NEW BRAUNFELS POLICE HEADQUARTERS

3030 W. San Antonio Street
New Braunfels, Texas 78130

SPECIFICATIONS: Construction Documents Addendum 2

September 30, 2020

PGAL Project No. R1004389.00

Prepared by
SPECIFICATIONS

DIVISION 00 – CONTRACT DOCUMENTS – Supplemental Information Under Separate Cover

DIVISION 1 - GENERAL REQUIREMENTS

DIVISION 2 – EXISTING CONDITIONS (Not Used)
DIVISION 3 – CONCRETE
03 10 00 Concrete Forming and Accessories
03 20 00 Concrete Reinforcing
03 30 00 Cast-In-Place Concrete

DIVISION 4 – MASONRY
04 20 00 Unit Masonry
04 22 13 Structural Reinforced Concrete Unit Masonry
04 42 00 Exterior Stone
04 72 00 Cast Stone Masonry

DIVISION 5 - METALS
05 12 00 Structural Steel Framing
05 21 00 Steel Joist Framing
05 31 00 Steel Decking
05 40 00 Cold-Formed Metal Framing
05 50 00 Metal Fabrications
05 51 00 Metal Stairs
05 51 33.23 Alternating Tread Stairs
05 52 13 Pipe and Tube Railings

DIVISION 6 – WOOD, PLASTICS, AND COMPOSITES
06 10 00 Rough Carpentry
06 16 00 Sheathing
06 40 00 Interior Millwork
06 41 16 Plastic –Laminate- Faced Architectural Cabinets
06 64 00 Plastic Paneling

DIVISION 7 - THERMAL AND MOISTURE PROTECTION
07 17 00 Bentonite Waterproof
07 19 00 Water Repellants
07 21 00 Insulation
07 21 19 Foamed-in-Place Insulation
07 24 00 Cement Board Stucco System
07 27 26 Fluid Applied Membrane Air Barriers
07 41 13.16 Standing Seam Metal Roof Panels
07 42 93 Soffit Panels
07 46 43 Rear Ventilated Façade System
07 54 23 Thermoplastic Membrane Roofing
07 62 00 Sheet Metal Flashing and Trim
07 71 00 Roof Specialties
07 72 00 Roof Accessories
07 81 00 Applied Fire Protection
07 84 13 Penetration Firestopping
07 92 00 Joint Sealant
DIVISION 8 – OPENINGS

08 11 13  Hollow Metal Doors and Frames
08 12 16  Aluminum Frames
08 14 16  Flush Wood Doors
08 31 13  Access Doors and Frames
08 33 36  Overhead Coiling Doors
08 41 13  Aluminum Framed Storefronts
08 42 36  Extruded Aluminum Balanced Doors
08 44 13  Glazed Aluminum Curtain Walls
08 51 13  Aluminum Windows
08 56 53  Security Windows
08 71 00  Finish Hardware
08 71 13  Automatic Door Operators
08 80 00  Glazing
08 83 00  Mirrors
08 88 53  Security Glazing
08 90 00  Louvers and Vents

DIVISION 9 – FINISHES

09 08 00  Sound Management Barrier
09 21 16  Gypsum Board Shaft Wall Assemblies
09 22 16  Non-Structural Metal Framing
09 29 00  Gypsum Board
09 30 00  Tiling
09 50 00  Acoustic Metal Ceilings
09 51 13  Acoustical Panel Ceiling
09 65 13  Resilient Base and Accessories
09 65 16.23 Resilient Sheet Flooring
09 65 66  Resilient Athletic Flooring
09 68 13  Tile Carpeting
09 84 33  Sound-Absorbing Wall Units
09 91 13  Exterior Painting
09 91 23  Interior Painting
09 93 00  Staining and Transparent Finishing
09 96 56  Epoxy Floor Coatings

DIVISION 10 – SPECIALTIES

10 12 00  Display Cases
10 14 00  Signage
10 21 13  Toilet Compartments
10 22 13  Wire mesh Partitions
10 26 00  Wall and Door Protection
10 26 41  Bullet Resistant Panels
10 28 00  Toilet Accessories
10 44 13  Fire Extinguisher Cabinets
10 44 16  Fire Extinguishers
10 65 00  Operable Partition
10 73 15  Extruded Aluminum Canopies
### DIVISION 11 – EQUIPMENT

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 31 00</td>
<td>Residential Appliances</td>
</tr>
<tr>
<td>11 53 13</td>
<td>Laboratory Fume hoods</td>
</tr>
</tbody>
</table>

### DIVISION 12 – FURNISHINGS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 21 13</td>
<td>Horizontal Louver Blinds</td>
</tr>
<tr>
<td>12 24 13</td>
<td>Roller Window Shades</td>
</tr>
<tr>
<td>12 36 16</td>
<td>Metal Countertops</td>
</tr>
<tr>
<td>12 36 53</td>
<td>Laboratory Work Surface Tops Phenolic</td>
</tr>
<tr>
<td>12 36 61.19</td>
<td>Quartz Agglomerate Countertops</td>
</tr>
</tbody>
</table>

### DIVISION 13 – SPECIAL CONSTRUCTION

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 10 10</td>
<td>Bullet Resistant Partitions and Equipment (includes Doors)</td>
</tr>
<tr>
<td>13 34 19</td>
<td>Metal Building Systems</td>
</tr>
</tbody>
</table>

### DIVISION 14 – CONVEYING SYSTEMS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 24 00</td>
<td>Hydraulic Elevators</td>
</tr>
<tr>
<td>14 58 10</td>
<td>Pneumatic Tube 09.10.20 Add 1</td>
</tr>
</tbody>
</table>

### DIVISION 21 – FIRE SUPPRESSION

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 02 01</td>
<td>Coordination Drawings</td>
</tr>
<tr>
<td>21 05 29</td>
<td>Hangers and Supports for Fire Suppression Piping and Equipment</td>
</tr>
<tr>
<td>21 13 13</td>
<td>Wet Pipe Sprinkler System</td>
</tr>
<tr>
<td>21 13 19</td>
<td>Preaction Sprinkler Systems</td>
</tr>
<tr>
<td>21 22 00</td>
<td>Ecaro-25 Clean Agent Specifications</td>
</tr>
</tbody>
</table>

### DIVISION 22 – PLUMBING

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 02 00</td>
<td>Basic Materials and Methods</td>
</tr>
<tr>
<td>22 02 01</td>
<td>Coordination Drawings</td>
</tr>
<tr>
<td>22 05 13</td>
<td>Common Motor Requirements for Plumbing Equipment</td>
</tr>
<tr>
<td>22 05 16</td>
<td>Expansion Fittings and Loops for Plumbing Piping</td>
</tr>
<tr>
<td>22 05 29</td>
<td>Hangers and Support for Plumbing Piping and Equipment</td>
</tr>
<tr>
<td>22 05 48</td>
<td>Vibration and Seismic Controls for Plumbing Piping</td>
</tr>
<tr>
<td>22 05 53</td>
<td>Identification for Plumbing Piping and Equipment</td>
</tr>
<tr>
<td>22 07 16</td>
<td>Plumbing Equipment Insulation</td>
</tr>
<tr>
<td>22 07 19</td>
<td>Plumbing Piping Insulation</td>
</tr>
<tr>
<td>22 08 00</td>
<td>Commissioning of Plumbing Systems</td>
</tr>
<tr>
<td>22 10 00</td>
<td>Plumbing Piping</td>
</tr>
<tr>
<td>22 11 19</td>
<td>Plumbing Specialties</td>
</tr>
<tr>
<td>22 11 21</td>
<td>Natural Gas Piping System</td>
</tr>
<tr>
<td>22 30 00</td>
<td>Plumbing Equipment</td>
</tr>
<tr>
<td>22 40 00</td>
<td>Plumbing Fixtures</td>
</tr>
</tbody>
</table>

TABLE OF CONTENTS
## DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING – DD ISSUE

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 02 00</td>
<td>Basic Materials and Methods</td>
</tr>
<tr>
<td>23 02 01</td>
<td>Coordination Drawings</td>
</tr>
<tr>
<td>23 05 13</td>
<td>Common Motor Requirements for HVAC Equipment</td>
</tr>
<tr>
<td>23 05 16</td>
<td>Expansion Fittings and Loops for HVAC Piping</td>
</tr>
<tr>
<td>23 05 26</td>
<td>Variable Frequency Motor Speed Control for HVAC Equipment</td>
</tr>
<tr>
<td>23 05 29</td>
<td>Hangers and Support for Piping and Equipment HVAC</td>
</tr>
<tr>
<td>23 05 48</td>
<td>Vibration and Seismic Controls for HVAC Piping and Equipment</td>
</tr>
<tr>
<td>23 05 53</td>
<td>Identification for HVAC Piping and Equipment</td>
</tr>
<tr>
<td>23 05 93</td>
<td>Testing, Adjusting, and Balancing</td>
</tr>
<tr>
<td>23 07 13</td>
<td>Duct Insulation</td>
</tr>
<tr>
<td>23 07 16</td>
<td>HVAC Equipment Insulation</td>
</tr>
<tr>
<td>23 07 19</td>
<td>HVAC Piping Insulation</td>
</tr>
<tr>
<td>23 08 00</td>
<td>Commissioning of HVAC Systems</td>
</tr>
<tr>
<td>23 09 63</td>
<td>Energy Management and Control Systems</td>
</tr>
<tr>
<td>23 21 13</td>
<td>Above Ground Hydronic Piping</td>
</tr>
<tr>
<td>23 21 16</td>
<td>Underground Hydronic Piping</td>
</tr>
<tr>
<td>23 21 19</td>
<td>Hydronic Specialties</td>
</tr>
<tr>
<td>23 21 23</td>
<td>Hydronic Pumps</td>
</tr>
<tr>
<td>23 23 00</td>
<td>Refrigerant Piping</td>
</tr>
<tr>
<td>23 25 13</td>
<td>Water Treatment for Closed Loop Hydronic Systems</td>
</tr>
<tr>
<td>23 31 13</td>
<td>Metal Ductwork</td>
</tr>
<tr>
<td>23 33 00</td>
<td>Ductwork Accessories</td>
</tr>
<tr>
<td>23 34 00</td>
<td>HVAC Fans</td>
</tr>
<tr>
<td>23 34 39</td>
<td>High-Volume, Low Speed Propeller Fans</td>
</tr>
<tr>
<td>23 36 13</td>
<td>Series Fan Powered Terminal Units</td>
</tr>
<tr>
<td>23 36 16</td>
<td>Single Duct VAV Terminal Box</td>
</tr>
<tr>
<td>23 37 13</td>
<td>Air Distribution Devices</td>
</tr>
<tr>
<td>23 41 00</td>
<td>Air Filters</td>
</tr>
<tr>
<td>23 62 13</td>
<td>Air Cooled Condensing Units</td>
</tr>
<tr>
<td>23 64 23</td>
<td>Air Cooled, Scroll Water Chillers</td>
</tr>
<tr>
<td>23 73 13</td>
<td>Modular Indoor Central Station Air Handling Units</td>
</tr>
<tr>
<td>23 73 26</td>
<td>Modular Outdoor Central Station Air Handling Units</td>
</tr>
<tr>
<td>23 81 23.16</td>
<td>Computer Room Air Conditioners 1.0 Ton Thru 8.0 Tons</td>
</tr>
<tr>
<td>23 81 23.19</td>
<td>Computer Room Air Conditioners 8.0 Tons Thru 30.0 Tons</td>
</tr>
<tr>
<td>23 81 36</td>
<td>Rooftop Heating and Cooling Units Electric Cooling</td>
</tr>
<tr>
<td>23 82 19</td>
<td>Fan Coil Unit</td>
</tr>
</tbody>
</table>

## DIVISION 26 – ELECTRICAL

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 02 00</td>
<td>Basic Materials and Methods</td>
</tr>
<tr>
<td>26 05 19</td>
<td>Wire, Cable, and Related Materials</td>
</tr>
<tr>
<td>23 05 26</td>
<td>Grounding</td>
</tr>
<tr>
<td>26 05 33</td>
<td>Raceways</td>
</tr>
<tr>
<td>26 05 73</td>
<td>Short-Circuit, Coordination Study, ARC Flash Hazard Analysis</td>
</tr>
<tr>
<td>26 08 00</td>
<td>Commissioning of Electrical Systems</td>
</tr>
<tr>
<td>26 22 22</td>
<td>Low Voltage Harmonic Distribution Transformers</td>
</tr>
<tr>
<td>26 24 13</td>
<td>Switchboards</td>
</tr>
<tr>
<td>26 24 16</td>
<td>Panelboards</td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>26 26 26</td>
<td>Wiring Devices</td>
</tr>
<tr>
<td>26 28 16</td>
<td>Safety and Disconnect Switches</td>
</tr>
<tr>
<td>26 29 01</td>
<td>Motors and Starters</td>
</tr>
<tr>
<td>26 29 26</td>
<td>Miscellaneous Electrical Controls and Wiring</td>
</tr>
<tr>
<td>26 32 13.16</td>
<td>(450kW) Natural Gas Engine Driven Standby Generating System</td>
</tr>
<tr>
<td>26 33 53</td>
<td>Uninterruptible Power System (UPS)</td>
</tr>
<tr>
<td>26 41 13.13</td>
<td>Lightning Protection System</td>
</tr>
<tr>
<td>26 43 13</td>
<td>Surge Protective Devices (SPD) – Service Entrance</td>
</tr>
<tr>
<td>26 43 13.13</td>
<td>Surge Protective Devices (SPD) – Standard Interrupting</td>
</tr>
<tr>
<td>26 51 00 13</td>
<td>Lighting Fixtures - Light Emitting Diode (LED)</td>
</tr>
<tr>
<td></td>
<td>Light Fixture Cut Sheets (Supplemental Information: Under Separate Cover)</td>
</tr>
</tbody>
</table>

**DIVISION 27 – COMMUNICATION**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>27 00 00</td>
<td>Communications</td>
</tr>
<tr>
<td>27 05 26</td>
<td>Grounding and Bonding for Communications Systems</td>
</tr>
<tr>
<td>27 05 28</td>
<td>Pathway for Communications System</td>
</tr>
<tr>
<td>27 05 43</td>
<td>Underground Ducts and Raceways</td>
</tr>
<tr>
<td>27 11 00</td>
<td>Communications Equipment Room Fittings</td>
</tr>
<tr>
<td>27 13 00</td>
<td>Communications Backbone Cabling</td>
</tr>
<tr>
<td>27 15 00</td>
<td>Communications Horizontal Cabling</td>
</tr>
<tr>
<td>27 30 00</td>
<td>Area of Refuge – Elevator Landing</td>
</tr>
<tr>
<td>27 41 16</td>
<td>Integrated Audiovisual Systems and Equipment</td>
</tr>
<tr>
<td>27 41 31</td>
<td>CATV System</td>
</tr>
<tr>
<td>27 51 29</td>
<td>Emergency Radio Communications Enhancement System</td>
</tr>
</tbody>
</table>

**DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 00 00</td>
<td>Electronic Safety and Security</td>
</tr>
<tr>
<td>28 02 00</td>
<td>Basic materials and Methods 09.10.20 Add 1</td>
</tr>
<tr>
<td>28 10 00</td>
<td>Access Control System</td>
</tr>
<tr>
<td>28 20 00</td>
<td>Video Control System</td>
</tr>
<tr>
<td>28 31 00</td>
<td>Intrusion Detection System</td>
</tr>
<tr>
<td>28 31 63</td>
<td>Fire Alarm and Smoke Detection System with Mass Notification</td>
</tr>
<tr>
<td>28 46 00.21</td>
<td>Fire Alarm System 09.10.20 Add 1</td>
</tr>
</tbody>
</table>

**DIVISION 31 – EARTHWORK – Additional info per City of New Braunfels sheet specifications**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 10 00</td>
<td>Site Clearing</td>
</tr>
<tr>
<td>31 11 00</td>
<td>Tree Protection</td>
</tr>
<tr>
<td>31 23 00</td>
<td>Excavation and Fill</td>
</tr>
<tr>
<td>31 23 00.11</td>
<td>Landscape Grading</td>
</tr>
<tr>
<td>31 63 24</td>
<td>Drilled and Underreamed Footings</td>
</tr>
</tbody>
</table>

**DIVISION 32 – EXTERIOR IMPROVEMENTS - Per City of New Braunfels sheet specifications**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 14 13</td>
<td>Concrete Pavers</td>
</tr>
<tr>
<td>32 20 00</td>
<td>Concrete Fence</td>
</tr>
<tr>
<td>32 20 10</td>
<td>Chain Link Fence</td>
</tr>
<tr>
<td>32 31 00</td>
<td>Steel Roll Gate System</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>32 84 23</td>
<td>Irrigation</td>
</tr>
<tr>
<td>32 92 23</td>
<td>Sodding</td>
</tr>
<tr>
<td>32 92 24</td>
<td>Hydraulic Seeding</td>
</tr>
<tr>
<td>32 93 00</td>
<td>Trees, Shrubs and Groundcovers</td>
</tr>
<tr>
<td>32 94 00</td>
<td>Site Furnishings 09.30.20 Add 2</td>
</tr>
<tr>
<td>32 94 01</td>
<td>Flagpoles</td>
</tr>
<tr>
<td>32 95 00</td>
<td>Metal Fabrications</td>
</tr>
<tr>
<td>32 96 00</td>
<td>Painting (Exterior Sitework)</td>
</tr>
</tbody>
</table>

DIVISION 33 – UTILITIES – Per City of New Braunfels sheet specifications

DIVISION 34 – TRANSPORTATION – Not Used

END OF TABLE OF CONTENTS
ARCHITECT
Pierce Goodwin Alexander & Linville, Inc.
Address:
2222 Wester Trails Blvd, Suite 300
Austin, TX  78745

Texas Registered Architect
Christopher Ruebush
Registration # 20946

STRUCTURAL ENGINEER
Walter P Moore
Address:
221 W 6th Street, Suite 800
Austin, TX, 78701

Texas Registered Engineer
Usnik D. Tuladhar
Registration # 100038

MECHANICAL, ELECTRICAL, PLUMBING ENGINEER
DBR Engineering Consultants, Inc.
Address:
9990 Richmond Avenue
South Building, Suite 300
Houston, TX, 77042

Texas Registered Engineer
William Meister
Registration # 101184

CIVIL ENGINEER
HMT
Address:
290 S Castle Ave., Suite 100
New Braunfels, Texas, 78130

Texas Registered Engineer
Chris Van Heerde
Registration #83047
LANDSCAPE ARCHITECT

Luck Design Team
Address:
9600 Escarpment Blvd. Suite 745-4
Austin, Texas 78749

Texas Registered Landscape Architect
Brent Luck
Registration #1896

END OF SECTION 00 00 02
SECTION 01 10 00 – SUMMARY OF WORK

PART 1 – GENERAL

1.1

A. Section Includes:
   1. Project information.
   2. Work covered by Contract Documents.
   3. Phased construction.
   4. Work under separate contracts.
   5. Access to site.
   6. Coordination with occupants.
   7. Work restrictions.
   8. Specification and drawing conventions.

