representatives of Owner, the Architect, and the Contractor.
SECTION THREE: REGULATIONS

1.0 Applicable Standards and Guidelines

1.1 All work described in this specification shall be completed in strict accordance with all applicable Federal, State and Local regulations, standards and codes governing lead-based paint abatement including, but not limited to the following:

   1. 29 CFR 1926.62 Lead
   2. 29 CFR 1910.134 Respiratory Protection
   3. 29 CFR 1926 All Sections
   4. 29 CFR 1910 All Sections
   5. 40-CFR-61.145: Standards for Demolition and Renovation

b. American National Standards Institute (ANSI) Publications:
   1. Z9.2-79 Fundamental Governing the Design and Operation of Local Exhaust Systems
   2. Z88.2-80 Practices for Respiratory Protection

SECTION FOUR: SUBMITTALS

1.0 Submittals - Before Work Begins
Prior to starting work on the project, the Contractor will submit to the Architect or his Project Manager the following:

1.1 Licenses and Certifications of the Abatement Contractor including:
   a. Certificate of Insurance
   b. Contractor’s written Respiratory Protection Plan,
   c. List of emergency contacts, and
   d. List of any citations issued against the Contractor by EPA, OSHA, or TDSHS within the past 24 months, or if none, a signed letter from a representative of the Contractor stating that no notices of violation have been received.

1.2 Personnel Licenses and Certifications
   a. Current contractor/supervisor training certificates for all personnel who will be on-site.
   b. Current medical surveillance physicals for all personnel who will be on-site.
   c. Current fit testing records indicating that all personnel who will be on-site have been fit tested for each respirator that they will be using during the project.

1.3 Safety Data Sheets for all products which will be used on the project as required by OSHA’s hazard Communication Standard codified at 29CFR 1910.1200.

2.0 Submittals – During Work
During the project, the Contractor will submit to the Architect or his Project Manager the following:

2.1 Copy of waste manifest to be submitted as waste is removed from the project site.

3.0 Submittals – Post Work
Within one week of the end of work on the project, the Contractor will submit to the Architect or his Project Manager the following:

3.1 The Abatement Supervisor’s Project Logbook as described in Section Two: Conditions & Coordination, Paragraph 6.3, item b.
SECTION FIVE: PERSONAL PROTECTIVE EQUIPMENT

1.0 Respiratory Protection

1.1 Respiratory protection shall be required for all individuals inside an active containment, performing lead-based paint removal activities inside a regulated area.
   a. “Active containment” shall be defined as a regulated area or containment in which lead-based paint removal activities have begun and which has not yet achieved final visual clearance.

1.2 The following shall be the minimum respiratory protection for this project:

<table>
<thead>
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<th>Activity</th>
<th>Minimum Respiratory Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment Prep</td>
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<tr>
<td>Small Lead-based Paint clean-up</td>
<td>½ face air purifying respirator w/ HEPA filtration</td>
</tr>
<tr>
<td>Gross Removal of Lead-based Paint</td>
<td>½ face air purifying respirator w/ HEPA filtration</td>
</tr>
<tr>
<td>Fine Cleaning of Regulated Area or</td>
<td>½ face air purifying respirator w/ HEPA filtration</td>
</tr>
<tr>
<td>Containment after Gross Removal</td>
<td></td>
</tr>
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</table>

1.3 All respiratory protection shall be MSHA/NIOSH approved in accordance with the provisions of 30 CFR Part 11.
   a. The Contractor shall supply all workers, supervisors, and authorized visitors with personally issued, NIOSH and MSHA approved respirators of the type required for the work being performed.
   b. The Contractor shall supply respirator filter replacements for each time workers enter regulated area or containment.
   c. The Contractor shall ensure that all Contractor personnel have been fit tested for any respirator which they will use on the project within the past 12 months.
      1. Qualitative fit testing is acceptable only for negative pressure respirators.
      2. Quantitative fit testing is required for PAPR.
   d. Workers shall perform the positive and negative air pressure fit test each time a respirator is donned.
   e. No facial hair which comes between the skin and the sealing surface of the respirator shall be permitted.
   f. Respiratory protection maintenance and decontamination procedures shall meet the following requirements:
      1. Respirators shall be inspected and decontaminated daily in accordance with OSHA 29 CFR 1910.134(b).
      2. HEPA filters for negative pressure respirators shall be changed after each shower.
      3. Workers shall wear respirators in the shower when going through decontamination procedures as stated in Part 56 of Title 12 section 9.2 (b).
2.0  Personal Protective Equipment

2.1  The Contractor shall provide to all workers, supervisors and authorized visitors and inspectors, protective disposable clothing consisting of full body coveralls and head covers.
   a. All disposable protective clothing shall be discarded and disposed of as lead contaminated waste every time the wearer exits the work area to the outside area through the decontamination facilities.

2.2  The Contractor shall provide eye protection, hard hats and safety shoes as required by job conditions and safety regulations. Safety shoes and hard hats shall be approved in accordance with ANSI Z89.1 1969 and ANSI Z41.1 1967.

2.3  Reusable footwear, hard hats and eye protection shall be left in the "Contaminated Equipment Room" until the end of the lead-based paint removal work.
SECTION SIX: CONTAINMENTS

1.0 Containment Materials
1.1 All materials shall be of high quality and capable of performing under hot and humid conditions.
   a. The Lead Risk Assessor shall have the authority to stop work in the case that he finds any of the containment materials to be of unacceptable quality until such time as adequate materials are available for the construction of containment.
1.2 The Contractor will provide the following materials for construction of containment:
   a. 6-mil and 4-mil polyethylene sheeting,
   b. Adhesive Tape (2” or 3” widths)
   c. Spray Adhesive
   d. Lead Warning Signs
   e. Barricade Tape
   f. Rags
   g. HEPA filtered Vacuum
   h. 2x4 lumber for the construction of temporary walls (if necessary)

2.0 Containment Preparation
2.1 Provide at least one (1) fire extinguisher for each 100 linear feet of containment area.
2.2 The Contractor will remove any movable items from the containment area.
2.3 The Contractor will establish a regulated area by hanging barricade tape and warning signs around the containment area in a wide enough radius to allow the public to encounter the signs/barricade tape and reroute to avoid the containment area.
2.4 The Contractor will deactivate any air conditioners, heating, or other powered ventilation into or out of the containment area.
2.5 The Contractor will clean the containment area using HEPA filtered vacuums and wet wiping.
2.6 When the area is clean, the Contractor will begin installing critical barriers of 6-mil polyethylene sheeting over all penetrations into the containment area including, doors, windows, vents, etc.
2.7 The Contractor will install at least one plexiglass window in containment to allow viewing of the work from the outside of containment by the Lead Risk Assessor and representatives of regulatory agencies.
   a. At the request of the Lead Risk Assessor, the Contractor shall install additional windows as necessary to accommodate the Lead Risk Assessor’s observation responsibilities.

3.0 Decontamination and Bagout Chambers
3.1 Install a three-stage personnel decontamination chamber (decon) on the containment. The decon will be the only route of entry or egress from the interior of containment.
   a. The decon will consist of three rooms: an equipment room (closest to containment), a shower (center), and a clean room.
   b. Airlock flaps or curtains shall be installed at both sides of all three rooms of the decon.
   c. The shower shall be stocked with soap and shall have running hot and cold water accessible to workers at all times.
The Contractor may elect to remove bags from the containment through the decon using the shower to decontaminate bags. In this case, the Contractor will adhere to the following waste decontamination sequence:

a. A worker in plain clothes stands in the clean room with an empty 6-mil poly bag.

b. Workers inside containment pass sealed bags of waste to a worker standing in the shower.

c. The worker in the shower washes the exterior of the waste bag, then passes it through the airlock flaps to the worker in the clean room and drops the cleaned bag into the empty bag, effectively double bagging it.

d. The worker in the clean room applies the required generator label to the bag and seals it, then hands the bag out to a worker on the outside of containment.

e. The worker outside of containment carries the bag to a lined, enclosed waste trailer or dumpster.

The Contractor also may elect to install a two stage bagout chamber as follows:

a. The bagout shall consist of two rooms, an inner room (closer to containment) and an outer room.

b. Air lock flaps or curtains shall divide the two rooms of the bagout and shall divide the inner room of the bagout from the containment and the outer room of the bagout from the area outside of containment.

Should the Contractor elect to construct a two-stage bagout, Contractor personnel will adhere to the following waste decontamination sequence:

a. A worker stands in the outer room of the bagout with an empty bag open and ready.

b. A worker in the inner room of the bagout washes off a sealed bag of waste using an airless sprayer, then passes the bag through the airlock flaps and drops it into the bag being held by the worker in the outer room of the bagout.

c. The worker in the outer room of the bagout applies the required generator label and seals the outer bag.

d. The worker in the outer room of the bagout may pass the bag out of the bagout through the airlock flaps to a worker outside of containment who takes the bag to the lined, enclosed waste trailer or dumpster, or

e. The worker in the outer room may stack double-bagged waste in the outer room of the bagout to be stored until Contractor personnel are ready to move bags to the lined, enclosed trailer or dumpster.

1. To prevent contamination of the outer room of the bagout and trip hazards, Contractor personnel shall not allow the floor of the outer room of the bagout to become cluttered with bags.
SECTION SEVEN: ABATEMENT PROCEDURES

1.0 Abatement Materials
The Contractor shall provide all necessary tools and materials to accomplish the removal of the specified Lead-based paint including but not limited to:
1.1 Wetting agents/surfactant to increase the ability of water to penetrate Lead-based paint
1.2 Airless sprayer or pump sprayer
1.3 Handheld scrapers for detail cleaning
1.4 Wire brushes or other scrubbers for detail cleaning
1.5 Rags
1.6 Spray Bottles
1.7 Waste Containers, 6-mil polyethylene bags or sealable 55-gallon steel drums

2.0 Restrictions on Work Times
2.1 The Contractor shall work during the dates and times outlined in Section 1 of this specification only.

3.0 The Following Equipment and Work Practices are Prohibited.
3.1 Lead coatings shall not be disturbed by using open flame burning or torching.
3.2 Lead coatings shall not be disturbed by machine sanding or grinding without a high-efficiency particulate air (HEPA) local exhaust control.
3.3 Lead coatings shall not be disturbed by abrasive blasting or sandblasting without HEPA local exhaust control.
3.4 Lead coatings shall not be disturbed by using heat guns operating above 1100 degrees Fahrenheit or charring the paint.
3.5 Lead coatings shall not be disturbed by dry sanding or dry scraping, except dry scraping in conjunction with heat guns or within 1.0 ft. (0.30 m.) of electrical outlets, or when treating defective paint spots totaling no more than 2 sq. ft. (0.2 sq. m.) in any one interior room or space, or totaling no more than 20 sq. ft. (2.0 sq. m.) on exterior surfaces.
3.6 Lead coatings shall not be disturbed by paint stripping in a poorly ventilated space using a volatile stripper that is a hazardous substance in accordance with regulations of the Consumer Product Safety Commission at 16 CFR 1500.3, and/or a hazardous chemical in accordance with the Occupational Safety and Health Administration regulations at 29 CFR 1910.1200 or 1926.59, as applicable to the work.

4.0 Lead-based Paint Removal
4.1 Lead-based paint shall be wetted down thoroughly and as often as necessary to prevent the emission of paint or dust.
4.2 If the removal is conducted in a regulated area, removal shall be conducted where the worker can be upwind when possible.
4.3 Contractor personnel shall remove paint using hand-held scrapers or wire brushes.
   a. Contractor personnel shall work in teams of two where one worker removes the paint while the other worker containerizes the loose paint in 6-mil poly bags or 55-gallon drums.
   b. The method shall not allow for the accumulation of Lead-based Paint waste on the floor of the work area.
4.4 Removed Lead-based paint shall be disposed of in doubled 6-mil polyethylene bags or sealable 55-gallon steel drums.
a. Removed Lead-based Paint shall not be allowed to dry before it is containerized.