B. Related Requirements:
   1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: City of New Braunfels Police Headquarters
   1. Project Location: New Braunfels, Texas

B. Owner: City of New Braunfels

C. Architect: PGAL
   Cris Ruebush, Project Manager
   2222 Western Trails Blvd, Suite 300
   Austin, Texas 78745
   (P) 512.236.1005
cruebush@pgal.com

1.3 WORK COVERED BY CONTRACT DOCUMENTS

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

B. Type of Contract.
1. Project will be constructed under a single contract.

1.4 PHASED CONSTRUCTION

A. The Work shall be conducted in a single phase with multiple bid packages.

1.5 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. General: Contractor shall comply with City requirements regarding Access to Site.

C. Use of Site: Limit use of Project site to site boundaries indicated. Do not disturb portions of adjacent property or roadways.

1.6 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes.

C. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.

3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 10 00
SECTION 01 25 00 – SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for substitutions.

1.2 REFERENCES

A. Definitions:

1. Substitutions: Means CONTRACTOR-suggested changes to products, materials, equipment, systems, assemblies, and methods of construction from those required by the Contract Documents to similar items that are not necessarily identical, but are still alike with respect to appearance and performance.

2. Proposed Substitutions: Means those substitutions proposed and considered during the bidding period, provided the bidder indicates the difference in cost that results if the substitution request is accepted.
   a. Bid prices for each substitution request include all costs required to incorporate the substitution into the project.
   b. Later requests for additional costs for substitutions are not considered.

3. Controlled Substitutions: Means those substitutions that are allowed under procedures specified in this Section.
   a. Substitutions for Cause: Means CONTRACTOR- suggested changes resulting from changing project conditions, such as product unavailability, regulatory change, or unavailability of required warranty terms.
   b. Substitutions for Convenience: Means those CONTRACTOR- and Owner- suggested changes that are not necessary to meet project requirements, but that may offer an advantage to the CONTRACTOR or City.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Substitution Requests:

1. City and the Architect consider only formal requests for substitution prepared by the Contractor on an approved substitution request form, for items and fabrication or installation methods in lieu of those specified when
   a. in the opinion of the Contractor, the specified product or process will not fulfill the design intent; or
   b. the Contractor ascertains the specified product is unavailable, as evidenced by written documentation that firm orders were placed in a timely manner; or that the unavailability is due to strike, lockout, bankruptcy, discontinuance of manufacture, or an act of God.
2. City and the Architect do not consider substitutions when
   a. indicated or implied on RFIs, or on shop drawing or project data submittals, without additional requests submitted on an approved substitution request form in conformance with the requirements of this Section;
   b. requested directly by a subcontractor or supplier; and
   c. acceptance requires substantial revision of Contract Documents.

3. By issuing a substitution request, the Contractor represents that
   a. the Contractor has investigated the substitute item or method, and has determined that it is equal to, or superior, in all respects, to the originally-specified item or method;
   b. the same warranties are provided for the substitution request item or method as the originally-specified item or method, without exception or limitation;
   c. the Contractor shall coordinate the installation of accepted substitutions into the Work, making such changes to adjacent materials as required to make the Work complete in all respects, without re-design of adjacent items and supporting materials;
   d. the Contractor waives all claims for extensions of time or time/sequence related intended or unintended consequences, including additional costs that subsequently arise;
   e. all cost data is complete, and includes all related costs under the Contractor’s Contract, but excludes development and implementation costs incurred by City and the Architect.

B. Compatibility: Investigate and document the compatibility of substitutions with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended or required by the manufacturers.

C. Approval or Rejection: Approval or rejection of a substitution is at City’s and the Architect’s sole discretion, which is final; and includes consideration of the following factors, among others, in comparing the equality of substitutions with all originally-indicated or -specified requirements.
   1. The quality of materials, structural strength, construction, fabrication, and performance.
   2. Final appearance, finishes, and surface characteristics.
   3. The supplier’s, fabricator’s, manufacturer’s history, track record, or reputation.
   4. Impact on adjoining or related work. Arrangements resulting in acceptance a substitution include equal in appearance, convenience, and practicality to original arrangements.
   5. Availability of replacement parts and maintenance services.
   6. Ease of maintenance, repair, cleaning, adjusting, and re-finishing.
   7. Code approvals and service history.

D. Resubmittal: Do not resubmit previously-rejected substitution requests in a modified form.
   1. Upon rejection of a substitution request, the CONTRACTOR may submit a different substitution within the specified time limits.
   2. If a second a substitution request is rejected or is not received by the Architect within specified time limits, provide the original item or method as specified, and without substitution.

E. Conformance: Acceptance of substitution requests does not relieve the Contractor from conformance to the Contract Documents. The Contractor bears all additional expenses resulting from approved substitutions, and those expenses resulting from approved substitutions affecting adjoining or adjacent work.
F. Unauthorized Substitutions: Substitute items installed without prior written approval are considered defective work. At no additional cost to City, remove and replace defective work and install the originally-specified item.

1.4 SUBMITTALS

A. Substitution Requests: Submit for consideration 3 copies of each substitution request. Identify originally-specified and substitution request items, or fabrication or installation methods. Include the specification Section number and title, and the Drawing numbers and titles.

1. Substitution Request Form: Use for acceptable to Architect.
2. Documentation: As evidence that a substitution requests conform to the originally-specified requirements, submit the following, as applicable.
   a. A statement indicating why the specified item or installation cannot be provided, if applicable.
   b. Coordination information, including a list of changes, modifications, or revisions to other parts of the work, and to construction performed by City and separate contractors, that is necessary to accommodate a substitution request.
   c. A detailed line-by-line comparison of significant qualities, salient properties, and performance of the substitution request with the originally-specified items. Include an annotated copy of the applicable Specification section.
   1) Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated.
   2) Indicate deviations, if any, from the specified requirements.
   d. Product Data, including drawings and descriptions of products; and fabrication and installation procedures.
   e. Samples, where applicable or requested.
   f. Certificates and qualification data, where applicable or requested.
   g. A list of similar installations for completed projects with project names and addresses, and the names and addresses of the architects and owners.
   h. Material test reports issued by a qualified testing agency indicating and interpreting test results for conformance to the specified requirements.
   i. Research reports issued by ICC-ES evidencing conformance with the building code in effect for project.
   j. A detailed comparison of the Contractor's construction schedule using the substitution request versus the specified items, including the overall effect on the Contract Time. If the specified item or method of construction cannot be provided within the Contract Time, include a letter from manufacturer, on manufacturer's letterhead, stating the date of receipt of the purchase order, lack of availability, or delays in delivery.
   k. Cost information, including a proposal for change, if any, to the Contract Sum.
   l. The Contractor’s certification that the a substitution request conforms to the requirements of the Contract Documents, except as indicated in the substitution request; is compatible with related materials; and is appropriate for the applications indicated.
   m. The Contractor’s waiver of rights to additional payment or time that may subsequently become necessary because of failure of a substitution request to produce indicated results.
3. Architect's Action: When necessary, the Architect requests additional information or documentation for evaluation within 7 calendar days of receiving a substitution request. The Architect notifies the CONTRACTOR of acceptance or rejection of the substitution request within 15 business days of receipt of receiving a substitution request, or within 7 calendar days of receiving additional information or documentation, whichever is later.

   a. A Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the work must be issued as acceptance of a substitution request. No exceptions.
   b. Provide the originally-specified item or method if the Architect does not make a decision on the use of a substitution request within time allocated for a response.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. General:

1. Failure of the Contractor to submit substitution requests for approval in the manner indicated above and within the prescribed time indicated below is sufficient cause for the Architect to reject such substitution.
2. If a substitution request is submitted after the time periods indicated below, the Architect, at its sole discretion, may still agree to review such substitution, in which case the Architect’s reasonable expenses for such reviews are be paid by the Contractor and are deducted from the Contract Sum, as approved by Owner.

B. Substitutions for Cause: Submit requests for substitution promptly upon discovery of a perceived need for change, but at least 15 business days before to the time required to prepare and review of related submittals.

1. The Architect considers the Contractor’s request for substitution only when all of the following conditions are satisfied. If the following conditions are not satisfied, the Architect returns requests for substitution without action, except to record nonconformance with these requirements.

   a. The requested substitution conforms to the Contract Documents and produces the indicated results.
   b. The requested substitution provides sustainable design characteristics that the specified product provided for achieving design performance requirements.
   c. The requested substitution is fully documented on the approved substitution request form and properly submitted.
   d. The requested substitution does not adversely affect the Contractor’s construction schedule.
   e. The requested substitution has all current and necessary approvals from the AHJ.
   f. The requested substitution is compatible in all respects with other portions of the work.
   g. The requested substitution is fully-coordinated with other portions of the work.
   h. The requested substitution provides the minimum specified warranty or warranties.
2. If the requested substitution involves more than one subcontractor, then the requested substitution is also
   a. coordinated with other portions of the work;
   b. uniform and consistent;
   c. compatible with other products; and
   d. acceptable to all other involved subcontractors.

C. Substitutions for Convenience: Not permitted unless otherwise indicated.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01 25 00
SECTION 01 26 00 – CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 MINOR CHANGES IN THE WORK

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

1.3 PROPOSAL REQUESTS

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

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within 20 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
   a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   c. Include costs of labor and supervision directly attributable to the change.
   d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
   e. Quotation Form: Use forms acceptable to Architect.

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

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

1.4 CHANGE ORDER PROCEDURES


1.5 CONSTRUCTION CHANGE DIRECTIVE


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

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00
PART 1 - SECTION 01 26 13 – REQUESTS FOR INTERPRETATION

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for RFIs.

B. Related Requirements:


2.2 REFERENCES

A. Abbreviations and Acronyms:

1. RFI: Requests for Interpretation.

B. Definitions:

1. Out of Sequence: Means a task indicated on the submittal and construction schedules that is (a) performed outside of the particular order in which project milestones, events, movements, or other activities follow each other; or (b) begun before its predecessor is started.

2. Reasonably Inferable: Means that if an item, system, or assembly, including components, accessories, and facility services, is either indicated or specified, then all material, labor, equipment, and facility services that are (a) normally furnished with such items, systems, or assemblies; and (b) that are necessary to make a complete installation, must be provided whether or not indicated or specified.

   a. Items the CONTRACTOR either could or should have reasonably anticipated must be included as part of the work, based on (1) the CONTRACTOR’s skill, knowledge, and experience; and (2) using an objective industry standard and not a subjective standard.

   b. Only those items specifically excepted may be omitted from the project.

3. Request for Interpretation: Means the procedure used by Southwest or the CONTRACTOR when it is necessary to confirm the interpretation of a detail, specification or note on the Drawings; or to secure a documented directive or clarification from the Architect that is needed in executing the work. Other terms, including “request for information” and similar terms, have the same meaning as “request for interpretation”.

2.3 ADMINISTRATIVE REQUIREMENTS

A. Submit an RFI to the Architect when

1. an unforeseen condition occurs;

2. questions regarding design intent of the Contract Documents or constructability arise;

3. clarification of information contained within the Contract Documents, or supplementary information not contained within the Contract Documents, is required; and

4. an interpretation of the Contract Documents, including that of apparent conflicts, is necessary.

B. When possible, request interpretations in writing at the next scheduled project meeting.

1. When an RFI is answered at the project meeting, enter the response into the meeting minutes.
2. When the urgency of need, or the complexity of an item makes clarification at the next scheduled project meeting impractical, then promptly prepare and submit to the Architect a formal written RFI.

C. Do not use RFIs to

1. confirm existing information contained in Contract Documents without providing any reason the existing information may be invalid;
2. confirm or request information provided in a previous RFI;
3. request approval of proposed substitutions;
4. request approval of submittals;
5. solicit comments or clarifications for any submittal or shop drawing review transmitted by the Architect to the CONTRACTOR;
6. request contract modifications;
7. confirm actions taken by the CONTRACTOR for requested contract modifications;
8. transfer coordination responsibility from the CONTRACTOR to City or the Architect;
9. request Southwest or Architect accept deviations from the Contract Documents for any reason; and
10. request Southwest or Architect accept non-conforming work.

D. RFIs that fail to conform to the above restrictions are considered frivolous, and are identified as such by the Architect, whose decision is final.

1. The CONTRACTOR shall promptly remove frivolous RFI’s from the RFI log.
2. City may assess the CONTRACTOR for any time and material costs incurred by City, City’s personnel, the Architect, the Architect’s consultants, and other individuals responding frivolous RFIs.

E. The CONTRACTOR shall prepare and maintain an RFI log.

1. At a minimum, the RFI log must include
   a. the RFI numbers;
   b. brief descriptions of the content or subjects addressed by each RFI;
   c. the dates the RFIs are submitted to the Architect (not the dates the RFIs are generated by the CONTRACTOR); and
   d. that dates the Architect’s responses are received (not the dates the RFI are closed-out by the CONTRACTOR).

2. The CONTRACTOR shall keep the RFI log current, and shall furnish a copy to City or Architect whenever requested.

2.4 PROCEDURAL REQUIREMENTS

A. City or the CONTRACTOR may issue an RFI to the Architect via forms acceptable to City.

B. Direct RFIs to the Architect by hand carry, mail, overnight express delivery, facsimile (fax), messenger, email, project management software, or otherwise as appropriate.

1. The CONTRACTOR’s shall verify the Architect has received all RFIs.
2. RFIs generated by subcontractors or material suppliers must be submitted through the CONTRACTOR; and must be thoroughly reviewed by the CONTRACTOR prior to submittal to the Architect. If the CONTRACTOR does not thoroughly review an RFI before submitting it to the Architect, the Architect returns the RFI without action, except to record nonconformance with these requirements.

3. RFIs received directly from a subcontractor are returned to the CONTRACTOR without action, except to record nonconformance with these requirements.

C. The Architect considers the CONTRACTOR's RFIs only when all of the following conditions are satisfied. If the following conditions are not fully satisfied, then the Architect returns the incomplete RFI without action, except to record nonconformance with these requirements.

1. Each RFI may address only one subject or request.
2. RFIs must be consecutively numbered; each page of the RFI, and every attachment to the RFI, must also bear the RFI number.
3. Each blank on every RFI form must be filled-in.
4. Each RFI must include
   a. the project name matching that listed on the Contract Documents; and the Architect’s project number or other identifying number matching that listed on the Contract Documents, if any.
   b. the date the RFI is submitted (not the date the RFI was generated).
   c. the CONTRACTOR’s name, address, telephone, and fax numbers.
   d. the Drawing numbers and detail references, where appropriate, including the date of each referenced Drawing;
   e. the Section number and title of all affected specification Section or Sections, including the date of each referenced specification Section.
   f. a clear and concise question, along with both a summary and explanation, and brief history, of the question when these are not self-evident;
   g. supplementary sketches and related documents material to the Contractor’s request, and that are for clarification of the issue;
   h. a CONTRACTOR-recommended solution or response to the requested interpretation or clarification; and
   i. a blank space for the Architect’s written response.

5. When the CONTRACTOR anticipates that the Architect’s written response to an RFI might necessitate a change the Contract Sum or Contract Time, a properly executed Change Order Proposal Request conforming to the requirements of Section 01 26 00 must also be submitted along with the RFI.

D. Submit RFIs within a reasonable time frame so as not to interfere with or impede the progress of the work.

1. Each RFI must be submitted with such promptness as to not cause any delay in the CONTRACTOR's own work, or the work of any subcontractor.
2. Adjustments to the Contract Time or Contract Sum resulting from the CONTRACTOR’s failure to submit an RFI with sufficient time to allow for the orderly processing of a response by the Architect are prohibited.
E. Allow at least 5 business days in the CONTRACTOR’s construction schedule for review and response time for each RFI, unless additional time is requested or needed by the Architect. The response time is increased when

1. more information from the CONTRACTOR is requested by the Architect;
2. the RFI is submitted out of sequence; or
3. in the opinion of the Architect, more time is needed to respond to the RFI.

   a. The CONTRACTOR shall alert the Architect in writing of the time available before a response may cause an impact to the Contract Sum or Contract Time.
   b. The CONTRACTOR’s failure of to alert the Architect in writing inures to the benefit of the Architect.

F. When the Architect requires clarification to any RFI, then the period of time allotted for the Architect's response begins when the Architect receives from the CONTRACTOR all requested information.

G. When the number and frequency of RFIs submitted becomes unwieldy, the Architect may recommend the CONTRACTOR abandon the process and submit requests as substitutions conforming to the requirements of Section 01 25 00; as change order requests conforming to the requirements of Section 01 26 00; or as submittals conforming to the requirements of Section 01 33 00.

2.5 QUALITY ASSURANCE

A. Before submitting RFIs to the Architect, verify the interpretation requested is not indicated in the Contract Documents, or cannot be determined from a careful review of the Contract Documents.