4.5 If the Contractor elects to use 6-mil poly bags for waste, then materials containing sharp edges shall be placed in small cardboard boxes or wrapped with cardboard prior to bagging to prevent tearing of the bags.

4.6 Waste bags and containers shall be properly labeled with lead warning labels and generator labels.

4.7 All disposable materials and equipment shall be packaged for disposal.

4.8 Other equipment shall be moved to the equipment room, decontaminated, bagged, and removed from the regulated area or containment.

4.9 All free water in contaminated areas shall be collected and added to Lead-based Paint waste and/or placed in plastic lined, leak proof containers, solidified or filtered appropriately in accordance with all applicable regulations.

5.0 Final Clean-Up of Work Area:

5.1 When all specified lead-containing materials have been removed, Contractor personnel shall remove all waste bags from the work area.

5.2 All surfaces in the containment shall be cleaned using HEPA vacuuming and wet wiping, using disposable rags.
   a. Rags shall be disposed of as lead-containing waste and replaced regularly to avoid spreading contamination throughout the containment.
   b. If the Contractor has elected to use sealable 55-gallon steel drums, then the drums shall be sprayed and wet-wiped.

5.3 After fine cleaning is finished, the Contractor shall request a visual clearance inspection from the Lead Risk Assessor or the Air Monitoring Technician on site. If the containment does not pass the visual clearance inspection, Contractor personnel shall re-clean the containment and call for another visual clearance inspection.

5.4 Because the application of encapsulant may cause issues with the adhesion of new paint, no lock-down encapsulation shall be permitted on this project.

5.5 When the containment has passed visual clearance inspection, Contractor personnel shall remove all equipment from the work area, remove all barrier tape and warning signs and shower out of containment.
SECTION EIGHT: INSPECTIONS & AIR MONITORING

1.0 Inspections

1.1 The Lead Risk Assessor on site shall inspect the regulated area or containment prior to the start of work inside the containment to ensure the following:
   a. All critical barriers are in place, intact, and functioning as intended,
   b. Containment is adequately sealed and under negative pressure of no less than -0.020 inches of water column,
   c. The personnel decontamination chamber is in place, stocked, has running hot and cold water, and is functional, and
   d. If the Contractor has elected to use a two-chamber bagout, that the bagout is constructed according to this specification.

1.2 During the work, the Lead Risk Assessor on site shall conduct periodic inspections – not less than twice per day - of the exterior of containment to ensure that the Contractor is working in compliance with all applicable Federal, State, and Local regulations and this specification.

1.3 The Lead Risk Assessor on site shall conduct visual clearance inspections to ensure that all specified Lead-based Paint has been removed.

2.0 Air Monitoring

2.1 The Lead Risk Assessor shall provide an Air Monitoring Technician to be on the project site.

2.2 The Air Monitoring Technician shall have the following qualifications:
   a. Current EPA Air Monitoring Technician Training or Refresher
   b. Medical Surveillance Physical
   c. Current respirator fit test

2.3 The Air Monitoring Technician shall be responsible for collecting the following air samples:
   a. Upwind and downwind samples if the lead-based paint removal is conducted in a regulated area.
   b. Personal air samples on a minimum of ¼ of the Contractor’s personnel inside containment.
      1. Personal samples shall be taken in sufficient numbers and time lengths as to allow for calculation of an 8-hour time weighted average exposure and a 30-minute excursion limit exposure.

2.4 The Air Monitoring Technician shall be responsible for shipping of all air samples to a NLLAP accredited lab for analysis.
   a. All air samples shall be analyzed using the Flame Atomic Absorption Spectrophotometer (AAS) method and adhering to the Lab’s written QA/QC plan.

3.0 Final Visual Clearance

3.1 Final visual clearance shall be conducted after all lead-based paint has been removed or stabilized.
SECTION NINE: LEAD-BASED PAINT HANDLING & DISPOSAL

1.0 Lead Containing Waste Requirements

1.1 The Contractor shall maintain compliance with the strictest set of regulations of U. S. EPA, OSHA’s Hazard Communication Standard, Department of Transportation and other applicable standards. Note: Any penalties incurred for failure to comply with any of the above regulations, will be the sole responsibility of the Contractor and his Sub-Contractors. The Owner(s) claims no responsibility for fines imposed due to the negligence of the Contractor.

1.2 Keep lead contaminated waste (LCW) separate from any other waste.

1.3 Keep LCW in a secured, enclosed, and locked container which has been lined with 6-mil polyethylene sheeting.

1.4 Prior to transport the Contractor shall:
   a. Ensure that LCW has been sufficiently wet down.
   b. Ensure the integrity of the airtight seals on waste bags or drums.
   c. Re-wet and re-package any damaged containers.
   d. Ensure that the person transporting lead waste holds a valid permit issued pursuant to State of Texas regulations

1.5 Transport of LCW
   a. Ensure that the LCW has been sufficiently wet down in a leak tight container.
   b. Examine the integrity of the container's leak tight seal at a minimum of once per 24-hour period.
   c. Re-wet and re-package any damaged containers.
   d. Maintain at storage site an adequate supply of spare leak tight containers.
   e. Maintain at storage site an adequate supply of amended water.
   f. Keep LCW separate from any other waste.
   g. Keep LCW in a secured, enclosed and locked container.

1.6 The Contractor or Sub-Contractor at the time of presenting for disposal of LCW shall comply with all applicable TCEQ, OSHA, EPA and DOT regulations issued pursuant to lead disposal.

1.7 For storage in the generation site the Contractor shall:
   a. Ensure that all waste to be stored is double-bagged in 6-mil polyethylene bags or sealed in 55-gallon steel drums while wet,
   b. Ensure that waste is stored in the outer room of the bagout chamber or in a room which has been lined with 6-mil polyethylene sheeting.
   c. Keep LCW separate from any other waste.