1. Carefully study the Contract Documents to ensure requested interpretations are not reasonably inferable therein.
2. RFIs requesting interpretations reasonable inferable from the Contract Documents are returned to the CONTRACTOR without review, except to record nonconformance with this requirement.

B. Where field conditions may dictate solutions, provide both an assessment of the potential problem and a suggested solution with each RFI submitted. RFIs that do not include a suggested solution may be returned to the CONTRACTOR without review, except to record nonconformance with this requirement.

C. When an RFI is used to request clarification to coordination issues (e.g. pipe and duct routing, clearances, specific locations of work shown diagrammatically, and similar items) the CONTRACTOR shall suggest a solution using drawings or sketches drawn to scale, and then submit them as attachments to the RFI.

1. The Architect reviews only those RFIs that include a suggested solution to a request.
2. If there is no apparent solution, then a statement to that effect must be added to the RFI in lieu of a suggested solution.
3. RFIs requesting clarification to coordination issue that do not include either a suggested solution, or a statement that there is no apparent solution, are returned to the CONTRACTOR without review, except to record nonconformance with this requirement.
D. When the CONTRACTOR believes that an Architect’s written response to an RFI might necessitate a change the Contract Sum or Contract Time, the CONTRACTOR shall notify City in writing within 5 business days of receiving the Architect’s response.

1. RFI responses are not approvals to perform additional or extra work.
2. When the CONTRACTOR believes that an Architect’s written response to an RFI might necessitate a change the Contract Sum or Contract Time, the CONTRACTOR shall provide evidence supporting the basis of the CONTRACTOR’s estimates changes as they relates to the RFI.
3. The CONTRACTOR may not proceed with any additional or extra work indicated by the RFI response until a Change Order or other acceptable modification is properly prepared, submitted, and executed in conformance with the requirements of Section 01 25 00.

4.
5.

PART 3 - PRODUCTS (NOT USED)

3.1

PART 4 - EXECUTION (NOT USED)

END OF SECTION 01 26 13
SECTION 01 29 00 – PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

B. Related Requirements:
   1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
   2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

   1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with continuation sheets.
      b. Submittal schedule.
      c. Items required to be indicated as separate activities in Contractor's construction schedule.

   2. Submit the schedule of values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

   3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

   1. Identification: Include the following Project identification on the schedule of values:
      a. Project name and location.
      b. Name of Architect.
      c. Architect's project number.
      d. Contractor's name and address.
      e. Date of submittal.

   2. Arrange schedule of values consistent with format of AIA Document G703.

   3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project...
Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

a. Include separate line items under principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

9. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.3 APPLICATIONS FOR PAYMENT
A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

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

C. Payment Application Times: Submit Application for Payment to Architect by the 21st day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

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

E. Application for Payment Forms: Use forms acceptable to Owner and Architect for Applications for Payment. Sample copies are included in Project Manual.
F. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

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

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

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

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Schedule of unit prices.
5. Submittal schedule (preliminary if not final).
6. List of Contractor's staff assignments.
7. List of Contractor's principal consultants.
10. Initial progress report.
12. Certificates of insurance and insurance policies.

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

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

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

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00
PART 1 - SECTION 01 31 00 – PROJECT MANAGEMENT AND COORDINATION
PART 2 -
PART 3 - PART 1 - GENERAL

3.1 SUMMARY

A. Section Includes: Administrative for coordinating construction operations for the project.

3.2 Related Requirements:

1. The executed Agreement for Project Administration, Budgeting and Scheduling.

3.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work of all subcontractors.

1. Establish on-site lines of authority and communication.
2. Allocate spaces for temporary structures furnished by subcontractors.
3. Monitor the use of temporary utilities.
4. Administer traffic and parking controls.

B. Construction Documents Review: Review the Construction Documents and prepare review reports as indicated in Section 4.3.8 of the executed Contract Agreement.

C. Construction Implementation Plan: Prepare and update as indicated in the executed Contract Agreement.

D. Construction Schedule: Prepare detailed construction schedules as indicated in the executed Contract Agreement and specified in Section 01 32 00 and monitor compliance of all subcontractors with the schedule as the work progresses.

E. Changes:

1. Before submitting to the Architect, review subcontractors’ requests for interpretations and substitution requests.
2. Submit to the Architect all recommendations for necessary or desirable changes in the work.

F. Permits and Fees: Verify that subcontractors obtain permits for all required inspections.

G. Submittals: Before submitting to the Architect, review subcontractor submittals for conformance to the Contract Documents.

H. Interpretation of Documents: Consult the Architect for Contract Document Interpretations as specified in Section 01 26 13.

1. Assist in resolution of questions that arise.
2. Transmit resolved interpretations in writing to all affected parties.
I. Cleaning: Verify specified cleaning specified in Section 01 74 00 is performed during progress of the work, and at the completion of each stage of the work.

J. Startup:

1. Direct checkout of utilities, operating systems and equipment.
2. Assist initial startup testing.
3. Record operation start dates of systems and equipment.
4. Submit to the Architect a written notice that startup operations and placing of equipment in service is complete.

K. Substantial Completion:

1. Upon determination the work is complete, submit a notice to the Architect that the work is ready for final inspection.

L. Final Completion:

1. Secure and transmit all required closeout submittals.
2. PART 4 - PRODUCTS (NOT USED)
PART 5 - EXECUTION (NOT USED)

END OF SECTION 01 31 00
SECTION 01 31 19 – PROJECT MEETINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for project meetings, including
   1. the preconstruction meeting;
   2. weekly progress meetings;
   3. coordination meetings;
   4. and other meetings.

B. Related Requirements: Additional requirements for preinstallation meetings specific to a particular work result are specified within the appropriate specification section.

1.2 ADMINISTRATIVE REQUIREMENTS

A. The GC shall
   1. conduct meetings specified in the Contract Documents;
   2. arrange for, and distribute notice and maintain records of all project meetings conducted during execution of the Contract that are required for the work;
   3. notify and invite City and the Architect to all project-related meetings;
   4. attend all project-related meetings scheduled by City or the Architect; and
   5. arrange for, distribute notice of, and maintain records of all special meetings when requested by City or the Architect;

1.3 PROCEDURAL REQUIREMENTS

A. General: Schedule and conduct meetings and conferences at the project site, unless otherwise indicated.

B. Attendees: Timely notification is required. Inform participants and others involved, and individuals whose presence is required, of the date, time, and location of each meeting. Notify City and the Architect of scheduled meeting dates and times at least 2 weeks in advance of convening any meeting.

C. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees at least 3 business days before each meeting date.

D. Minutes: Record significant discussions and agreements. Distribute meeting minutes to concerned parties, including City and the Architect, within 3 business days of each meeting.

E. Revisions to Published Minutes:
1. If published meeting minutes are not challenged in writing prior to the next regularly scheduled progress meeting, they are accepted as accurately stating the activities and decisions of the meeting.
2. Persons challenging published minutes must reproduce and distribute copies of the challenge to all indicated recipients of the particular set of challenged minutes.
3. Challenges to minutes must be settled at the next regularly scheduled meeting as the first topic of discussion regarding “old business”.

1.4 PRECONSTRUCTION MEETING

A. General: Not more than 5 business days after execution of the Agreement, and before beginning work, schedule a preconstruction meeting at the project site or another convenient location to review responsibilities and personnel assignments.

B. Attendees: The following must attend the preconstruction meeting.

1. City’s authorized representative.
2. The Architect and the Architect’s consultants.
3. The General Contractor and the General Contractor’s superintendent.
4. Major subcontractors and material suppliers.
5. Other concerned parties.

C. Agenda:

1. Review, discuss, clarify and establish the following.

   a. Identify individuals who represent the parties to the Contract, their duties and responsibilities, and proper lines of communication.
   b. Submittal requirements for list of subcontractors, materials, equipment, and named products.
   c. Procedures for measurement and payment, including the schedule of values, applications for payment, architect’s supplemental instructions, work changes proposal requests, change order proposal requests, change orders, and construction change directives.
   d. Preliminary scheduling, the construction progress schedule, and the submittal schedule.
   e. Critical issues.
   f. Long lead items and priorities; and their relationship to critical dates.
   g. Submittal procedures for shop drawings, product data, and samples.
   h. Requirements for informational submittals.
   i. Requirements for quality control submittals and submittals required for closeout.
   j. Allowable product options and substitutions; explaining the contractual requirements, obligations, and procedures associated with them.
   k. Procedures for RFIs, construction change directives, and filing claims.
   l. Procedures for tests and inspections, including timely notification when the work is ready for tests and inspections.
   m. Responsibilities and limitations of authority of an inspection service or laboratory and distribution of reports.
   n. Procedures for maintaining project record documents.
   o. The schedule for project meetings.

2. Review, discuss, clarify, and establish the following mobilization issues:
a. Access to the site, including access roads, parking restrictions, environmental controls, and security.
b. Identification of benchmarks and data, including survey and layout of work.
c. Use of site and existing facilities by the GC, including access to building areas, use of elevators, and maintenance of fire exits.
d. Occupancy and use by City, tenants, and the public during construction periods, including partial use and occupancy of completed work, and related coordination of insurance requirements.
e. Separation of work areas, barriers, and dust control.
f. Maintenance of the site, including traffic control, cleaning, and trash removal.
g. Hours of work, including restriction for noise control, disruption of utilities and similar items.
h. Protection of existing materials and equipment indicated as remaining in place.
i. Use of existing utilities, consumption limitations, and prior notification of interruption of services or system operations.
j. Project phases or sequences.

D. Minutes: Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

1. Distribute minutes of the meeting to each party present and to parties who should have been present.
2. Do not begin construction if the meeting cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the work and reconvene the conference at earliest feasible date.

1.5 WEEKLY PROGRESS MEETINGS

A. General: Conduct progress meetings at intervals indicated in the in the executed Construction Manager at Risk Agreement. Coordinate dates of meetings with the preparation of payment requests.

B. Attendees: As indicated in the executed Construction Manager at Risk Agreement, and including the following.

1. The GC’s project manager.
2. The GC’s jobsite superintendent.
3. City's representative.
4. The Architect; and the Architect’s consultants, as required by the published agenda.
5. Subcontractors, as required by the published agenda.

C. Agenda:

1. Review and approve the minutes from the previous progress meeting.
2. Review work progress since the last meeting.

   a. Determine whether each activity is on time, or ahead of or behind schedule relative to the GC's construction schedule.
   b. Determine how construction that is behind schedule can be accelerated; secure firm time commitments from parties involved in expediting the work.
c. Discuss whether or not schedule revisions are necessary to ensure that current and subsequent activities can be completed within the Contract Time.

3. Review the status of RFIs and submittals that have not been returned within the minimum time that was allotted or should have been allotted in conformance with Section 01 26 00 and Section 01 33 00.
   a. Discuss the status of only those RFIs and submittals that have not been returned within the period of time allotted for the Architect's response specified in Section 01 26 00 and Section 01 33 00. RFI’s whose review is still within the period of time allotted for the Architect's response do not need to be discussed unless there is a significant change in status that may affect progress.
   b. Review the time available before any late response may cause an impact to the Contract Sum or Contract Time.

4. Review other items of significance that could affect progress of construction.
   a. Note field observations, problems, and decisions.
   b. Review any off-site fabrication problems.
   c. Develop corrective measures and procedures to regain planned schedule.
   d. Revise construction schedule as indicated.
   e. Plan progress during next work period.

5. Include topics for discussion as appropriate to status of the project.
6. Complete other current business.

D. Minutes: Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
   1. Distribute minutes of the meeting to each party present and to parties who should have been present.
   2. Revise the GC's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue a revised schedule concurrently with the minutes of each meeting.

1.6 COORDINATION MEETINGS

A. General: Conduct Project coordination meetings as indicated in Section 4.3.2 of the executed GC at Risk Agreement. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation meetings.

B. Attendees: In addition to representatives of City, GC, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

C. Agenda:
   1. Review and approve the minutes from the previous progress meeting.
   2. Review work progress since the last meeting.
a. Determine whether each activity is on time, ahead of schedule, or behind schedule, relative to the GC’s construction schedule.
b. Determine how construction that is behind schedule is expedited; secure firm commitments from parties involved its expediting.
c. Discuss whether or not schedule revisions are required to ensure that the current and subsequent activities can be completed within the Contract Time.

3. Review both the present and future needs of each contractor present, including

   a. interface requirements;
   b. sequence of operations;
   c. status of submittals;
   d. deliveries;
   e. off-site fabrication;
   f. access;
   g. site utilization;
   h. temporary facilities and controls;
   i. work hours;
   j. hazards and risks;
   k. progress cleaning;
   l. quality and work standards; and
   m. change orders.

4. Review other significant items and topics that may affect progress. Include topics for discussion as appropriate to status of Project.

D. Minutes: Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

   1. Distribute minutes of the meeting to each party present and to parties who should have been present.
   2. Revise the GC’s construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue a revised schedule concurrently with the minutes of each meeting.

1.7 OTHER MEETINGS

A. When required for the coordination of the work, the GC may convene other meetings to discuss project procedures, coordinate the sequencing of the work, coordinate testing and inspection, coordinate the work of specialty trades, and schedule work by Southwest’s other contractors:

   1. Prepare agenda and make physical arrangements for meetings in a convenient, comfortable room in which to conduct the meeting, furnished as necessary to accommodate the people involved and to accomplish the purpose of the meeting;
   2. Coordinate all meetings in advance with Southwest’s representative;
   3. Distribute written notice and agenda for all meetings, including regularly scheduled and/or specifically called meetings, 3 days in advance of the meeting date;
   4. Preside over meetings; and
   5. Prepare minutes of meeting:
a. Document all issues, discussion and decisions, and
b. Distribute copies of minutes to participants within 48 hours after meeting through the
   Project Management Information System

END OF SECTION 01 31 19
SECTION 01 31 33 – COORDINATION DRAWINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for producing coordination drawings.

B. Related Requirements:

1. The executed GC at Risk Agreement for requirements related to project coordination.

1.2 REFERENCES

A. Definitions:

1. Coordination Drawings: Means reproducible overlay drawings indicating the work, with both horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions, equipment, lights, mechanical, electrical, conveying systems, other building features, and other services

   a. in and above ceilings;
   b. within walls;
   c. within chases;
   d. in mechanical and electrical spaces; and
   e. elsewhere, as indicated.

2. Layout Drawings: Means drawings showing proposed locations and sizes of sleeves, core drills, blockouts, and embedded items in concrete walls, columns, floors and beams.

3. Order of Precedence: Means the sequential hierarchy of the importance of items.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Before beginning work in any given area of the Project, the GC shall submit to the Architect for information the coordination drawings and the layout drawings affecting the work in that area.

1. The GC shall schedule and conduct coordination meetings with its subcontractors, and with the Architect and City as specified in Section 01 31 19 and as required for resolving interferences.

   a. The GC must identify and resolve major interferences at these coordination meetings before beginning production of any drawings.
   b. The GC is responsible for scheduling coordination meetings and other communications necessary to produce, submit, and obtain approval of coordination drawings in a timely manner so as to not delay the work.
2. The GC shall furnish coordination drawings within 30 calendar days after any initial coordination meeting, and at least 30 calendar days before the ordering or fabrication of any equipment or products indicated by the coordination drawings; in no instance may coordination drawings be submitted later than time of shop drawing submittal of the affected trades’ shop drawings for review.

3. The GC shall furnish combined coordination and layout drawing plans and sections of the following in sufficient detail to assure that all work will fit in the space provided.
   
   a. HVAC ductwork;
   b. hydronic, steam, condensate, fuel oil, and fire protection piping;
   c. plumbing;
   d. special water systems;
   e. natural gas and medical gas systems;
   f. electrical cable tray;
   g. conduit;
   h. conveying systems;
   i. equipment; and
   j. other work.

4. For the GC’s use preparing coordination drawings, the Architect may provide scaled background drawings, which indicate
   
   a. partitions;
   b. fire and smoke rated barriers
   c. ceiling heights;
   d. structural framing locations and elevations;
   e. column lines;
   f. other work; and
   g. existing obstructions.

B. If after the submittal of coordination drawings or layout drawings the GC determines that the work cannot be installed as indicated by the coordination or layout drawings, then the GC shall prepare and submit to the Architect for record revised coordination or layout drawings at no additional cost to City.

C. The GC shall maintain at least one copy of current coordination drawings at project site.

D. Additional costs for modifications to the work resulting from the GC’s failure to resolve interferences; provide correct coordination drawings; or call attention to changes required in other work as result of modifications are borne by the GC.

1.4 PROCEDURAL REQUIREMENTS

A. General:

1. Prepare coordination drawings where coordination is needed for installation of products and materials fabricated by separate entities, especially to work out all "tight" conditions involving Work of various Sections in advance of installation.
a. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components.
b. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
c. Showing proposed locations and sizes of sleeves, core drills, block-outs, and embedded items in concrete walls, columns, floors and beams.

1) At floor slabs and walls that are core drilled or cut, the GC shall find and mark all reinforcing in both faces located by means of x-ray, pachometer, or profometer.
2) Submit to the Architect a sketch showing location of rebar and proposed cores.

2. Before beginning work and installation in any given area, the GC must approve the coordination drawings affecting the work in that area. GC must also give written approval of changes to coordination drawings prior to start of work in affected area.

3. Modifications required as result of failure to resolve interferences, provide correct coordination drawings, or call attention to changes required in other work as result of modifications are the GC’s responsibility.

B. Coordination Drawings Order of Precedence:

1. In the event of conflicts involving location and layout of work, use following priority to resolve conflicts.
   a. Structure and partitions have the highest priority.
   b. Equipment location and access.
   c. Ceiling system and recessed light fixtures.
   d. Gravity drainage lines.
   e. High pressure ductwork and devices.
   f. Large pipe mains, valves and devices.
   g. Pneumatic tube and material conveying systems.
   h. Low pressure ductwork, diffusers, registers, grilles, HVAC equipment.
   i. Fire protection piping, devices and heads.
   j. Small piping, tubing, electrical conduit, and devices.

   1) Conduits installed in corridors must maintain at least 9 inches above the finished ceiling.
   2) Space utilized for conduit must be selected to allow access to all devices that normally require adjustment, repair, resetting, etc.

   k. Sleeves through rated partitions.
   l. Access panels have the lowest priority.

C. Layout Drawings:

1. Utilize the approved coordination drawings to prepare detailed layout drawings.
2. Indicate dimensioned locations and sizes of all required sleeves, blockouts and embedded items.
3. Submit layout drawings to the Architect for information in the same manner as what is specified for coordination drawings.
D. Submit a copy of the coordination drawings to the Architect no later than time of submittal of the individual trades’ shop drawings. The individual trades’ shop drawings are not reviewed without submittal of related coordination drawings having complete contractor and subcontractor sign-off.

1. The GC and each subcontractor for the above work must certify by endorsement on the coordination drawings that the coordination drawings represent a complete and accurate record of the work to be executed.

2. After coordination drawings are completed, subcontractors must date and sign each coordination drawing with the understanding that the signature signifies that the work shown therein has been fully coordinated and is ready for construction.

1.5 SUBMITTALS

A. Submit minimum 1/4-inch scale dimensioned drawings showing work with horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions, equipment, lights, mechanical, electrical, conveying systems, and other services in and above ceilings; within walls; within chases; in mechanical spaces; in electrical spaces.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01 31 33
PART 1 - SECTION 01 32 00 – CONSTRUCTION PROGRESS DOCUMENTATION

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for documenting construction progress, including

1. a preliminary schedule and constructability review report;
2. a startup construction schedule;
3. the contractor's construction schedule;
4. construction schedule updating reports;
5. daily construction reports;
6. material location reports;
7. site condition reports; and
8. special reports.

2.2 REFERENCES

A. Abbreviations and Acronyms:

1. GC: Critical Path Method.

B. Definitions:

1. Activity: Means a discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

   a. Critical Activity: Means an activity on the critical path that must start and finish on the planned early start and finish times.
   b. Predecessor Activity: Means an activity that precedes another activity in the network.
   c. Successor Activity: Means an activity that follows another activity in the network.

2. Critical Path Method: Means a method of planning and scheduling a construction project by arranging activities based on relationships. Network calculations (a) determine when activities can be performed; and (b) identify the critical path.

3. Critical Path: Means the longest connected chain of planned activities through the network schedule that establishes the minimum overall project duration and contains no float. Any delay of an activity on the critical path directly impacts the planned project completion date.

4. Event: The starting or ending point of an activity.

5. Float: The measure of leeway in starting and completing an activity.

   a. Float time belongs to City.
   b. Free Float: Means the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
c. Total Float: Means the measure of leeway in starting or completing an activity without adversely affecting the planned project completion date.

6. Resource Loading: Means the allocation of manpower and equipment necessary for the completion of an activity as scheduled.

2.3 SUBMITTALS

A. Submittal Formats: Submit required submittals in the following format:

1. Working electronic copy of the schedule file, where indicated.
2. PDF electronic file.

B. Startup construction schedule.

C. Startup Network Diagram: Submit the startup network diagram at a size required to display the entire network for the entire construction period. Show logic ties for activities.

D. GC's Construction Schedule: Submit the initial schedule at a size required to display the entire schedule for the entire construction period.

1. Submit a working electronic copy of the schedule, using software indicated, and labeled to conform to the requirements for submittals. Include the type of the schedule (initial or updated) and date on label.

E. GC Reports: Concurrent with GC schedule, submit each of the following reports. The format for each activity in the reports must contain an activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: Submit a list of all activities sorted by activity number, and then early start date, or actual start date, if known.
2. Logic Report: Submit a list of preceding and succeeding activities for all activities sorted in ascending order by activity number, and then early start date, or actual start date, if known.
3. Total Float Report: Submit a list of all activities sorted in ascending order of total float.
4. Earnings Report: Submit a compilation of the GC's total earnings from the Notice to Proceed until the most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at weekly intervals.

I. Site Condition Reports: Submit at the time of discovery of differing conditions.

J. Special Reports: Submit at the time of each unusual event.

K. Prescheduling Conference: Conduct a prescheduling conference at the project site in conformance with Section 01 31 00. Review methods and procedures related to the preliminary construction schedule and the GC's construction schedule, including, the following.
1. Review software limitations; and report content and format.
2. Verify the availability of qualified personnel needed to develop and update the schedule.
3. Discuss constraints, including phasing, area separations and partial City occupancy.
4. Review delivery dates for Owner-furnished products.
5. Review the schedule for the work of City's separate contracts.
6. Review the submittal requirements and procedures.
7. Review the time required for review of submittals and resubmittals.
8. Review the requirements for tests and inspections by independent testing and inspection agencies.
9. Review the time required for project closeout, and City startup procedures, including commissioning activities.
10. Review and finalize a list of construction activities included in the schedule.
11. Review procedures for updating schedule.

2.4 COORDINATION

A. Coordinate the GC's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the work from all entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 3 - PRODUCTS

3.1 PRELIMINARY SCHEDULE AND CONSTRUCTABILITY REVIEW REPORT

A. Prepare and submit a Preliminary Project Schedule and a Constructability Review Report as indicated in the executed GC at Risk Agreement.

3.2 SUBMITTALS SCHEDULE

A. The GC shall prepare and submit a submittal schedule as indicated in the executed GC at Risk Agreement.

3.3 PROJECT SCHEDULE CONTROL

A. The GC shall perform scheduling during the Construction Phase as indicated in the executed GC at Risk Agreement.

3.4 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Time Frame: Extend the schedule from the date established for the Notice to Proceed to date of final completion.
1. The contract completion date may not be changed by submitting a schedule that shows an early completion date, unless specifically authorized by a properly-executed Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the work. Comply with the following.

1. Activity Duration: Define activities so that each activity is no longer than 20 days, unless specifically authorized in writing by the Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items requiring at least 60 days as separate activities in schedule. Procurement cycle activities include submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 in the schedule. Coordinate submittal review times listed in the GC's construction schedule with the submittal schedule.
4. Startup and Testing Time: Include at least 15 business days for startup and testing.
5. Substantial Completion: Indicate completion in advance of the date established for Substantial Completion, and allow time for the Architect's and the Construction Manager's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include at least 30 calendar days for completion of punch list items and final completion.

C. Constraints: Include in schedule constraints and work restrictions indicated in the Contract Documents and the following; show how the sequence of the work is affected.

1. Phasing: Arrange a list of activities on the schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by City: Include a separate activity for each portion of the work performed by City.
4. Products Ordered in Advance: Include a separate activity for each product.
   a. Include delivery dates indicated in Section 01 10 00.
   b. Delivery dates indicated stipulate the earliest possible delivery date.
5. Owner-Furnished Products: Include a separate activity for each product.
   a. Include delivery date indicated in Section 01 10 00.
   b. Delivery dates indicated stipulate the earliest possible delivery date.
6. Work Restrictions: Show the effect of the following items on the schedule.
   a. Coordination with existing construction.
   b. Limitations of continued occupancies.
   c. Uninterruptible services.
   d. Partial occupancy before Substantial Completion.
   e. Use-of-premises restrictions.
   g. Seasonal variations.
   h. Environmental control.
7. Work Stages: Indicate important stages of construction for each major portion of the work, including
a. subcontract awards;
b. submittals;
c. purchases;
d. mockups;
e. fabrication;
f. sample testing;
g. deliveries;
h. installation;
i. tests and inspections;
j. adjusting;
k. curing;
l. building flush-out; and
m. startup and placement into final use and operation.

8. Construction Areas: Identify each major area of construction for each major portion of the work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following.

a. Structural completion.
b. Temporary enclosure and space conditioning.
c. Permanent space enclosure.
d. Completion of mechanical installation.
e. Completion of electrical installation.
f. Substantial Completion.

D. Milestones: Include in schedule milestones indicated on the Contract Documents, including, the Notice to Proceed, Substantial Completion and final completion.

E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence before the next schedule update. Summarize the following.

1. Unresolved issues.
2. Unanswered Requests for Interpretation.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the work and Contract Time.

F. Recovery Schedule: When periodic updates indicate the work is 14 calendar days or more behind the current approved schedule, submit a separate recovery schedule indicating the means by which the GC intends to regain conformance to the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve conformance, and the outside date by which recovery will be accomplished.

G. Computer Scheduling Software: Prepare schedules using current version of a program developed specifically to manage construction schedules.

1. Use approved software programs and operating systems.
3.5 STARTUP CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit horizontal, bar-chart-type startup construction schedule within 7 calendar days of the date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for the first 90 calendar days of construction. Include skeleton diagram for the remainder of the work and a cash requirement prediction based on indicated activities.

3.6 CONTRACTOR’S CONSTRUCTION SCHEDULE (GC SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit a diagram within 14 days of the date established for the Notice to Proceed. Outline significant construction activities for the first 90 calendar days of construction. Include a skeleton diagram for the remainder of the work and a cash requirement prediction based on indicated activities.

C. GC Schedule: Prepare the GC’s construction schedule using a time-scaled GC network analysis diagram for the work.

1. Develop the network diagram in sufficient time to the submit GC schedule to the Architect so that it can be accepted by City for use at least 60 calendar days after the date established for the Notice to Proceed.

   a. Failure to include on the GC’s construction schedule any work item required for performance of the work under the Contract for Construction does not relieve the GC from completing all of the work necessary within applicable completion dates, regardless of City's approval of the schedule.

2. Conduct educational workshops to train and inform key project personnel, including the subcontractors' personnel, in the proper methods of providing data and using the GC schedule information.

3. Establish procedures for monitoring and updating the GC schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

4. Use “one workday” as the unit of time for individual activities. Indicate non-working days and holidays incorporated into the schedule to coordinate with the Contract Time.

D. GC Schedule Preparation: Prepare a list of all activities required to complete the work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following.

   a. Preparation and processing of submittals.
   b. Mobilization and demobilization.
   c. Purchase of materials.
   d. Delivery.
   e. Fabrication.
f. Utility interruptions.
g. Installation.
h. Work by City that may affect or be affected by the GC's activities.
i. Testing[ and commissioning].
j. Punch list and final completion.
k. Activities occurring following final completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates must be consistent with Contract milestone dates.

3. Processing: Process information to output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the GC schedule within the limitations of the Contract Time.

4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

   a. Sub-networks on separate sheets are permissible for activities clearly off the critical path.

E. Contract Modifications: For each proposed contract modification and concurrent with its submittal, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.

F. Initial Issuance of the Schedule: Prepare an initial network diagram from a sorted activity list indicating straight “early start-total float.” Identify critical activities. Prepare tabulated reports showing the following.

   1. GC or subcontractor and the work or activity.
   2. Description of activity.
   3. Main events of activity.
   4. Immediate preceding and succeeding activities.
   5. Early and late start dates.
   6. Early and late finish dates.
   7. Activity duration in workdays.
   8. Total float or slack time.
   9. Average workforce size.
   10. Activity dollar value of (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to the schedule, prepare tabulated reports showing the following.

   1. Identification of activities that have changed.
   2. Changes in early and late start dates.
   3. Changes in early and late finish dates.
   5. Changes in the critical path.
   6. Changes in the total float or slack time.

H. Value Summaries: Prepare 2 cumulative value lists, sorted by finish dates.

   1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issuance of both lists, substitute the actual finish dates for activities completed as of the list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
   a. In both value summary lists, tabulate “actual percent complete” and “cumulative value completed” with total at bottom.
   b. Submit value summary printouts one week before each regularly scheduled progress meeting.

3.7 REPORTS

A. Daily Construction Reports: Prepare a daily construction report concerning events at the project site and recording at least the following.

1. List of subcontractors at the project site.
2. List of separate contractors at the project site.
3. Approximate count of personnel at the project site.
4. Equipment at the project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including the presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
13. AHJ orders and requests.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services that are connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorization.

B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at the project site. Such list must be cumulative, showing materials previously reported, plus all items recently delivered. Include a statement of progress with this list, and delivery dates for materials or items fabricated or stored away from the project site. Indicate the following categories for stored materials.

1. Material stored before the previous report and remaining in storage.
2. Material stored before the previous report and since removed from storage and installed.
3. Material stored after the previous report and remaining in storage.

C. Site Condition Reports: Upon discovery of a difference between site conditions and the Contract Documents, promptly prepare and submit a detailed report along with a Request for Interpretation.
Include a detailed description of the differing conditions, together with recommendations for modifying the Contract Documents.

3.8 SPECIAL REPORTS

A. General: Submit special reports directly to City within one day(s) of an occurrence. Distribute copies of report to the Architect, and to other parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at the project site, whether or not directly related to the work, prepare and submit a special report.
   1. List the chain of events, persons participating, response by the GC's personnel, evaluation of results or effects, and similar pertinent information.
   2. Advise City in advance when these events are known or predictable.

PART 4 - EXECUTION

4.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Updating the GC's Construction Schedule: Update the contractor’s construction schedule at least monthly to reflect actual construction progress and activities. Issue updated schedules at least 5 business days before each regularly scheduled progress meeting.
   1. Promptly revise the schedule after each meeting or other activity where revisions are recognized or made. Issue an updated schedule concurrently with the report of each meeting.
   2. Include a report with an updated schedule that indicates every change, including, changes in logic, durations, actual starts and finishes, and activity durations.
   3. As the work progresses, indicate the final completion percentage for each activity.

B. Distribution: Distribute copies of the GC’s construction schedule to the Architect, the Construction Manager, City, separate contractors, testing and inspecting agencies, and other parties identified by the GC with a need-to-know schedule responsibility.
   1. Post copies of the schedule in all project meeting rooms and all temporary field offices.
   2. When revisions are made, distribute updated schedules to the same parties and re-post copies in the same locations. Delete parties from distribution when their assigned portion of the work is complete and they are no longer involved in performance of construction activities.

END OF SECTION 01 32 00
PART 1 - SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes:

1. Requirements for initial construction submittals, including a proposed products list, a proposed substitutions list, a proposed subcontractor’s list, and a submittal schedule.
2. Administrative and procedural requirements for submitting shop drawings, product, samples, and other specified submittals.

B. Related Requirements:

1. Section 01 13 13 for submittals related to delegated design portions of the work.
2. Section 01 31 33 for submitting coordination drawings.
3. Section 01 32 00 for submitting schedules and reports, including the contractor’s construction schedule.
4. Section 01 43 00 for submitting test and inspection reports.
5. Section 01 78 36 for submitting warranties.
6. Section 01 78 23 for submitting operation and maintenance manuals.
7. Section 01 78 39 for submitting project record documents, including record drawings, record specifications, and record product data.
8. Section 01 79 00 for submitting video recordings of demonstration of equipment and training of City’s personnel.
9. General Conditions Article 3.6 for additional requirements for documents, shop drawings, product data, and samples at the site.

2.2 DEFINITIONS

A. Action Submittal: Means information or physical samples required by the specifications, which receive a responsive action from the Architect. Action submittals are those submittals indicated in individual specification Sections as "action submittals."

B. Informational Submittal: Means information required by the specifications that does not require responsive action from the Architect. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual specification Sections as "informational submittals."

1. Information submittals must be printed on green-colored paper.
2. If submitted digitally, each page must be clearly marked as an informational submittal.

C. Partial or Incomplete Submittal: Means a submittal that does not contain complete information about all specified requirements.
D. Combined Submittal: Means a submittal for which information for each specific item or class of material or equipment required by multiple specification sections is organized into a single submittal package.

E. Early Submittal: Means a submittal for products or assemblies that do not affecting the critical path, and do not correspond to the chronological sequence of construction.

F. Out of Sequence Submittal: Means a submittal that is (a) submitted outside of the particular order indicated on the submittal and construction schedules in which project milestones, events, movements, or other activities follow each other; or (b) submitted before its predecessor submittals are submitted.

G. Samples for Initial Selection: Means a complete collection showing the manufacturer’s full range of colors, textures, and patterns available for selection. The Architect returns the submittal with options selected.

H. Samples for Verification: Means full-size production units prepared from the same material and finish as what is specified for the work.

2.3 INITIAL CONSTRUCTION SUBMITTALS

A. Proposed Products List: Within 15 business days of the Notice to Proceed, submit a complete list of major products proposed for inclusion on the project, with the manufacturer’s name, trade name, and model number of each product. For products specified only by reference standards, furnish the manufacturer’s trade name, model or catalog designation, and reference standards.

B. Proposed Substitutions List: Within 30 calendar days of the Notice to Proceed, prepare and submit a written summary using form acceptable to the Architect identifying proposed substitute materials and equipment.

C. Proposed Subcontractors and Major Material Suppliers List: Prepare and submit a written summary as indicated in the executed Construction Manager at Risk Agreement using form acceptable to the Architect identifying individuals or firms proposed for each portion of the work, including those who are to furnish products or equipment fabricated to a special design.

D. Submittals Schedule: Submit a schedule of submittals as indicated in the executed Construction Manager at Risk Agreement, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by the Architect and the GC and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and GC’s construction schedule.

2. Initial Submittal: Transmit concurrently with the GC’s preliminary schedule indicated in the executed Construction Manager at Risk Agreement, and specified in Section 01 32 00. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Transmit concurrently with GC Project Schedule as indicated in the executed Construction Manager at Risk Agreement.
   a. Transmit revisions to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in tabular format:
   a. Scheduled date for first submittal.
   b. Specification Section numbers and titles.
   c. Submittal category (e.g., Action, Informational, etc.)
   d. Name of subcontractor.
   e. Description of the work covered.
   f. Scheduled date for the Architect's and the GC's final release or approval.
   g. Scheduled date of fabrication.
   h. Scheduled dates for purchasing.
   i. Scheduled dates for installation.
   j. Activity or event number.