1.8 LCW shall be stored on the generation site either in a poly-lined room or a lined, enclosed and locked trailer or dumpster until such time as it can be transported to an approved lead disposal landfill.

1.9 LCW Disposal:
   a. The Contractor shall transport all sealed LCW to a landfill site approved by the Texas Commission on Environmental Quality (TCEQ).
   b. Transportation shall be performed by a DOT licensed waste-hauler.
   c. The Contractor shall be responsible for maintaining all sealed containers during the processing of bags (i.e. handling, loading, transporting, unloading).
   d. At the completion of the project the Contractor shall provide a manifest duly executed by the Contractor, the transporter, and the disposal facility. The manifest shall be all-inclusive, describing the volume of materials, dates of
transport and date of disposal. A waste manifest shall be produced for each load.
e. The enclosed trailer or dumpster that is to receive lead material and other refuse from the contaminated area may be located adjacent to the exterior door as selected by the Contractor and approved by the Owner(s).
f. The trailer or dumpster is to be of the totally closeable type and is to be kept closed and locked to prevent vandalism.
Lead Sampling Report

Presented To:

Millennium Engineers Group, Inc.
5804 N. Gumwood Ave.
Pharr, Texas, 78577

Project:

Sandhills State Park (Section House)
2500 E. I-20
Monahans, Texas, 79756

E-Tech Project 1280-12963-000

Inspection Date: 25 August 2020
Report Date: 28 August 2020
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Attachment 1 - Lab Results
Attachment 2 - Chain of Custody
Attachment 3 - Photo Log
Attachment 4 – Site Drawing
Attachment 5 – Copy of E-Tech License
1.0 Executive Summary

E-Tech Environmental and Safety Solutions, Inc. was retained to perform lead paint inspection of the Section House located at the Sandhills State Park east of Monahans, Texas.

On 25 August 2020, Wally McNeil of E-Tech performed a visual inspection and collected bulk samples of suspect lead paint. A total of six (6) paint chip samples were taken for lead analysis.

The paint chip samples were submitted under chain of custody for standard turn around analysis to Accurate Analytical Testing in Romulus, Michigan. Accurate Analytical Testing laboratory is NELAC accredited for lead-based paint analysis. The analytical results indicate that four (4) of the samples contained greater than 5,000 parts per million of lead, the EPA threshold for lead in paint.

2.0 Lead-Based Paint Sampling Methodology

Each test location was identified numerically and plotted on a site drawing of the Section House. A two inch by two inch square was drawn at each sample location. The perimeter of the square was scored using a utility knife. After the square was scored, a chisel was used to scrape the paint from the test area into a zip-lock storage bag. The zip-lock bag was labeled and submitted with a chain of custody to Accurate Analytical Testing, a NELAC certified lab.

3.0 Conclusions

Four (4) of the paint chip samples were above the threshold of 5,000 ppm. The positive samples are identified as:

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Approximate Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>L3</td>
<td>Exterior Siding</td>
</tr>
<tr>
<td>L4</td>
<td>Exterior Bunting</td>
</tr>
<tr>
<td>L5</td>
<td>Exterior Door</td>
</tr>
<tr>
<td>L6</td>
<td>Exterior Door Casing</td>
</tr>
</tbody>
</table>

4.0 Recommendations

Stabilize the areas that have been identified as lead containing prior to disturbance during planned renovations.

Hire a certified lead Renovation, Repair and Painting (RRP) contractor to stabilize or remove the lead from the identified areas.

Ensure that areas that are not disturbed, but that are identified to contain lead, are maintained in good condition, no cracked or peeling paint.

Do not dry sand or dry scrape lead containing identified areas.
Properly dispose of any lead contaminated materials that are removed.

5.0 Limitations

The field observations, measurements and research reported herein are considered sufficient in detail and scope to determine the asbestos content of the tested materials at the subject property on the date of the inspection. The assessment, conclusions and recommendations presented herein are based upon specifically limited data. They do not represent all conditions at the subject property. E-Tech warrants the findings and conclusions contained herein have been promulgated in accordance with generally accepted industrial hygiene methodology and only for the site described in this report.

6.0 Use by Third Parties

This report was prepared pursuant to the agreement between E-Tech and Millennium Engineers Group, Inc. The agreement relationship included an exchange of information about the subject property. Reliance or any use of this report by anyone other than the client, for whom it was prepared, is prohibited and therefore not foreseeable to E-Tech.

Reliance or use by any such third party without explicit authorization of the report does not make said third party a third party beneficiary to E-Tech’s agreement with the client. Any such unauthorized reliance on or use of this report, including any of its information or conclusions, will be at third party’s risk. For the same reasons, no warranties or representations, expressed or implied in this report, are made to any such third party.

7.0 Unidentifiable Conditions

This lead related environmental consulting report has been developed to provide the client with information regarding apparent conditions related to the subject property. Although E Tech believes that the findings and conclusions provided in this report are reasonable, the assessment is necessarily limited to the conditions observed and to the information available at the time of the inspection. Due to the nature of the work, there is a possibility conditions exist that could not be identified within the scope of the assessment or which were not apparent at the time it was conducted. It is also possible that the testing methods employed at the time of the report may later be superseded by other methods. E-Tech does not accept responsibility for changes in the state of the art.

We have employed state-of-the-art practices to perform this analysis of risk and identification, but this evaluation is limited in scope to the areas listed above. Our services consist of professional opinions and recommendations made in accordance with generally accepted engineering principles and practices.
Written by,

Jimmy W. McNeil, Jr.
Lead Risk Assessor
Certificate # 2070395
Expires: 5/26/2020
Attachments

Attachment 1 - Paint Chip Lab Results
Attachment 2 - Chain of Custody
Attachment 3 - Photographs
Attachment 4 - Copy of E-Tech License
Paint Chip Lab Results
Certificate of Analysis: Lead In Paint by EPA SW-846 7420 and 3050B*

<table>
<thead>
<tr>
<th>Lab Sample ID</th>
<th>Client Code</th>
<th>Sample Description</th>
<th>PPM</th>
<th>Result Lead (% by weight)</th>
<th>Calculated R L (% by weight)</th>
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<tbody>
<tr>
<td>5646808</td>
<td>L1</td>
<td>EXT WINDOW CASING 4 SQ IN</td>
<td>539</td>
<td>0.0539</td>
<td>0.0007</td>
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<tr>
<td>5646809</td>
<td>L2</td>
<td>EXT WINDOW CASING 4 SQ IN</td>
<td>308</td>
<td>0.0308</td>
<td>0.0009</td>
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<tr>
<td>5646810</td>
<td>L3</td>
<td>EXT SIDING 4 SQ IN</td>
<td>39097</td>
<td>3.9097</td>
<td>0.0006</td>
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<tr>
<td>5646811</td>
<td>L4</td>
<td>EXT BUNTING 4 SQ IN</td>
<td>18220</td>
<td>1.8220</td>
<td>0.0006</td>
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<tr>
<td>5646812</td>
<td>L5</td>
<td>EXT DOOR 4 SQ IN</td>
<td>6898</td>
<td>0.6898</td>
<td>0.0006</td>
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<tr>
<td>5646813</td>
<td>L6</td>
<td>EXT DOOR CASING 4 SQ IN</td>
<td>8747</td>
<td>0.8747</td>
<td>0.0005</td>
</tr>
</tbody>
</table>

Analyst Signature

Tom Hamlin

---

RL= Reporting Limit  * For true values assume (2) significant figures. The method and batch QC is acceptable unless otherwise stated. Current EPA/HUD Interim Standard for lead in paint samples is: 5000 PPM (parts per million) or ug/g which is equivalent to 0.5% by weight. AAT internal sop S203. The laboratory operates in accord with ISO 17025 guidelines and holds limited scopes of accreditation under AIHA-LAP and NY State DOH ELAP programs. These results are submitted pursuant to AAT LLC current terms and conditions of sale, including the company's standard warranty and limitation of liability provisions. Analytical results relate to the samples as received by the lab. AAT will not assume any liability or responsibility for the manner in which the results are used or interpreted. Reproduction of this document other than in its entirety is not permitted. All Quality control requirements for the samples this report contains have been met. AAT does not blank correct reported values. Sample data apply only to items analyzed. Samples are stored for 15 days following report date. *= Validated modified method  AIHA LAP- Lab ID #100986, NY State DOH ELAP -Lab ID #11864, State of Ohio- Lab ID # 10042

Date Printed: 08/28/2020 4:14AM  
AAT Project: 584545
To: E Tech Environmental  
13000 W County Road 100  
Odessa, TX 79765  

Att: Wally McNeil  
Email: wally@etechenv.com  
Phone: 432-559-3566  

AAT Project: 584545  
Client Project: 12963  
Date Reported: 8/28/2020 4:00:00AM  

Project Location: 2500 W. I-20  

<table>
<thead>
<tr>
<th>Sample</th>
<th>Client Code</th>
<th>Analysis Requested</th>
<th>Completed</th>
<th>Analyst</th>
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<tbody>
<tr>
<td>5646808</td>
<td>L1</td>
<td>Lead Paint</td>
<td>08/27/2020</td>
<td>Tom Hamlin</td>
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<tr>
<td>5646809</td>
<td>L2</td>
<td>Lead Paint</td>
<td>08/27/2020</td>
<td>Tom Hamlin</td>
</tr>
<tr>
<td>5646810</td>
<td>L3</td>
<td>Lead Paint</td>
<td>08/27/2020</td>
<td>Tom Hamlin</td>
</tr>
<tr>
<td>5646811</td>
<td>L4</td>
<td>Lead Paint</td>
<td>08/27/2020</td>
<td>Tom Hamlin</td>
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<tr>
<td>5646812</td>
<td>L5</td>
<td>Lead Paint</td>
<td>08/27/2020</td>
<td>Tom Hamlin</td>
</tr>
<tr>
<td>5646813</td>
<td>L6</td>
<td>Lead Paint</td>
<td>08/27/2020</td>
<td>Tom Hamlin</td>
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</tbody>
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Reviewed By: Quality Assurance Coordinator - Stephen Northcott
Chain of Custody
**PROJECT NUMBER** 12963  
**SAMPLE DATE** 8/25/2020

**PROJECT ADDRESS** 2500 E. I-20

**SAMPLE START TIME** 8:45  
**SAMPLE END TIME** 9:30

<table>
<thead>
<tr>
<th>SAMPLE ID</th>
<th>ROOM</th>
<th>ROOM USAGE</th>
<th>S; T; F</th>
<th>AREA</th>
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<tbody>
<tr>
<td>L1</td>
<td>Extetior</td>
<td>Window Casing</td>
<td>4 sq. inches</td>
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<tr>
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<td>Extetior</td>
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<td>4 sq. inches</td>
<td></td>
</tr>
<tr>
<td>L3</td>
<td>Extetior</td>
<td>Siding</td>
<td>4 sq. inches</td>
<td></td>
</tr>
<tr>
<td>L4</td>
<td>Extetior</td>
<td>Bunting</td>
<td>4 sq. inches</td>
<td></td>
</tr>
<tr>
<td>L5</td>
<td>Extetior</td>
<td>Door</td>
<td>4 sq. inches</td>
<td></td>
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<tr>
<td>L6</td>
<td>Extetior</td>
<td>Door Casing</td>
<td>4 sq. inches</td>
<td></td>
</tr>
</tbody>
</table>

**REQUESTED ANALYSIS**

- LEAD / PPM
  - SINGLE WIPE DUST: ( )
  - PAINT CHIP: (X)

**SUBMITTING COMPANY**

E-Tech Environmental  
13000 W. CR 100  
Odessa, Tx. 79765

**CONTACT INFORMATION**

Wally McNeil  
Office: 432-563-2200  
Fax: 432-563-2213  
Cell: 432-559-3566  
Email: wally@etechenv.com