2.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential action.
   2. Transmit all submittal items required for each specification Section concurrently unless partial submittals for portions of the Work are indicated on the approved submittal schedule.
   3. Transmit action submittals and informational submittals required by the same specification Section as separate packages under separate transmittals.
   4. Coordinate the transmittal of different types of submittals for related parts of the Work so processing is not delayed because of a need to review submittals concurrently for coordination.
      a. The Architect and the GC may withhold action on a submittals requiring coordination with other submittals until related submittals are received.

B. Transmit submittals within a reasonable time frame so as not to interfere with or impede the progress of the work.
   1. Each submittal must be transmitted with such promptness as to not cause any delay in the GC's own work, or the work of any subcontractor.
   2. Adjustments to the Contract Time or Contract Sum resulting from the GC’s failure to transmit a submittal with sufficient time to allow for the orderly processing and review by the Architect are prohibited.

C. Allow at least the following number of days in the GC’s construction schedule for review and response time for each submittal, unless additional time is requested or needed by the Architect.
   1. Initial Review: Allow at least 15 business days in the GC’s construction schedule for initial review of each submittal. Allow additional time if coordination with subsequent submittals is
required. The Architect advises the GC when a submittal being processed must be delayed for coordination.

2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.

3. Resubmittal Review Allow at least 15 business days in the GC’s construction schedule for review of each resubmittal.

4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, Allow at least 21 business days in the GC’s construction schedule for initial review of each submittal.

5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to the Architect's consultants, allow at least 15 business days in the GC’s construction schedule for review of each submittal. Submittals are returned to the Architect before being returned to GC.

D. Review and response time for each submittal begins when

1. the Architect receives the complete submittal from the GC (not when the submittal is transmitted by the GC); or
2. the Architect receives all requested additional information from the GC for those submittals requiring additional information or clarification from the GC; and

E. Review and response time for each submittal is increased when

1. more information from the GC is requested by the Architect;
2. the submittal is transmitted out of sequence; or
3. in the opinion of the Architect, more time is needed to review the submittal.
   a. The GC shall alert the Architect in writing of the time available before a review may cause an impact to the Contract Sum or Contract Time.
   b. The GC’s failure of to alert the Architect in writing inures to the benefit of the Architect.

F. Paper Submittals: Place a permanent label or title block on each submittal item for identification.

1. Indicate the name of the company or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches on the label or beside the title block to record the GC’s review and approval markings, and any action taken by the Architect and the GC.
3. Include the following information for processing and recording action taken.
   a. Project name.
   b. Date.
   c. Name of Architect.
   d. Name of GC.
   e. Name of GC.
   f. Name of subcontractor.
   g. Name of supplier.
   h. Name of manufacturer.
   i. Submittal number or other unique identifier, including revision identifier.

   1) Submittal number shall use specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
j. Number and title of appropriate specification Section.
k. Drawing number and detail references, as appropriate.
l. Location(s) where product is to be installed, as appropriate.
m. Other necessary identification.

4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless the Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

a. Transmit one copy of submittal to concurrent reviewer in addition to specified number of copies to the Architect.

5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. The Architect discards without review those submittals received from sources other than the GC.

a. Transmittal Form for Paper Submittals: Provide locations on form for the following information.

1) Project name.
2) Date.
3) Destination (To:).
4) Source (From:).
5) Name and address of Architect.
6) Name of GC.
7) Name of GC.
8) Name of firm or entity that prepared submittal.
9) Names of subcontractor, manufacturer, and supplier.
10) Category and type of submittal.
11) Submittal purpose and description.
12) Specification Section number and title.
13) Specification paragraph number or drawing designation and generic name for each of multiple items.
14) Drawing number and detail references, as appropriate.
15) Indication of full or partial submittal.
16) Transmittal number, numbered consecutively.
17) Submittal and transmittal distribution record.
18) Remarks.
19) Signature of transmitter.

G. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows.

1. Assemble the complete submittal package into a single indexed file incorporating the submittal requirements of a single specification Section, and a transmittal form with links enabling navigation to each item.
2. Name each file with the submittal number or other unique identifier, including revision identifier.
a. File names must use a project identifier and the specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide a means for insertion to permanently record the GC’s review and approval markings and the action taken by the Architect and the GC.

4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to Owner, containing the following information:

   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name of GC.
   e. Name of Sub-Contractor
   f. Name of firm or entity that prepared submittal.
   g. Names of subcontractor, manufacturer, and supplier.
   h. Category and type of submittal.
   i. Submittal purpose and description.
   j. Specification Section number and title.
   k. Specification paragraph number or drawing designation and generic name for each of multiple items.
   l. Drawing number and detail references, as appropriate.
   m. Location(s) where product is to be installed, as appropriate.
   n. Related physical samples submitted directly.
   o. Indication of full or partial submittal.
   p. Transmittal number, numbered consecutively.
   q. Submittal and transmittal distribution record.
   r. Other necessary identification.
   s. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:

   a. Project name.
   b. Number and title of appropriate specification Section.
   c. Manufacturer name.
   d. Product name.

H. Options: Identify options requiring selection by Architect.

I. Deviations and Additional Information: On an attached separate sheet, prepared on the GC’s letterhead, record relevant information, requests for data, revisions other than those requested by the Architect and the GC on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include the same identification information as required for the related submittal.

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

   1. Note the date and content of the previous submittal.
   2. Note the date and content of the revision in the label or title block and clearly indicate the extent of the revision.
3. Retransmit submittals until they are marked with approval notation from Architect's and GC's action stamp.

K. Distribution: Furnish copies of final submittals to the manufacturers, subcontractors, suppliers, fabricators, installers, AHJ, and others as necessary for performance of the work. Include a distribution on each transmittal form.

L. Use for Construction: Retain one complete copy of each submittal, including all resubmittal, at the project site.

1. Use only final action submittals that are marked with approval notation from Architect's and GC's action stamp.
2. Do not perform any portion of the work requiring submittal and review until the Architect has reviewed and returned the respective submittal. Perform such work in compliance with returned submittals.

2.5 PROCEDURAL REQUIREMENTS

A. General Submittal Procedure Requirements:

1. Prepare and transmit only complete submittals that are required by each individual specification Section.
   a. Submittals not required by the specifications are returned to the GC without review, except to record nonconformance with these requirements.
   b. Partial or incomplete submittals are returned to the GC without review, except to record nonconformance with these requirements.
   c. Multiple submittals are returned to the GC without review, except to record nonconformance with these requirements.

2. Submittals not conforming to the specified procedural requirements are returned to the GC without review, except to record nonconformance with these requirements.
3. Stagger submittals to correspond to the chronological sequence of construction.
   a. Early submittals are returned to the GC for later re-submittal without review, except to record nonconformance with these requirements.
   b. Out-of-sequence submittals are returned to the GC without review, except to record nonconformance with these requirements.

B. Electronic Submittals:

1. Post electronic submittals as PDF electronic files directly to the project web site specifically established for project.
2. Transmit electronic submittals via email as PDF electronic files.

C. Paper Submittals: Package each submittal individually and appropriately for transmittal and handling. Collate multiple-page submittals into sets, and staple or bind each set as appropriate before transmittal to the Architect.

1. Action Submittals: Transmit 3 paper copies of each submittal, unless otherwise indicated. The Architect returns 2 copies.
2. Informational Submittals: Transmit 2 paper copies of each submittal, unless otherwise indicated. The Architect does not return any copies.
3. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
   a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications, where indicated.
   b. Provide a notarized statement on original paper copy certificates and certifications, where indicated.

2.6 ACTION SUBMITTALS

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

1. If information must be specially-prepared for a submittal because standard published data are not suitable for use, transmit as Shop Drawings, not as Product Data.
2. Mark each copy of every submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer’s catalog cuts.
   b. Manufacturer’s product specifications.
   c. Standard color charts.
   d. Statement of compliance with specified referenced standards.
   e. Testing by recognized testing agency.
   f. Application of testing agency labels and seals.
   g. Notation of coordination requirements.
   h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams showing factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Transmit Product Data before or concurrent with Samples.
6. Transmit Product Data as
SUBMITTAL PROCEDURES

a. An electronic PDF.
b. 3 paper copies, unless otherwise indicated. The Architect returns 2 copies.

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

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
   d. Notation of coordination requirements.
   e. Notation of dimensions established by field measurement.
   f. Relationship and attachment to adjoining construction clearly indicated.
   g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, transmit Shop Drawings on sheets at least 8-1/2 by 11 inches, but not larger than 30 by 42 inches.

3. Transmit Shop Drawings in the following format:
   a. PDF electronic file.
   b. 2 opaque (bond) copies of each submittal. The Architect returns one copy.
   c. 3 opaque copies of each submittal. The Architect will retain 2 copies; the remainder will be returned.

C. Samples: Transmit Samples for reviewing the kind, color, pattern, and texture for comparison to other submittals and actual components, as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

2. Identification: Attach a label on an unexposed side of each Sample that includes the following.
   a. Generic description of the sample.
   b. Product name and manufacturer’s name.
   c. Sample source.
   d. Number and title of applicable specification Section.
   e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of the Sample transmittal, a digital image file illustrating the Sample’s characteristics, and identification information for record.

4. Disposition: Maintain sets of approved Samples at project site, available for quality-control comparisons throughout the course of the project. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the work are indicated in individual specification Sections. Such Samples must be in an undamaged condition at the time of use.
   b. Samples not incorporated into the work, or otherwise designated as City's property, are the property of GC.
5. Samples for Initial Selection: Transmit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

   a. Number of Samples: Transmit one full set(s) of available choices where selection of color, pattern, texture, or similar characteristics is required from the manufacturer's product line. The Architect returns the submittal with the options selected.

6. Samples for Verification: Transmit full-size units or Samples of the specified size, prepared from the same material used for the Work, cured and finished in the manner specified and physically identical to the material or product proposed for use; and that shows the full range of color and texture variations expected. Samples include the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

   a. Number of Samples: Transmit 3 sets of Samples. The Architect retains 2 Sample sets; the remainder will be returned. Mark up and retain one returned Sample set as a project record sample.

      1) Transmit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are demonstrated.

      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, transmit at least 3 sets of paired units that show approximate limits of variations.

2.7 INFORMATIONAL SUBMITTALS

A. Product Schedule:

   1. As required in individual specification Sections, prepare a written summary indicating the types of products required for the work along with their intended location. Include the following information in tabular form:

      a. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by GC if none is indicated.

      b. Manufacturer and product name, and model number if applicable.

      c. Number and name of room or space.

      d. Location within room or space.

   2. Transmit product schedule in the following format:

      a. PDF electronic file.

      b. 3 paper copies of the product schedule or list, unless otherwise indicated. The Architect returns 2 copies.

B. Application for Payment and Schedule of Values: As indicated in the executed Construction Manager at Risk Agreement.

C. GC's Construction Schedule: As specified in Section 01 32 00.
D. Coordination Drawing Submittals: As specified in Section 01 32 33.

E. Closeout Submittals and Maintenance Material Submittals: As specified in Section 01 77 00.

F. Maintenance Data: As specified in Section 01 78 23.

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

H. Welding Certificates: Prepare written certification that welding procedures and personnel conform to the requirements in the Contract Documents. Transmit a record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include the names of firms and personnel certified.

I. Installer Certificates: Submit written statements on manufacturers' letterhead certifying that the installer complies with requirements in the Contract Documents and, where required, is authorized by the manufacturer for this specific project.

J. Manufacturer Certificates: Submit written statements, prepared on the manufacturer's letterhead, certifying that the manufacturer’s qualification and other characteristics conform to the requirements of the Contract Documents. Include evidence of manufacturing experience, when requested.

K. Product Certificates: Submit written statements, prepared on the manufacturer's letterhead, certifying that the product complies with requirements in the Contract Documents.

L. Material Certificates: Submit written statements, prepared on the manufacturer's letterhead, certifying that the material complies with requirements in the Contract Documents.

M. Material Test Reports: Submit reports prepared by a qualified testing and inspection agency, on the testing agency's standard form, indicating and interpreting the results of tested or inspected material for conformance with the requirements in the Contract Documents.

N. Research Reports: Submit reports issued by a model code organization acceptable to the AHJ, that the products conform to the building code in effect for project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

O. Preconstruction Test Reports: Submit reports prepared by a qualified testing and inspection agency, on the testing agency's standard form, indicating and interpreting the results of tests or inspections performed before installation to confirm conformance to the Contract Documents.

P. Compatibility Test Reports: Submit reports prepared by a qualified testing and inspection agency, on the testing agency's standard form, indicating and interpreting the results of compatibility tests
performed before installation of a particular product. Include written recommendations for primers and substrate preparation necessary to promote proper adhesion.

Q. Field Test Reports: Submit reports prepared by a qualified testing and inspection agency, on the testing agency's standard form, indicating and interpreting the results of field tests for conformance with the requirements in the Contract Documents performed either during the installation of a product or after the product is installed in its final location.

PART 3 - PRODUCTS (NOT USED)

PART 4 - EXECUTION

4.1 CONTRACTOR'S SUBMITTAL REVIEW

A. Review each submittal and check for coordination with other work of the Contract and for compliance with the Contract Documents.

1. Note corrections and field dimensions.
2. Mark with review stamp before submitting to the Architect.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. Review stamp:

1. Provide a uniform review stamp containing, at a minimum, the following information:
   a. Name of company.
   b. Status of review.
   c. Date.
   d. Initials of reviewer.

2. Stamp and initial submittals as follows:
   a. Stamp and initial the first page of every product data submittal.
   b. Stamp and initial every sheet of each shop drawing submittal.
   c. Stamp and initial the back of every sample submitted for review.

3. By stamping and submitting each submittal, the GC represents that the GC has determined and verified the following:
   a. Compliance with the requirements of the Contract Documents.
   b. Field measurements.
   c. Quantities.
   d. Dimensions.
   e. Specified performance criteria.
   f. Installation requirements.
   g. Catalog number and similar information.
h. Materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to performance of the work.

i. Coordination of the requirements of the item submitted with the overall the project.

J. Additional information relative to the GC's sole responsibility for means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto.

D. Submittals that do not correctly bear the GC's approval stamp and are returned to the GC without review.

4.2 ARCHITECT'S ACTION

A. Action Submittals: the Architect will review each submittal for conformance with the information given and the design concept expressed in the Contract Documents, will make marks to indicate corrections or modifications required, and will return each submittal to the GC for distribution.

B. the Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken as follows:

1. “NO EXCEPTIONS”: Fabrication, manufacture and/or construction may proceed. The work generally is in compliance with the Contract Documents.

2. “MAKE CORRECTIONS NOTED”: Fabrication, manufacture and/or construction may proceed providing the work is in compliance with the Architect’s notations and the Contract Documents.

3. “REVISE AND RESUBMIT”: No work may be fabricated, manufactured and/or constructed. Additional submittal required. This submittal is not permitted on the site.

4. “REJECTED”: No work may be fabricated, manufactured and/or constructed. New submittal required. This submittal is not permitted on the site.

C. Review of separate item does not constitute review of an assembly in which item functions.

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

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

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

G. Submittals not required by the Contract Documents may be returned by the Architect without action.

H. Submittals containing substitutions for specified materials, products, equipment, manufacturers, model numbers, components, assemblies, color, texture, finish, pattern, characteristics, elements or other properties are rejected.
4.3 RESUBMITTAL REQUIREMENTS

A. Revise initial shop drawings, when required, and retransmit as specified for initial submittal. Indicate on drawings changes made, other than those requested by the Architect, clearly by clouding or similar acceptable method.

B. Transmit new product data and samples as required for initial submittal.

C. Transmit revised calculations as required for initial submittal.

D. Identify resubmittal with the original submittal number followed by an alphabetic suffix (i.e. 10A).

END OF SECTION 01 33 00
AN AGREEMENT BETWEEN ARCHITECT OF RECORD AND CONTRACTOR FOR TRANSFER OF COMPUTER AIDED DRAFTING (CAD) AND/OR REVIT FORMAT FILES ON ELECTRONIC MEDIA

Christopher Ruebush
Architect of Record (AOR)
PGAL

Contractor

A/E’s Project No:  R1004389.00
Project Name:  NEW BRAUNFELS POLICE HEADQUARTERS

The AOR will provide the following BIM Model, dated January 4, 2019 for the convenience of the contractor in preparing shop fabrication drawings:
Architectural Model

Drawings were prepared on the following:
Computer Hardware: IBM Compatible Operating System: Windows 10 Professional
Software: AutoCAD Architecture  Release: Revit Format 2020

Contractor shall pay AOR a service fee of $000.00 for Architectural Files only.

TERMS AND CONDITIONS:

AOR makes no representation as to the compatibility of the CAD and/or REVIT format files with any hardware or software.

Since the information the AOR set forth on the CAD and/or REVIT format files can be modified or amended, unintentionally or otherwise, the AOR reserves the right to remove all indicia of its ownership and/or involvement from each electronic display.

All information on the CAD and REVIT format is considered instruments of service of the AOR and shall not be used for other projects, for additions to this project, or completion of the project by others. CAD and/or REVIT format shall remain the property of the AOR and in no case shall the transfer of these files be considered a forfeit of ownership.

AOR makes no representation regarding the accuracy, completeness, or permanence of CAD and/or REVIT format files, nor for their merchantability or fitness for a particular purpose or an intended use. Addenda information or revisions made after the date indicated on the CAD and/or REVIT format files may not have been incorporated. In the event of a conflict between the sealed contract drawings and CAD and/or REVIT format files, the sealed contract drawings shall govern. It is the Contractor’s responsibility to determine if any conflicts exist. The CAD and/or REVIT format files shall not be considered to be Contract Documents.