**TURN AROUND TIME**

- SAME DAY ( )  
- 48 HOUR ( )  
- 24 HOUR ( )  
- STD (X)

**CLIENT COMMENTS**

FLAA

**SAMPLE CONDITION**

- SEALS INTACT: Y N
- PRESERVATIVES: Y N
- CONTAINERS LABELED: Y N

**LAB REMARKS**

**LAB PROJECT NUMBER** 5841545

**SAMPLES RELINQUISHED BY**  
Wally McNeil  
**SAMPLES RECEIVED BY**  
1600  
**TIME**

- AM:  
- PM:
Attachment 3 - Photographs
<table>
<thead>
<tr>
<th>Photo No:</th>
<th>1.</th>
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<tbody>
<tr>
<td><strong>Direction Taken:</strong></td>
<td>West</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td>Sign outside of the Section House.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Photo No:</th>
<th>2.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direction Taken:</strong></td>
<td>West</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td>Front entrance or east side of the Section House.</td>
</tr>
<tr>
<td>Photo No.</td>
<td>3.</td>
</tr>
<tr>
<td>----------</td>
<td>----</td>
</tr>
<tr>
<td><strong>Direction Taken:</strong></td>
<td>South</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td>North side of the Section House.</td>
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<table>
<thead>
<tr>
<th>Photo No.</th>
<th>4.</th>
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<tbody>
<tr>
<td><strong>Direction Taken:</strong></td>
<td>East</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td>West side of the Section House.</td>
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</tbody>
</table>
Project Name: Sandhills State Park  
Project No: 1280-12963-000

<table>
<thead>
<tr>
<th>Photo No:</th>
<th>5.</th>
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</thead>
<tbody>
<tr>
<td><strong>Direction Taken:</strong></td>
<td>Northeast</td>
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<tr>
<td><strong>Description:</strong></td>
<td>South side of the Section House.</td>
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<table>
<thead>
<tr>
<th>Photo No:</th>
<th>6.</th>
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<tbody>
<tr>
<td><strong>Direction Taken:</strong></td>
<td>North</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td>Typical window and window casing for the Section House.</td>
</tr>
<tr>
<td>Photo No.</td>
<td>7.</td>
</tr>
<tr>
<td>-----------</td>
<td>----</td>
</tr>
<tr>
<td><strong>Direction Taken:</strong></td>
<td>North</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td>Close-up of a window and window casing.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Photo No.</th>
<th>8.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direction Taken:</strong></td>
<td>North</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td>Typical window and window casing for the Section House.</td>
</tr>
</tbody>
</table>
Project Name: Sandhills State Park  
Project No: 1280-12963-000

Photograph Log  
Date Taken: August 25, 2020

Photo No: 9.

Direction Taken:  
North

Description:  
Close-up of the cracked paint on the window casing.

Photo No: 10.

Direction Taken:  
Northwest

Description:  
Siding and bunting on the east side of the Section House.
**Photo No:** 11.

**Direction Taken:** West

**Description:** Close-up of the cracked paint on the siding.
Attachment 4 – Site Drawing
Attachment 5 - Copy of E-Tech License
Texas Department of State Health Services

BE IT KNOWN THAT:

ETECH ENVIRONMENTAL & SAFETY SOLUTIONS, INC.

is certified to perform as a

Lead Firm

in the State of Texas and is hereby governed by the rights, privileges and responsibilities set forth in Texas Occupations Code, Chapter 1553 and Title 25, Texas Administrative Code, Chapter 295 relating to Texas Environmental Lead Reduction, as long as this license is not suspended or revoked.

Certification Number: 2110806
Expiration Date: 06/19/2022

Control Number: 7185

John Hellerstedt, M.D., Commissioner of Health

(Void After Expiration Date)

VOID IF ALTERED  NON-TRANSFERABLE  SEE BACK
Texas Department of State Health Services

BE IT KNOWN THAT

JIMMY W MCNEIL JR

is certified to perform as a

Lead Risk Assessor

in the State of Texas and is hereby governed by the rights, privileges and responsibilities
set forth in Texas Occupations Code, Chapter 1955 and Title 25, Texas Administrative Code, Chapter 205
relating to Texas Environmental Lead Reduction, as long as this license is not suspended or revoked.

Certification Number: 2070395  Expiration Date: 05/26/2022

Control Number: 7764

John Hellerstedt, M.D.,
Commissioner of Health

(Void After Expiration Date)

VOID IF ALTERED  NON-TRANSFERABLE

SEE BACK
Mold Remediation Protocol
Monahans Sandhills State Park Visitor Center

Prepared For:
Millennium Engineers Group, Inc.
5804 N. Gumwood Avenue
Pharr, TX 78577

Issue Date: 9/3/2020

Prepared By:
Brandon Smitherman
Mold Assessment Consultant
°Tech Environmental & Safety Solutions, Inc.
P.O. Box 62228 Midland, TX 79711

°Tech Project #: 1280-13588-000
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1. **Introduction**

This protocol is for the remediation of mold and mold-contaminated materials at the Monahans Sandhills State Park Visitor Center located at 2500 E. I-20, Exit 86 near Monahans, Texas.

The remediation will be conducted by a licensed Mold Remediation Company employing at least one (1) licensed Mold Remediation Contractor (Contractor) and registered Mold Remediation Workers. The post remediation verification will be conducted by a licensed Mold Assessment Consultant (Consultant). Upon completion of the remediation and verification, The Mold Assessment Consultant and Mold Remediation Contractor will provide a completed Certificate of Mold Damage Remediation to the Property Owner and client.

The remediation work will be performed in accordance with this protocol, Texas Occupations Code Chapter 1958, 16 Texas Administrative Code Chapter 78, and all other applicable Federal, State, and Local regulations.

2. **Scope of Work**

The scope of work will be as follows:

- Remove approximately 3,700 square feet of mold contaminated carpet
- Remove approximately 133 square feet of mold-contaminated ceiling drywall
- Thoroughly clean and disinfect underlying substrates and wood framework.

See the floor plan below showing the location of the materials to be removed.

3. **Coordination**

3.1. **Contractor Responsibilities**

3.1.1. Communicate and coordinate with the Client, Property Owner, and Consultant.

3.1.2. File the required Notification of Mold Remediation Activities with the Texas Department of Licensing & Regulation no less than five (5) calendar days prior to the start date of the remediation project and amend the notification if necessary, during the project to ensure that the department is notified of accurate Project Start and Stop Dates.

3.1.3. Prepare a remediation work plan specific to the project which fulfills all requirements of this protocol and provides specific instructions and/or standard operating procedures for the performance of the remediation project and provide the work plan to the client at least one day prior to the start date of the remediation.

3.1.4. Conduct the remediation in accordance with the work plan.

3.1.5. Ensure all Contractor staff use PPE as outlined in the protocol and/or work plan.

3.1.6. Immediately inform the Consultant in the even that conditions are encountered which
might cause a significant change in the scope of the project.

3.1.7. Comply with and accommodate the inspections by the Consultant including the post remediation assessment and periodic inspections during the remediation work.

3.1.8. Ensure that containment remains in place until the Consultant issues written notification that the project has achieved clearance.

3.1.9. Provide copies of before and after photographs of the remediation scene to the property owner within seven (7) calendar days after the project stop date.

3.1.10. Coordinate with the Consultant to provide a completed Certificate of Mold Damage Remediation to the property owner no more than ten (10) calendar days after the project stop date.

3.2. Consultant Responsibilities

3.2.1. Communicate and coordinate with Contractor, Client, and Property Owner.

3.2.2. Conduct at least one inspection during the active remediation work to ensure that the procedures outlined in the work plan and this protocol are being followed.

3.2.3. Provide timely recommendations to the Property Owner and Client if unexpected conditions are encountered during the remediation and provide directions on handling such situations to the Contractor.

3.2.4. Conduct post remediation assessment and clearance according to the criteria laid out in paragraph 8 of this protocol.

3.2.5. Issue a written passed clearance report to the client at the conclusion of the remediation to include:

- A description of relevant worksite observations,
- The type and location of measurements and samples collected,
- All data including temperature, humidity and material moisture readings,
- Results of analytical evaluation of the samples,
- Copies of all photographs taken by the Consultant, and
- A clear statement that the project has passed clearance.

4. Equipment & Materials

The Contractor will provide all necessary equipment and materials including but not limited to the following:

- Notice signs – minimum of 8” x 10” with black lettering on yellow background reading “NOTICE: Mold remediation in progress”
- 6-mil polyethylene sheeting
- Abatement-grade duct tape and spray adhesive
- HEPA filtered negative air machines
- Dehumidifiers – sufficient to maintain relative humidity inside containment to 50% (± 5%)
- HEPA vacuums
- Disinfectants/Biocides – Contractor may select type/s and brand/s based on his experience however his selection/s must be registered by the EPA for the intended use. The contractor will provide the Client and Property Owner with safety data sheets and proof of EPA registration for any such products used on this project. **The use of anti-microbial coatings or other long-lasting products will not be permitted on this project.**
• All necessary tools
• Manometer capable of digitally recording negative pressure readings during all times of active remediation.

5. **Containment**

Only individuals licensed or registered under 16 TAC Chapter 78 will be allowed inside the Visitor Center building at any time between the start date and the stop date of the remediation.

5.1. **Containment Delineation**

There will be one (1) containment on this project. The containment will include the majority of the interior of the Visitor Center building. When the carpet remediation is completed and all cleaning and disinfecting in the main part of the building is finished, the active portion of the containment will be reduced to include only the northwest vestibule. See floor plans below showing the containment design.

5.2. **Notice signs**

Install notice signs reading “NOTICE: Mold remediation in progress” written in black lettering on a yellow background with a minimum size of 8” x 10” at all building entrances.

5.3. **Critical Barriers**

Prior to beginning any remediation activities, install critical barriers made of at least one layer of 6-mil polyethylene sheeting over all supply and return air vents. Seal critical barriers air-tight using spray glue and/or tape to prevent any airflow in or out of the HVAC duct system during remediation activities. Additional critical barriers will be installed over all windows and over any other openings as necessary to achieve and maintain negative pressure inside the Visitor Center building.

5.4. **Surface Protection**

Install walls of 6-mil poly as indicated on the floor plan above to prevent contamination of the walls. Coordinate with the Client to determine whether the lay-in ceiling tiles will be gone at the time of the remediation. If the lay-in ceiling is to be in place, consider inverted prep to prevent contamination of ceiling tiles. Install a layer of 6-mil poly over any additional surfaces such as floors, immovable objects, etc.

5.5. **Negative Pressure & Recirculation**

Install at least one (1) HEPA filtered negative air machines at each location indicated on the floor plan above. Additionally, negative air machines may be placed in the exterior doorway of the northeast vestibule if necessary to provide adequate negative pressure.
Use negative air machines in sufficient numbers to maintain negative pressure in the building of at least -0.02 inches of water column during all mold disturbance activities. Negative air machines will be in operation throughout all remediation activities and at the Contractor’s discretion, may be powered down overnight.

Duct the exhaust of all negative air machines outdoors during active remediation.

Connect a manometer capable of digitally recording negative pressure readings throughout the project. During the carpet remediation, the manometer’s differential pressure hose may terminate anywhere inside the building. During the ceiling remediation, the differential pressure hose must terminate inside the northwest vestibule.

Upon completion of all remediation activities inside the containment, operate negative air machines inside containment in “recirculation mode” for at least twenty-four (24) hours prior to the Consultant’s post remediation assessment. Recirculation will continue until such time as the Consultant provides written notice that the project has achieved clearance or until such time as the Consultant provides notice that the project has failed to achieve clearance.