The use of CAD and/or REVIT format files shall not in any way obviate the Contractor’s responsibility for the proper checking and coordination of dimensions, details, member sizes and gage, and quantities of materials as required to facilitate complete and accurate fabrication, erection and sequencing of construction. The CAD and/or REVIT format files is not intended to provide the level of detail needed in order to extract precise material or object quantities.
The Contractor, including its clients, sub consultants and subcontractors, shall indemnify and hold harmless the AOR, its officers, directors, shareholders, employees, affiliates and its sub-consultants from any and all claims, damages, losses, expenses, penalties, causes of action and liabilities of any kind, including attorney’s fees, and other defense costs, arising out of or resulting from the use of the CAD and/or REVIT format files by the Contractor, or by any third party recipient or user of the CAD and/or REVIT format files from the Contractor. Each party agrees to waive claims against the other parties for consequential damages arising out of or relating to their use of, or access to, the CAD and/or REVIT format files. Consequential damages include, but are not limited to, loss of use and loss of profit, loss of business, loss of income, loss of reputation or any other consequential damages that either party may have incurred from any cause of action.

The AOR believes that no licensing or copyright fees are due to others on account of the transfer of the CAD and/or REVIT format files, but to the extent any are, the Contractor will be responsible for and pay the appropriate fees. Contractor agrees to defend, indemnify and hold the AOR harmless from and against any and all loss, damage, liability or expense (including without limitation, attorneys’ fees and other defense costs) of any kind by reason of any actual or alleged infringement of any patent, copyright, trademark, trade secret or other proprietary right of a third party arising out of or resulting from the use of CAD and/or REVIT format files on any work done by Contractor or any of its subcontractors.

Any purchase order number provided by the Contractor is for Contractor’s accounting purposes only. Purchase order terms and conditions are void and are not a part of this agreement.

Payment of the aforementioned service fee is due prior to the release of the CAD/Revit files.

This agreement shall be governed by the laws of the State of Texas.

If a dispute arises out of or relates to this Agreement, or the breach thereof, and if the dispute cannot be settled through negotiations, the parties agree first to try in good faith to settle the dispute by mediation administered by a mutually acceptable mediator before resorting to arbitration, litigation or some other dispute resolution procedure. The fees for the mediator will be shared equally by the parties.

IN WITNESS WHEREOF, the parties hereto have each caused this Agreement to be executed by its duly authorized representatives to be effective as of the _________ day of _______________, 2019.

AUTHORIZED ACCEPTANCE:

PGAL

_______________________________

by Architect of Record (AOR) Print Name and Title

Christopher Ruebush

END OF SECTION 013500
PART 1 - SECTION 01 42 00 - REFERENCES

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for

1. specification format and conventions;
2. abbreviations and acronyms used throughout the Contract Documents; and
3. definitions used throughout the Contract Documents.

2.2 ADMINISTRATIVE REQUIREMENTS

A. Abbreviations and Acronyms:

1. Certain abbreviations and acronyms contained in the Contract Documents are defined particularly for these specifications.
2. Where acronyms are not defined, they mean the recognized name of the standard, regulation, or organization indicated in either


B. Definitions:

1. Basic Contract Document definitions are included in the Conditions of the Contract.
2. Certain other terms, phrases, and words, and their derivatives, contained in the Contract Documents are defined particularly for these specifications in either this Section or within the appropriate specification section where a specific term is used.
3. Where terms, phrases, or words, and their derivatives and abbreviations, are not defined, their ordinary meanings indicated in “Webster’s Third New International Dictionary of the English Language, Unabridged”, copyright 1986, are assumed to apply as the context of usage requires.
4. Words implied, but not stated, are inferred as the context of usage requires.
5. Terms, phrases, and words used in the neuter gender include the feminine and the masculine; the masculine gender includes the feminine and neuter; and the feminine gender includes the masculine and neuter. Similarly, when the context requires, the singular includes the plural, and the plural the singular.
6. Underlined, bold, or capitalized words do not signify, imply, or convey any special or unusual meaning; nor do they signify, imply, or convey that words not underlined, bolded, or capitalized have any less meaning.
2.3 REFERENCES

A. Abbreviations:

1. deg.: Degree.

B. Acronyms:

1. AA: Aluminum Association
2. AAMA: the Architectural Aluminum Manufacturer’s Association
3. AHJ: Authority (Authorities) Having Jurisdiction
4. AISI: American Iron and Steel Institute
5. ANSI: American National Standards Institute
6. ASTM: American Society for Testing and Materials
7. AWS: American Welding Society
8. CARB: California Air Resources Board
9. CFS: Cold-Formed Steel.
10. CHPS: The Collaborative for High Performance Schools
11. CRI: Carpet and Rug Institute
12. DFT: Dry Film Thickness
13. DSA: Division of the State the Architect
15. FSC: Forest Stewardship Council
16. FSI: Flame Spread Index
17. GEI: GREENGUARD Environmental Institute
18. HDG: Hot Dip Galvanized
19. IOR: Inspector of Record
20. LEED: Leadership in Energy and Environmental Design
22. OSHPD: Office of Statewide Health Planning and Development
23. HDG: Hot Dip Galvanized
24. MFMA: Metal Framing Manufactures Association
25. MSG: Manufacturer’s Standard Gage
26. NOMMA: National Ornamental Metals Manufacturer’s Association
27. SC: Service Condition
28. SCAQMD: South Coast Air Quality Management District
29. SCS Scientific Certification Systems
30. SDI: Smoke Developed Index
31. SSMA: Steel Stud Manufacturing Association
32. SSPC: Society for Protective Coatings.
33. SWG: Standard Wire Gage
34. TCA: Tile Council of America
36. UL: Underwriters Laboratories.
37. USGBC U.S. Green Building Council

C. Definitions:

1. **Aboveground**: Means situated completely on or above the final finish grade or surface of the ground, or finish floor of grade-level floor construction. Other terms, including “above grade”
and similar terms have the same meaning as “aboveground”. Locations that do not meet the
definition above for “aboveground” are considered “below ground” or “below grade”, and
similar locations.
2. Appearance: Means the characteristic visible aspect of an item; specifically its color, sheen,
and texture.
3. Approved: Means recognized in writing by the Architect as in conformance with the
requirements of the Contract Documents. Other terms, including “approve”, “approval”, and
similar terms, have the same meaning as “approved”.
   a. Approvals are restricted to limitations of the Architect’s responsibilities and duties outlined
in the Conditions of the Contract, without any implied meaning extending the Architect's
responsibility into the CMR's area of the CMR coordination, supervision, or means and
methods of construction as outlined in the Conditions of the Contract.
   b. In no situation does an approval by the Architect release the CMR from responsibility to
fulfill all requirements of the Contract Documents.
4. Approved Substitute: Means a substitution proposed and evidenced by the CMR as either in
compliance with or exceeding the quality of specified products, systems or methods of
execution relative to appearance, convenience and practicality, including product
considerations, manufacturer considerations, manufacturer’s product representative
considerations, installation considerations and cost considerations, and approved by the
Architect for incorporation into the work.
5. As Necessary: Means essential to the completion of the work.
6. As Required: Means either (a) as instructed by the Contract Documents or (b) essential to the
completing the work.
7. Assembly: A composite entity composed of various parts fit together in an orderly way,
usually with logical selection or sequence, so as to make into an operative whole (e.g., a stair
or curtain wall assembly)
8. Authority (Authorities) Having Jurisdiction: Means the agencies, either individually or
collectively, charged by statute with administration and enforcement of building code
requirements and other regulations at the project location.
9. Below Ground: See definition of “Aboveground”.
10. Board: Means sawn timber measuring less than 2 inches in nominal thickness at the least
dimension.
11. Building Information Model: Means digital computer data used by the Architect as
instruments of service to produce Contract Documents, including 2-dimensional and 3-
dimensional computer model and drawing files in CAD format, and spreadsheet or word
processing files.
12. Cold-Formed Metal Framing: Means structural metal framing members having a base metal
thickness range of between 118 mils (10-gage) and 33 mils (20-gage), and installed in
transverse and axial load-bearing applications.
13. Concealed: Means embedded in concrete, masonry or other construction; located or installed
within furred spaces; situated within walls or partitions; suspended above ceilings; or placed in
trenches, crawl spaces, or enclosures; or otherwise not visible, either outside the building or
inside occupied space within the building, during normal activity when the project is
completed; or that is identified as exposed on Drawings.
14. Component: One of a group of individual parts of which a subassembly, assembly or system is
comprised; especially a part that can be separated from or attached to the group.
15. Concealed: See definition for “Exposed”.
16. Day: Basic reference to the primary unit of Contract time as defined by the General
Conditions.
17. **Defective**: Means a product, system, or method of execution that has failed, or that otherwise does not comply with the requirements of the Contract Documents. Other terms, including “defect”, “defective work”, and similar terms, have the same meaning as “defective”. See definition for “failure” for a partial list of defects, which are not limited to those indicated.

18. **Dimension Lumber**: Means sawn timber measuring between 2 and 5 inches in nominal thickness at the least dimension.

19. **Directed**: Means a written instruction issued by the Architect to the CMR. Other terms, including “authorized”, “permitted”, “requested”, and similar terms, have the same meaning as “directed”.

20. **Enclosure**: Means a level of protective resistance to weather for interior spaces provided during the construction phase by either permanent construction or substantial temporary closures. Other terms, including “enclosed” and similar terms, have the same meaning as “enclosure”.

   a. **Uncontrolled Enclosure**: Means short-term, limited, temporary protection against wind for up to 6 months before completion of the permanent enclosure, as determined by the Architect.

   b. **Partially-Controlled Enclosure**: Means medium-term, limited, temporary protection against both wind and rain for up to 12 months before completion of the permanent enclosure, as determined by the Architect.

   c. **Permanent Enclosure**: Means complete permanent protection against wind, temperature, humidity, atmospheric pressure, and precipitation, provided by a permanent insulated and weathertight roofing system, permanent insulated and weathertight exterior wall construction, and openings closed with permanent construction or substantial temporary closures equivalent in protection to permanent construction, as determined by the Architect.

21. **Engineering Services**: Means those services performed for the design, fabrication and installation of components and assemblies similar in material, design, complexity and extent to those indicated or required for this project.

22. **Equipment**: As defined by the General Conditions.

23. **Ex situ**: Means either off-site or away from the position an item will ultimately occupy.

24. **Existing Products**: Means an item salvaged or recycled from the project, or from another project or facility, where indicated, and incorporated into the work.

25. **Exposed**: Means an item that either does not meet the definition above for “concealed”, or that is identified as exposed on Drawings.

   a. **Weather-Exposed**: Means a floor, wall, soffit, ceiling, roof or similar surface that is exposed to unconditioned wind, temperature, humidity, atmospheric pressure or precipitation, except

      1) ceilings or roof soffits enclosed by walls or by beams that extend at least 12 inches below such ceilings or roof soffits;
      2) walls or portions of walls within an enclosed roof area when located a horizontal distance from an exterior opening equal to twice the height of the opening; and
      3) ceiling or roof soffits beyond a horizontal distance 10 feet from the outer edge of the ceiling or roof soffits.

26. **Exterior**: See definition below for “interior”. 

27. **Fabricate**: Means to specifically assemble, or make out of selected materials, to meet individual requirements for the project. Other terms, including “fabrication”, “fabricator” and similar terms, have the same meaning as “fabricate”.

28. **Factory finished**: Means finished off the project site under controlled environmental conditions, requiring no additional finish at the project site except for minor touchup of areas damaged during delivery, storage, handling and installation. Other terms, including “shop-applied”, “prefinished”, and similar terms, have the same meaning as “factory finished”.

29. **Failure**: Means the inability of an item, system, assembly, or method of execution to perform its intended function as designed, including incipient and catastrophic failure.

   a. **Incipient Failure**: Means initial or nascent non-catastrophic failure of a product or system, or a method of execution leading to such a failure, including

      1) excessive material loss due to abrasion resulting from normal traffic;
      2) cracking, flaking, spalling, or eroding in excess of specified requirements;
      3) peeling or delaminating from substrate;
      4) staining of adjacent surfaces caused by migration of materials, components or accessories;
      5) buckling, deflection, or other structural performance exceeding the specified limits;
      6) performance either exceeding maximum specified performance requirement limits or falling below minimum specified performance requirement limits;
      7) stresses transferred from supporting framing members to other items that are not engineered to support or resist the transferred loads;
      8) material fatigue, including deterioration, cracking or brittleness, identified by inspection, data analysis or other means of detection;
      9) displacement of glazing gaskets;
      10) loosening, weakening, or permanent damage to fasteners, anchors, attachments and other components; and
      11) vibration or noise caused by thermal or structural movement, or wind, including rattle and flutter.

   b. **Catastrophic Failure**: Means discernible failure impossible to acceptably remedy or correct in place, or that necessitates remedial repair, in each case as determined by the Architect, including

      1) buckling, deflection, or other structural performance necessitating remedial repair;
      2) failure of operable units to open or close, or to otherwise achieve the full range of design movement;
      3) permanent deformation of any material or component exceeding specified limits;
      4) breakage or fallout from an assembly of any material or component;
      5) air infiltration or water leakage;
      6) material adhesive or cohesive failure, including tearing;
      7) corrosion, staining or other deleterious effects due either to physical contact of dissimilar metals or to water runoff passing over dissimilar metals;
      8) water leakage;
      9) loss of waterproofing integrity, allowing the intrusion of water, oils, gasoline, grease, salt, chemicals, acids or other fluids to outside surface of substrate; and
      10) chalking or color changes relative to a control sample of the original application beyond those described in manufacturer-published information.
30. **Furnish**: Means to supply and deliver an item to the project site in an operable condition, ready for unpacking, assembly, and installation.

31. **Heavy Timber**: Means sawn timber measuring 5 or more inches in nominal thickness at the least dimension.

32. **Include**: Means inclusion without limitation, in the largest encompassing sense. Other terms, including “such as”, and similar terms, have the same meaning as “include”.

33. **Indicate**: Means expressed by graphic representations or in written form on the Contract Drawings, or elsewhere in the specifications, without limitation of location, unless specifically noted. Other terms, including “indicated”, “shown”, “noted”, “scheduled”, and similar terms, have the same meaning as “indicated”.

34. **In situ**: Means in the position an item will finally occupy.

35. **Install**: Means to handle, unload, store, unpackage, assemble, erect, construct, place, anchor, apply, connect, work to dimension, complete, finish, cure, adjust, clean, protect and similar operations at the project site, in final position, and in operable and useable condition.

36. **Installer**: As defined by the General Conditions.

37. **Instructions**: Means written directions, diagrams, recommendations, precautions, specifications and similar instructions published by a product supplier, manufacturer or fabricator.

38. **Interior**: Means conditioned space or pertaining to conditioned space that is completely enclosed by floor, wall, and ceiling or roof construction, and solid doors or fenestration systems. Ventilated unconditioned spaces are not interior spaces.

   a. Semi-Exterior: Means an unconditioned or semi-heated space, or pertaining to unconditioned or semi-heated space, that is completely enclosed by floor, wall, and ceiling or roof construction, and solid doors or fenestration systems through which thermal energy may be transferred to or from interior spaces, other semi-exterior spaces, or the exterior. Ventilated unconditioned spaces are not semi-exterior spaces.
   b. Exterior: Means a space that does not meet the definition above for either an “interior” or a “semi-exterior” space.

39. **Lightgage Metal Framing**: Means non-structural metal framing members having a base metal thickness of 30 mils (20-gage) or less than, and installed in non-load-bearing interior construction assemblies supporting plaster or gypsum board.

40. **Manufacture**: Means to produce standard, custom or proprietary units generally utilizing a mass-production method. Other terms, including “manufactured”, “manufacturer”, and similar terms, have the same meaning as “manufacture”.

41. **Match**: Means provide a portion of the work using the same product, system or execution method identical in dimension, finish, color, texture, and work results to one of the following, as determined by City.

   a. Another portion of the work.
   b. Existing conditions adjacent to new work.
   c. A design reference sample in City’s or the Architect’s possession.
   d. An approved sample, range of samples, mockup or sample panel.

42. **Material**: Means a basic substance, often a commodity, used in construction or to manufacturer products and other items used in construction.

43. **May**: Means “has discretion to”, “is permitted to”, or “is authorized to”. See definitions below for “must” and “shall”.

REFERENCES 14200 - 6
44. **Must**: Means “is required to” when used to impose an obligation on someone or something other than the object of a sentence; or when the active subject is incapable of assuming a duty or obligation. See definition above for “may” and definition below for “shall”.

45. **Non-Roof Surface**: Means the top cover of a building having a slope more than 60 degrees from the zero-degree horizontal plane.

46. **Or Equal**: See definition above for “approved substitute”.

47. **Partially-Controlled Enclosure**: See definition above for “enclosure”.

48. **Permanent Enclosure**: See definition above for “enclosure”.

49. **Permanently Deformable**: Means displacement or change in dimension of a material or component after an applied load has been removed and the specimen has relaxed for specified period of time.

50. **Practical**: Means useful, based on previous experience.

51. **Practicable**: Means useable for a specific purpose; capable of being done with means at hand and circumstances as they are.

52. **Product**: Means components, or assemblies of components, purchased for permanent incorporation into the work, whether purchased specifically for the project or taken from previously purchased stock that was not previously incorporated into another project or facility. Other terms including “manufactured units”, “equipment”, “accessories”, and similar terms, have the same meaning as “products”.

53. **Provide**: Means to furnish and install, complete and in-place, ready for operation and use. Whenever the terms “furnish”, “install” or “provide” are not explicitly stated, the term “provide” is implied.

54. **Reasonably Inferable**: Means that if an item, system, or assembly, including components, accessories, and facility services, is either indicated or specified, then all material, labor, equipment, and facility services that are (a) normally furnished with such items, systems, or assemblies; and (b) that are necessary to make a complete installation, must be provided whether or not indicated or specified.

   a. Items the CMR either could or should have reasonably anticipated must be included as part of the work, based on (1) the CMR’s skill, knowledge, and experience; and (2) using an objective industry standard and not a subjective standard.

   b. Only those items specifically excepted may be omitted from the project.

55. **Regulation**: Means a law, ordinance, statute, or lawful order issued by authorities having jurisdiction, and rules, conventions, or agreements within the construction industry that prescribe performance of the work.