If the project fails to achieve clearance, then the negative air machines will be re-installed and ducted outdoors throughout additional remediation activities. When the Contractor is finished re-cleaning, the negative air machines will be placed into “recirculation mode” for 24 hours prior to the next post remediation assessment.

5.6. Decontamination

Construct a decontamination chamber in the south vestibule as shown on the floor plan above. The decontamination chamber must consist of a minimum of one (1) chamber of sufficient size for workers to don and doff disposable coveralls and to house a waste bag for disposal of coveralls.

6. Personal Protective Equipment

6.1. Respiratory Protection

At the time of the mold assessment inspection, an asbestos inspection was also conducted at the Visitor Center. All materials tested negative for asbestos. A copy of the asbestos inspection should be kept on site during all demolition/renovation activities. Minimum respiratory protection for this project will be NIOSH certified N-95 dust masks. The Contractor may require increased respiratory protection at his discretion.

6.2. Other PPE

Tyvek or other brand of impermeable disposable coveralls will be required for entry into the containment. Provide steel-toed rubber boots, gloves, eye protection, and Hardhats.

7. Remediation Method

7.1. Order of Remediation

7.1.1. Remove carpet & Clean/disinfect substrates
7.1.2. Close the door between the southwest vestibule and the main building area
7.1.3. Remove the drywall ceiling in the southwest vestibule & clean/disinfect substrates

7.2. Mold-Contaminated Carpet

7.2.1. Remove the carpet beginning on the west end of the building and working west.
7.2.2. Cut the carpet into manageable strips
7.2.3. Lift strips of carpet off the slab as intact as possible
7.2.4. Roll carpet strips and move them to a dumpster or waste trailer.
7.2.5. If there is visible discoloration under the carpet, remove the carpet glue and thoroughly
clean and disinfect to at least two (2) feet beyond the discolored areas.

7.2.6. Conduct fine cleaning working from ceiling to walls to floors using wet wiping and/or HEPA vacuuming methods.

7.3. **Mold-Contaminated Drywall Ceiling**

7.3.1. Prevent the spread of contamination from the southwest vestibule into the main building by sealing the door between the southwest vestibule and the main building. This may be accomplished by lining the door with poly and closing the door or by installing a set of airlock flaps over the doorway.

7.3.2. Remove the ceiling drywall using caution to remove the largest pieces possible, causing minimal disturbance.

7.3.3. Bag or wrap the drywall in 6-mil poly and transport it to the dumpster.

7.3.4. Thoroughly clean/disinfect any discolored wood framing or other discolored substrate made visible by removing the drywall. Disinfect a minimum of two (2) feet beyond any discoloration.

7.3.5. Conduct fine cleaning, removing any dust or other particles starting at the ceiling, proceeding down the walls and finishing with the floor using wet wiping and/or HEPA vacuuming methods.

7.4. **Recirculation**

7.4.1. When all active remediation work is completed, the Contractor will leave the containment intact, open the door between the main building and the northwest vestibule, seal exterior doors, and place the HEPA filtered negative air machines into “recirculation mode” – placing the machines inside the containment to continuously recirculate and filter the air for twenty-four (24) hours prior to the post remediation assessment.

Recirculation will continue until the Consultant provides written notice that the project has achieved clearance or until the Consultant provides notice that the project has failed to achieve clearance.

If the project fails to achieve clearance, the Contractor will re-install the negative air machines as they were during the remediation, conduct re-cleaning and then operate the negative air machines in recirculation mode for 24 hours prior to the next post remediation assessment.

8. **Post Remediation Assessment**

The Consultant will conduct a post-remediation assessment no sooner than 24 hours after all remediation activity is completed in the containment. The Contractor will ensure that the containment is left in place until the Consultant provides written notice that the project has achieved clearance.

8.1. **Clearance Criteria**

8.1.1. Visual – The Consultant will visually inspect the areas inside of containment for visible mold growth and mold contamination. If the Consultant finds the containment free of visible mold contamination and wood rot, the assessment will continue to procedural testing.

8.1.2. Procedural – The consultant will collect the following:

- Temperature readings from central in each room of containment,
Relative Humidity readings from central in each room of containment,
- Moisture content readings from each exposed substrate (this excludes materials which remain covered in poly), and
- Photos including wide angles of the interior of containment and close-ups of specific areas where mold contamination was visible during the initial assessment.

If the Consultant finds relative humidity no greater than 55% and moisture content of all materials within normal ranges for each material tested, then the assessment will proceed to the analytical testing.

8.1.3. Analytical – The consultant will collect no fewer than five (6) spore trap air samples throughout the building including at least one in each of the three display rooms on the west end of the building and at least one in the northwest vestibule. The consultant will also collect at least two spore trap air samples from outdoors; one (1) sample from north of the visitor center and one (1) sample from south of the visitor center. The samples will be sent to a laboratory under chain of custody and analyzed on 1-day turnaround.

8.1.4. Clearance Criteria – The project will be considered “cleared” after a post remediation assessment where:
- No visible mold is observed,
- No visible wood rot is observed,
- All relative humidity readings are no greater than 55%,
- All moisture content readings are within normal ranges,
- Analysis of spore traps indicates that samples collected indoors have lower total spore concentrations than those collected outdoors.

9. Reporting & CMDR

9.1. Passed Clearance Report
The Consultant will provide the Client with a written Passed Clearance Report or notice of failure to achieve clearance upon receipt of analytical results following a post remediation assessment.

9.2. Photos
Within seven (7) days of the project stop date, the Contractor will provide the Property Owner with copies of photos taken of the remediation scene before and after the remediation.

9.3. Certificate of Mold Damage Remediation
Within ten (10) days of the project stop date, the Contractor will provide the Property Owner with a completed Certificate of Mold Damage Remediation (CMDR). The CMDR must be completed by the Contractor and the Consultant; both Contractor and Consultant are responsible for coordinating to complete the CMDR in a timely fashion so that the Contractor can meet the 10-day deadline for submittal.