56. **Related Trades**: Means those installers, applicators, erectors, constructors, and fabricators whose work will come into contact with, will penetrate, is directly adjacent to, or is otherwise integral to or materially impacted by the work of a given scope.

57. **Roof Surface**: Means the top cover of a building having a slope 30 degrees or more measured from the 90-degree vertical plane (i.e., less than 60 degrees measured from the zero-degree horizontal plane.

58. **Samples**: As defined by the General Conditions.

   a. **Design Reference Sample**: Means samples of appearance (color, texture, sheen and finish), pre-approved by the Architect.

   b. **Sample**: Means samples of appearance (color, texture, sheen and finish), submitted to the Architect for review and approval.

   c. **Field Sample**: Means physical examples illustrating proposed finishes, coatings, or finish such as concrete, brick, or stone, installed or applied in the field for review by the Architect.
d. **Sample Panel**: Means scaled-down pre-production samples incorporating full-scale details of architectural features, finishes, textures, transitions and repair techniques for review by the Architect.

e. **Mock-Up**: Means full-size assemblies erected for review of construction, coordination of the work specified in several sections, testing, operation, training of the trades and similar activities, and aesthetic or other for review by the Architect.

59. **Section**: Means a numbered and titled portion of these Specifications.

60. **Selected Products**: Means materials, products, components and accessories selected by the CMR from among specified materials, products, components and accessories, or from approved substitution requests, for inclusion into the project. Other terms including “selected materials”, “selected manufactured units”, “selected equipment”, “selected components”, “selected accessories”, “selected mixes”, and similar terms, have the same meaning as “selected products”.

61. **Service Condition (SC)**: Means a benchmark used to measure a product, assembly or system’s exposure to weather or abrasion, and expressed by one of the following.

   a. **Very Severe Exposure (SC-4)**: Exposure to harsh conditions or subject to frequent exposure to moisture, chemicals, cleaners, and saline solutions, plus likely damage by denting, scratching, or abrasive wear.
   
   b. **Severe Exposure (SC-3)**: Exposure to condensation, perspiration, infrequent wetting by rain, and cleaners.
   
   c. **Moderate Exposure (SC-2)**: Exposure to mostly dry indoor atmospheres, but subject to occasional condensation, wear, or abrasion.
   
   d. **Mild Exposure (SC-1)**: Exposure to indoor atmospheres with rare condensation; and subject to minimum wear or abrasion.

62. **Shall**: Means “has a contractual obligation or duty to” when used to convey a contractual obligation imposed on the subject of a sentence. See definitions above for “may” and “must”.

63. **Similar**: Means a portion of work that matches the whole or part, as indicated, of another portion of the work, but has a different geometric configuration.

64. **Submit**: Means for the CMR to prepare and present written or graphic evidence to the Architect for approval, unless otherwise stated.

65. **Substitution**: Means an unspecified product, system or execution method proposed by a Bidder or the CMR for incorporation into the work.

66. **Suitable**: Means meant or adapted for the purpose indicated or intended by the Contract Documents, as determined by the Architect. Other terms including “reasonable”, “proper”, “correct”, “necessary”, and similar terms, have the same meaning as “suitable”.

67. **Symmetrical**: Means a portion of work that matches either itself or the whole or part of another portion of the work, as indicated, the geometric configuration of which is reflected about a centerline or axis of a surface or a space, or rotated around a point in space.

68. **System**: Means a group of many, often diverse parts joined in regular interaction or interdependence, and subject to a common plan or serving a common purpose to form an integral, organic, or organized whole (e.g., a suspended acoustical ceiling system)

   a. **Subsystem**: Means a portion of a system with characteristics similar to a system

69. **Timber**: Means the wood of trees cut and prepared for use as building material.

70. **Uncontrolled Enclosure**: See definition above for “enclosure”.

71. **Underground**: Means a location that does not meet the definition above for “aboveground” or “above grade”.

REFERENCES
72. **Wall**: Means one of the sides of a room or building connecting a floor and ceiling or foundation and roof, and having a slope less than 30 degrees from the 90-degree vertical plane.

73. **Weather Exposed**: See definition below for “exposed”.

74. **Wet Work**: Means materials that need moisture or water added as part of application or installation, which subsequently dry are considered to be wet work (e.g., concrete, plaster, drywall mud, paints and coatings, sealants, etc.).

75. **Work Result**: Means the results of applying particular skills and techniques to construction materials, products, assemblies and systems.

   a. A work result may pertain to either several manufactured products (e.g., exterior insulation and finish system) or a single product (e.g., a chalkboard).
   b. A work result could also involve only labor and equipment (e.g., a trenching).

### 2.4 REFERENCE STANDARDS

A. **General**: Work specified by reference to a standard or specification published by a government agency, technical association, trade association, professional society or institute, testing agency, or other organization must either meet or exceed the minimum standards of quality for materials and workmanship established by the designated standard or specification.

1. Each entity engaged in construction on the project must be familiar with the specified industry standards applicable to that entity’s construction activity.

2. In case of conflict between referenced standards and documents and the Contract Documents, or between referenced documents, the document having the most stringent requirements applies. Submit discrepancies to the Architect for a decision before proceeding with the affected work any requirements that are different but apparently equal, and uncertainties as to which quality level is more stringent.

3. Where both a standard and a brand name are specified for a product in the project Manual, the proprietary product named must conform to or exceed the requirements of the specified reference standard. The listing of a trade name in a Project Manual may not be construed as warranting that such product conforms to the respective reference standard.

B. **Applicability**:

1. The applicable edition of a reference standard or specification is the latest date of issue (a) 30 days before bids are received; (b) when bids are requested; or (c) if there is no bid, then on the effective date of the Agreement, except

   a. where a specified publication date follows the title of a referenced standard or specification in the body text of the Contract Documents; and
   b. issues listed in governing building codes and regulations supersede the above requirements.

2. Provisions of any referenced standards or specifications, whether or not specifically incorporated by reference in the Contract Documents, may not change the duties and responsibilities of City, the Architect, or the CMR, or any of their consultants, agents or employees from those set forth in the Contract Documents, nor to assign to any of them any responsibility, duty or authority for safety precautions or procedures, or to supervise or direct the performance of the work.
PART 3 - PRODUCTS

3.1 COPIES OF STANDARDS

A. Copies of applicable referenced standards and specification are not bound in the Project Manual.

B. Where copies of standards are needed for superintendence and quality control of the work, obtain a copy or copies directly from the publication source and maintain copies in an orderly manner at the project site, available to the CMR's personnel, subcontractors, City, and the Architect during normal business hours.

PART 4 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01 42 00
SECTION 01 43 00 – QUALITY ASSURANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for quality assurance and quality control activities.
2. Testing and inspecting services necessary to verify conformance with indicated or specified requirements.

B. Related Requirements:

1. Section 01 43 39 for administrative and procedural requirements for mockups, laboratory testing specimens, and field samples.
2. Section 01 45 23 for special tests and inspections required by the AHJ.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. CCA: Construction Contract Administration.
2. NIST: National Institute of Standards and Technology.
3. NRTL: Nationally Recognized Testing Laboratory.
4. NVLAP: National Voluntary Laboratory Accreditation Program.
5. QA: Quality Assurance.
6. QC: Quality Control.

B. Definitions:

1. Field Quality Control Testing: Means the tests and inspections of installed work performed by a qualified testing agency acceptable to the AHJ at the project site.
2. Preconstruction Testing: Means the tests and inspections performed specifically for the project to verify performance or compliance with the specified criteria before products and materials are incorporated into the work.
3. Product Testing: Means the tests and inspections performed by a qualified testing agency acceptable to the AHJ to establish product performance and conformance to specified industry standards.
4. QA Services: Means the activities, actions, and procedures implemented before and during the execution of the work to guard against defects and deficiencies; and to result in construction that conforms to the requirements of the Contract Documents.
5. QC Services: Means the activities, actions, and procedures, including tests, inspections, procedures, and related actions, that are implemented during and after the execution of the work to measure and evaluate whether or not actual in-service items and completed construction conforms to the requirements of the Contract Documents. Services do not include CCA activities performed by the Architect.
6. Required Auxiliary Services: Means the following.
   a. Providing access to the work for testing and inspection, and furnishing incidental labor and facilities necessary to facilitate tests and inspections.
   b. Taking adequate quantities of representative samples of materials required for specified testing; or assisting the agency in taking samples.
   c. Providing facilities for storage and curing of test samples; and delivery of samples to testing laboratories.
   d. Providing testing and inspection agencies with preliminary design mixes proposed for use where mixes require control by a testing agency.
   e. Providing security and protection of samples and test equipment at the project site.

7. Source Quality Control Testing: Means the tests and inspections performed by a qualified testing agency acceptable to the AHJ at the source (i.e., at the plant, mill, factory, or shop).

8. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term “testing laboratory” means the same as “testing agency”.
   a. NRTL: Means an NRTL conforming to the requirements of 29 CFR 1910.7.
   b. NVLAP: Means a testing agency accredited in conformance with NIST’s NVLAP.

9. Installer: Means either the CMR or other entity engaged by the CMR as an employee, subcontractor, or sub-subcontractor to perform a particular construction operation, including installation, erection, application, and similar operations. Other terms, including “Applicator”, and “Erector” and similar terms have the same meaning as “Installer”.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Documented QA/QC Program: Implement and effectively manage a documented program as indicated in the executed CMR at Risk Agreement.

B. Conflicting Requirements:
   1. If conformance with 2 or more requirements or standards is specified, and if the requirements or standards appear different or in conflict, then assume the most stringent requirements or standards govern, and then promptly submit an RFI to the Architect for interpretation before proceeding with the work.
   2. Refer uncertainties and requirements that are different, but apparently equal, to the Architect for an interpretation before proceeding with the work.

C. Coordination: Coordinate the sequence of activities to accommodate required QA and QC services with the least practicable delay, and to avoid removing and replacing construction to accommodate testing and inspecting.

D. Scheduling: Schedule times for tests, inspections, obtaining samples, and similar activities.
1.4 SUBMITTALS

A. Certificates: Submit copies of permits, licenses, certifications, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for conformance with standards and regulations necessary for the performing the work.

B. Inspection Reports: Submit certified written reports that include the following.

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of the testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of the individuals performing tests and inspections.
6. Description of the work and test and inspection method.
7. Identification of tested or inspected product and the specification Section.
8. Complete test or inspection data.
9. Test and inspection results along with an interpretation of the test results.
10. A record of the temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinions on whether tested or inspected work conforms to the Contract Document requirements.
12. Name and signature of inspector.
13. Recommendations for retesting and re-inspection.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Must be an NRTL, NVLAP, or independent agency conforming to the requirements of ASTM E 239 and acceptable to the AHJ, with at least 10 consecutive years’ experience providing testing and inspecting services on a weekly basis for projects similar in material, design, complexity, and extent to this project, and whose products have resulted in applications with a record of successful in-service performance.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

3.1 QUALITY CONTROL

A. Quality Control Services:

1. Where City requires testing and inspection, such tests and inspections are performed by City’s authorized Materials Testing Laboratory; and must be witnessed by the testing agency’s personnel, the applicator, the manufacturer’s field representative, the CMR, and the Architect.

   a. City furnishes the CMR with names, addresses, and telephone numbers of authorized Materials Testing Laboratories, and a description of the types of testing and inspecting they are engaged to perform.

   b. The CMR shall

      1) arrange all tests and inspections;
2) coordinate its work and the construction schedule with the specified tests;
3) coordinate the requirements of each required or specified test and inspection with other specified or required tests and inspections;
4) provide all work, facilities, personnel, and controls necessary for each test and inspection;
5) notify the testing agency personnel, the applicator, the manufacturer’s field representative, and the Architect that the work is ready for inspection; and
6) receive all test reports and distribute copies to the applicator and the manufacturer’s field representative.

2. Where quality control services are indicated as the CMR's responsibility, engage a qualified testing agency to perform these quality-control services.
   a. The CMR may not employ the same entities engaged by City, unless agreed to in writing by City.
   b. Notify testing agencies at least 24 hours in advance of time when work that requires testing or inspecting will be performed.
   c. Submit a certified written report of each quality-control service to the Architect.
   d. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

3. Tests and inspections not explicitly assigned to City are the CMR's responsibility.
   a. Unless otherwise indicated, provide those quality-control services (1) required by the Contract Documents; and (2) required by the AHJ.
   b. Perform quality-control services required of the CMR by the AHJ, whether specified or not.

4. Testing and inspecting requested by the CMR and not required by the Contract Documents are the CMR's responsibility.

5. Regardless of whether original tests or inspections were the CMR's responsibility, provide quality-control services, including retesting and reinspection, for construction that replaced work that failed to comply with the Contract Documents.

B. Testing Agency Responsibilities:

1. Testing and inspecting agencies
   a. provide qualified personnel to perform required tests and inspections.
   b. notify the Architect and the CMR promptly of irregularities or deficiencies observed in the work during performance of its services;
   c. determine the location from which test samples are taken and in which in-situ tests are conducted;
   d. conduct and interpret tests and inspections, and state in each report whether tested and inspected work conforms to the specified requirements;
   e. submit certified written reports of each test, inspection, and similar quality-control service to the Architect through the CMR;

2. Testing and inspecting agencies may not
   a. release, revoke, alter, or increase any Contract Document requirements;
b. approve or accept any portion of the work; and

c. perform any of the CMR’s duties.

C. Manufacturer Services: Where specified, the work may be subject to examination by the manufacturer’s field representative.

1. As the work progresses, the manufacturer’s field representative periodically examines the work for defective materials, defective fabrication and application (workmanship), and conformance to the manufacturer’s application instructions and other requirements.

   a. Verify areas have not been missed.
   b. Note defects and identify conditions and items that do not conform to the manufacturer’s application instructions and other requirements.

2. During each field representative visit, itemize into a punch list all defects, improperly performing items, and nonconforming conditions and items.

3. For each item listed, record the field representative’s recommendations for correcting each defect and improperly performing item, or for bringing each nonconforming condition or item into conformance to the manufacturer’s application instructions and other requirements.

4. Before final inspection or acceptance of the work, schedule a meeting at the project site with the manufacturer’s field representative to review surface preparation and application procedures.

   a. Invite all parties that were present at the preinstallation meeting to attend.
   b. Notify invitees at least 10 days before the scheduled meeting.

D. Nonconforming Work: When testing reveals items that are deficient, faulty, do not perform properly, or do not conform to the specified requirements, make corrections acceptable to the Architect, and then arrange and pay costs for re-testing until it can be demonstrated that all items perform properly and conform to the specified requirements, as determined by the Architect.

E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel.

END OF SECTION 01 43 00
SECTION 01 45 16 – CONTRACTOR QUALITY CONTROL

PART 1 - GENERAL

SUMMARY

A. Section Includes: Administrative and procedural requirements for quality control of the work.

REFERENCES

B. Required Auxiliary Services: Means the following.

1. Providing access to the work for testing and inspection, and furnishing incidental labor and facilities necessary to facilitate tests and inspections.
2. Taking adequate quantities of representative samples of materials required for specified testing; or assisting the agency in taking samples.
3. Providing facilities for storage and curing of test samples; and delivery of samples to testing laboratories.
4. Providing testing and inspection agencies with preliminary design mixes proposed for use where mixes require control by a testing agency.
5. Providing security and protection of samples and test equipment at the project site.

ADMINISTRATIVE REQUIREMENTS

GS’s Quality Control Program:

6. Establish a quality control program to perform sufficient testing and inspection of all items of work, including that of all subcontractors, to ensure conformance with the Contract Document requirements for materials, workmanship, construction, finish, functional performance, and identification.

   a. Quality control programs must ensure the work conforms to the requirements of the Contract Documents.
   b. Quality controls must be adequate to cover all construction operations.

7. Apply, install, connect, erect, use, clean, adjust, and condition items in compliance with their manufacturer’s instructions, unless more restrictive or stringent requirements are specified in the Specifications.

8. In the event of conflicts between the manufacturer’s instructions and the Contract Documents, assume the manufacturer’s installation instructions govern, and then submit an RFI to the Architect for an interpretation before proceeding.

C. GC Assistance:

1. Cooperate with testing and inspecting agencies, and other companies providing similar services, and provide reasonable auxiliary services as requested.

QUALITY ASSURANCE

D. Installer’s Qualifications: Where the Specifications dictate a certain level of experience or expertise from the installer by requiring a minimum number of years of experience in the successful
installation of a product or a minimum number of successful installations for the product specified, it is the GC responsibility to

1. Verify the installer's competence and track record before signing a subcontract to perform the affected work; and
2. Collect evidence of the specified minimum qualifications and retain such evidence in the event of an audit.

ADMINISTRATIVE STAFF

E. Provide a competent and adequate staff for administration, coordination, supervision, and superintendence of the work.

1. Key staff members must be full time employees operating full-time at the project site.
2. Do not change key members of this staff without the written consent of City, unless such staff members prove to be unsatisfactory to the GC and cease to be in his employ. If the GC intends to change a key staff member, the GC shall give City written notice at least 15 business days before the intended change.

F. The GC’s project administrative staff must include the following.

1. Project Manager: A person with the responsibility for prosecution of the work; and who has the authority to act in matters of coordination, direction, and technical administration of the work. Provide City with name of the project manager before commencement of the work.
2. Superintendent: A person in attendance at the project site during performance of the work that represents the GC; communications given to the superintendent are as binding as if given to the GC.
3. Additional Staff:
   a. Provide services of coordinating engineers for HVAC, Plumbing, Fire Protection, and Electrical Work and responsible for the following.
      1) Coordination of the mechanical and electrical work with the work of other trades.
      2) Review of mechanical and electrical shop drawings.
      3) Resolution of conflicts and interferences between trades.
      4) Directing adjustments in the work as required to comply with the Contract Documents.
      5) Commissioning of mechanical and electrical systems.
   b. Coordinating engineer must have previous experience in coordinating these areas of work on projects similar in material, design, complexity and extent to this project.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

EXAMINATION

A. Before beginning installation of any material, product, component, system, assembly or equipment, verify existing work performed as part of the work of other Sections conforms to the installed item
manufacturer’s application tolerance requirements; provides true, flat, and level surfaces; and satisfies all other conditions relating to the quality of waterproofing application, durability, appearance, and performance.

B. In place construction that does not conform to the manufacturer’s allowable installation requirements is non-conforming work, which must be promptly corrected and repaired.

1. Before proceeding with preparation or installation, the Contractor shall either perform, or arrange and pay all costs for performing all remedial work necessary to correct deficient conditions and bring them into conformance with the manufacturer’s allowable installation requirements.

2. Proceeding with preparation or installation stipulates the installer’s acceptance of existing conditions. After beginning work, the installer performs, or arranges and pays all costs for performing all remedial work necessary to correct deficient conditions and bring them into conformance with the manufacturer’s allowable installation requirements.

END OF SECTION 01 45 16
SECTION 014529 – STRUCTURAL TESTING AND INSPECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for quality assurance and quality control to be completed by the Testing Laboratory, Contractor, and/or the Geotechnical Engineer for the following structural items:

1. Concrete Forming and Accessories.
2. Concrete Reinforcing.
3. Cast-in-Place Concrete.
5. Structural Steel.
6. Steel Joists
7. Steel Decking.

B. Related Requirements:

1. Specification 014000 “Quality Requirements” for other independent testing agency procedures and administrative requirements.

1.3 PRICE AND PAYMENT PROCEDURES

A. Unit Prices:

1. Cost Proposal: The Testing Laboratory’s proposal to the Owner shall contain unit price stipulations for specified tests and inspections and on an hourly basis for personnel. A total estimated price shall also be submitted.

B. Measurement and Payment

1. Payment of the Testing Laboratory: The Owner will pay for the initial Laboratory services for inspection and testing of materials for compliance with the requirements of the Contract Documents.
2. Payment for Substitution Testing: The Contractor shall arrange for and pay for any additional samples and tests above those required by the Contract Documents as requested by the Contractor for his convenience in performing the work.
3. Payment for Retesting: When initial tests indicate work does not comply with the requirements of the Contract Documents, the Contractor shall be liable to the Owner for the cost for any additional inspections, sampling, testing, and retesting done by the Testing Laboratory.

4. Payment by Contractor: The Contractor shall furnish and pay for the following items if required:
   
a. Soil survey of the location of borrow soil materials, samples of existing soil materials, and delivery to the Contractor’s Testing Laboratory.
b. Samples of concrete aggregates and delivery to the Contractor’s Testing Laboratory.
c. Concrete mix designs as prepared by his concrete supplier.
d. Site-situated storage boxes for concrete cylinders
e. Concrete coring, tests of below strength concrete, and load tests, if ordered by the Owner, Architect, or Engineer.
f. Certification of reinforcing steel and prestressing steel mill order.
g. Certification of structural steel mill order.
h. Certification of portland cement, lime, fly ash.
i. Certification of welders and preparation of Welding Procedure Specifications.
j. Tests, samples, and mock-ups of substitute material where the substitution is requested by the Contractor and the tests are necessary in the opinion of the Owner, Architect or Engineer to establish equality with specified items.
k. The making and testing of concrete cylinders for the purpose of evaluating strength at time of form stripping or for post-tensioning or the time spent evaluating the in situ strength of concrete using the Maturity Method.
l. Any other tests when such costs are required by the Contract Documents to be paid by the Contractor.

5. Payment for Tests of Suspected Deficient Work: If, in the opinion of the Building Official, Owner, Architect, or Engineer, any of the work of the Contractor is not satisfactory, the Contractor shall furnish and pay for all tests that the Owner, Architect, or Engineer deem advisable to determine its proper construction. The Owner shall pay all costs if the tests prove the questioned work to be satisfactory.

1.4 OWNER RESPONSIBILITIES

A. The Owner shall engage a Geotechnical Engineer to provide inspection services for the foundations as outlined below in Article 3.10.

B. The Owner shall provide a copy of the project plans and specifications to the Testing Laboratory prior to the start of construction and prior to any preinstallation meetings.

1.5 CONTRACTOR RESPONSIBILITIES

A. The Contractor shall not engage the same Testing Laboratory for construction services as the Owner has for Structural Testing Laboratory Services as defined herein.

B. Furnishing Samples and Certificates: The Contractor shall provide to the laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.
C. Furnishing Casual Labor, Equipment and Facilities: The Contractor shall furnish casual labor, equipment, and facilities as required for sampling and testing by the laboratory and otherwise facilitate the required inspections and tests.

1.6 TESTING LABORATORY RESPONSIBILITIES

A. The Testing Laboratory shall sample and test materials as they are being installed for compliance with specified acceptance criteria. The Testing Laboratory will report and interpret the test results. The Laboratory shall monitor and report on the installation of construction work and shall perform tests on the completed construction as required to indicate Contractor’s compliance with the various material specifications governing this work.

B. The Testing Laboratory shall serve as a Special Inspector to provide Special Inspection services for the items listed below. The scope of such services for each item shall be as defined in the Building Code or as defined in the local building code of the jurisdiction wherein the project is located. These inspections are mandatory for conformance to the legal requirements of the building code and shall be in addition to the inspections and tests otherwise defined in this specification.

1. Special Inspector Responsibilities:

a. The special inspector shall observe the work assigned to ascertain that, to the best of his/her knowledge, it is in conformance with the approved design drawings and specifications.

b. The special inspector shall furnish inspection reports to the Building Official, the Architect/Engineer, and the Owner. All discrepancies shall be brought to the immediate attention of the Architect/Engineer, Contractor, and Owner. A report that the corrected work has been inspected shall be sent to the Building Official, the Architect/Engineer, and the Owner.

c. The special inspector shall create and maintain a log of all discrepancies throughout the duration of the Project. This log shall include, but is not limited to, discrepancy date, description of discrepancy, drawing and/or detail reference, description of as-built condition, description of any remedial work performed, and status of discrepancy. This log shall be submitted to the Architect/Engineer on a periodic basis for review and comment. Upon completion of the Project, this log shall be submitted in its entirety as an attachment to the final signed report described below.

d. The special inspector shall submit a final signed report stating whether the work requiring special inspection was, to the best of the inspector’s knowledge, in conformance to the approved plans and specifications and the applicable workmanship provisions of the building code.

C. The Testing Laboratory shall provide inspections on the following items:

1. Reinforcing steel placement.
2. Concrete work.
3. Bolts to be installed in concrete.
5. Inspection of structural steel, bolting, and welding material.
7. High-strength bolting.
8. Compacted earth fill.
10. Masonry work.
11. Cold-formed metal framing.

D. Inspections Required by Government Agencies: The Testing Laboratory shall perform inspections and submit reports and certifications as required by government agencies having jurisdiction over the aspects of the project covered by this specification.

E. Notification of Deficiencies in the Work: The Testing Laboratory shall notify the Architect, Engineer, and Contractor within 24 hours of discovery of observed irregularities and deficiencies of the Work and other conditions not in compliance with the requirements of the Contract Documents. Notification shall be by telephone or e-mail and then in writing.

F. Accounting: The Testing Laboratory shall be responsible for separating and billing costs attributed to the Owner and costs attributed to the Contractor.

G. Monitoring Product and Material Certifications: The Testing Laboratory shall be responsible for monitoring the submittals of product and material certifications from manufacturers and suppliers as specified in the Specifications and shall report to the Owner, Architect, and Engineer when those submittals are not made in a timely manner.

H. Limitations of Authority: The Testing Laboratory is not authorized to revoke, alter, relax, enlarge upon, or release any requirements of the Specifications or to approve or accept any portion of the work or to perform any duties of the General Contractor and his Subcontractors.

1.7 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. The Testing Laboratory shall cooperate with the Architect, Engineer, and Contractor and provide qualified personnel promptly on notice.
2. The Contractor shall cooperate with Testing Laboratory personnel and provide access to the work and to manufacturers’ operations.
3. Notification of Source Change: The Contractor shall be responsible for notifying the Owner, Architect, Engineer, and Testing Laboratory when the source of any material is changed after the original tests or inspections have been made.

B. Preinstallation Meetings: The Testing Laboratory shall attend preinstallation meetings with the Architect, Engineer, Contractor, and material suppliers as required to coordinate materials inspection and testing requirements with the planned construction schedule and shall participate in such meetings throughout the course of the project.

C. Scheduling:

1. Advance Notice: The Contractor shall be responsible for notifying the Testing Laboratory sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests. Failure to sufficiently notify may result in additional costs incurred by the Testing Laboratory that may be back-charged to the Contractor by the Owner.
1.8 **SUBMITTALS**

A. **Quality Control Reports:**

1. **Information on Reports:** The Testing Laboratory shall submit copies of reports of inspections and tests promptly. The reports shall contain at least the following information:

   a. Project name.
   b. Date report issued.
   c. Testing Laboratory name and address.
   d. Name and signature of inspector/technician.
   e. Date of inspection and/or sampling.
   f. Date of test.
   g. Identification of product and Specification section.
   h. Location in the project.
   i. Identification of inspection or test.
   j. Record of weather conditions and temperature (if applicable).
   k. Results of test regarding compliance with Contract Documents.

2. **Copies:** The Laboratory shall send signed copies of test and inspection reports to the following parties:

   a. Two copies to the Owner or his/her representative.
   b. Two copies to the General Contractor.
   c. One copy to the Architect.
   d. One copy to the Engineer of Record.

B. **Discrepancy Log:** The Testing Laboratory shall create and maintain a log of all discrepancies throughout the duration of the project.

1. **Information on Log:** This log shall include, but is not limited to:

   a. Discrepancy date.
   b. Description of discrepancy.
   c. Drawing and/or detail reference.
   d. Description of as-built condition.
   e. Description of any remedial work performed.
   f. Status of discrepancy.

2. **Submission Schedule:** This log shall be submitted to the Architect/Engineer on a periodic basis for review and comment. Upon completion of the Project, this log shall be submitted in its entirety as an attachment to the final signed report described below under Certifications.

C. **Certification:** Upon completion of the job, the Laboratory shall furnish to the Owner, Architect, and Engineer of Record, a statement signed by a licensed professional engineer that, to the best of their knowledge, required tests and inspections were made in accordance with the requirements of the Contract Documents.
1.9 QUALITY ASSURANCE

A. Qualifications of Special Inspector: The special inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of the Building Official, for inspection of the particular type of construction or operation being inspected. The Special Inspector shall meet the legal qualifications of the building code having jurisdiction.

B. Qualifications of Testing Laboratory:

1. The Testing Laboratory shall meet the basic requirements of ASTM E 329 and shall submit to the Owner, Architect, and Engineer evidence of current accreditation from the American Association for Laboratory Accreditation, the AASHTO Accreditation Program or the “NIST” National Voluntary Laboratory Accreditation Program.

2. The Testing Laboratory shall be an Approved Agency by the Building Official to perform Special Inspections and other tests and inspections as outlined in the applicable building code.

3. Tests and inspections shall be conducted in accordance with specified requirements, and if not specified, in accordance with the applicable standards of the American Society for Testing and Materials or other recognized and accepted authorities in the field.

4. Qualifications of Welding Inspectors

a. Inspectors performing visual weld inspection shall meet the requirements of AWS D1.1 Section 6.1.4. Inspectors shall have current certification as an AWS Certified Welding Inspector (CWI). Assistant inspectors, if any, shall be supervised by an Inspector and shall be qualified by training and experience to perform the specific functions to which they are assigned.

b. Inspectors performing nondestructive examinations of welds other than visual inspection (MT, PT, UT, and RT) shall meet the requirements of AWS D1.1, Section 6.14.6.

C. The Contractor shall not engage the same testing laboratory for construction services as the Owner has for quality assurance testing, unless agreed to by the Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCOPE OF WORK

A. The work to be performed by the Testing Laboratory shall be as specified in this Section of the Specification and as determined in meetings with the Owner, Architect, and Engineer.

3.2 CONCRETE FORMING AND ACCESSORIES

A. Field Inspection:

1. Shallow Foundation Elements:
a. Verify element width, length, depth, and elevation.
b. Verify that forms are plumb and straight, braced against movement, and lubricated for removal.
c. Verify that carton forms, are dry and neatly formed around piers.

2. Slabs-on-Grade:
   a. Verify formwork at turndowns and slab edges is plumb and straight, braced against movement and lubricated for removal.

3. Plinths and Walls:
   a. Verify that forms are plumb and straight, braced against movement, lubricated for removal, and conform to approved shop drawings.
   b. Verify proper dimensions and orientation.
   c. Verify top of column elevation is set in form and that it is 1/2 inch below the future slab soffit.

3.3 CONCRETE REINFORCING

A. Quality Assurance:
   1. Review the Welding Procedure Specification (WPS) submitted by the contractor for any reinforcing steel other than ASTM A 706 that is proposed to be welded for consistency with acceptable welding practices and AWS.
   2. Review welder qualifications by certification or verify by retesting. Obtain welder certificates.

B. Field Inspection: The scope of the work to be performed by the inspector on the jobsite shall be as follows:
   1. Reinforcing Steel: The Testing Laboratory or designated Special Inspector shall inspect 100% of reinforcement before each concrete pour to verify the information noted below. Inspection reports shall be prepared and distributed in accordance with the local building code and as specified in this specification.
      a. Primary and secondary longitudinal reinforcement has correct size and number in proper layers.
      b. Longitudinal reinforcement has correct length and lap.
      c. Ties and stirrups are of correct size, spacing, and number and have the proper termination hook geometry.
      d. Unscheduled face reinforcement in beams are provided and are of correct size, number and spacing and have the proper end terminations.
      e. Proper hooks are provided at bar ends as detailed.
      f. Reinforcement is properly supported and braced to formwork to prevent movement during concrete placement.
      g. Reinforcement has proper cover.
      h. Sufficient spacing between reinforcement for concrete placement.
      i. Dowel reinforcement is of proper size, at proper spacing, and has proper lap length and embedment length.
j. Welded wire reinforcement is composed of flat sheets, has proper wire gage and spacing, is properly supported, and is properly lapped.

k. Proper construction/control/expansion joint spacing and reinforcement.

l. Reinforcement around embedded items is placed according to details.

m. Proper installation of flat slab shear head reinforcement.

n. Mechanical Tension Splices: The Testing Laboratory shall provide 100% visual inspection of mechanical tension splices on the project and consult with the manufacturer regarding recommendations for installation. Inspection shall verify compliance with specifications and conformance with the manufacturer’s recommendations for installation after consulting with the manufacturer, who is to be present for the first installation of the splice on the project.

3.4 CAST-IN-PLACE CONCRETE

A. Quality Assurance:

1. Concrete Mix Designs: The Testing Laboratory shall review the submitted mix designs for conformance to the specifications and for suitability for use in the project.

2. Preinstallation Meetings: The Testing Laboratory shall attend the preinstallation meetings as noted in Specification 033000 “Cast-in-Place Concrete.”

B. Source Inspection:

C. Field Testing: The following tests shall be completed by the Testing Laboratory:

1. During Concrete Placement:
   a. Record the amount of water added and note if it exceeds the amount allowed to be added shown in the approved mix design.
   b. Mold concrete test cylinders as specified below in Paragraph 3.a.
   c. Perform tests to determine slump, concrete temperature, unit weight, and air entrainment as specified below.
   d. Record information for concrete test reports as specified below.
   e. Pick up and transport to Laboratory cylinders cast the previous day.

2. After Concrete Placement:
   a. In-situ Concrete Strength Verification for Form Stripping: The Testing Laboratory shall perform the tests necessary to determine the concrete strength prior to form stripping:
      1) If concrete strength for form stripping is to be determined using field-cured cylinders, the cylinder shall be broken at the time of form removal as directed by the Contractor.
   b. Investigation of Low Strength Concrete Test Results:
      1) Cost of Investigations for Low Strength Concrete: The Contractor shall reimburse the Owner for the costs of investigations of low strength concrete, as defined in Part I above.
2) Scope of Investigations: See Specification Section 033000 “Cast-In-Place Concrete” for the investigations that may be required by the Engineer. The Testing Laboratory will conduct these investigations if required.

c. Post-Installed Anchors in Concrete:

1) Verify maximum anchor tightening torque for all applicable post-installed anchors.
2) Verify that all drilled holes for adhesive anchors are within 6 degrees of perpendicular to the surface of the concrete member.

d. Floor Flatness and Levelness Measuring: Perform tests as defined below.

e. Testing of Concrete Floor Slabs for Acceptability to Receive an Adhesive-Applied, Low-Permeable Floor Covering: Perform tests as defined below.

f. Testing of Non-Shrink Grout for Base Plates, Bearing Plates, and Precast Wall Panels:

1) Compressive Strength Tests: Compressive strength of grout shall be determined by testing grout cubes according to the requirements of ASTM C 109 - Modified. Test one set of three cubes at one day, and one set of three cubes at 28 days.
2) Frequency of Testing: One set of cubes (6 cubes) shall be made for every ten base plates and bearing plates or fraction thereof but not less than one set for each day's operation. One set of cubes shall be made for each day's operation of grouting wall panels.

3. Standards for Concrete Tests:

a. Concrete Test Cylinders: Mold and test concrete cylinders as described below:

1) Cylinder Molding and Testing: Cylinders for strength tests shall be molded and Laboratory cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39. Cylinders may be either 6” in diameter by 12” or 4” in diameter by 8”, however, the diameter of the cylinder shall be at least three times the nominal maximum size of the coarse aggregate in the mix tested. All of the cylinders for each class of concrete shall be of the same dimension for all sets of that class.

2) Field Samples: Field samples for strength tests shall be taken in accordance with ASTM C 172 at the point of placement.

3) Quantity of Cylinders: Each set of test cylinders shall consist of a minimum of four standard test cylinders. If concrete strength for form stripping is to be determined using field-cured cylinders, one additional cylinder per set will be required for formed slab and pan-formed beam floors for the purpose of evaluating the concrete strength at the time of form stripping. This cylinder shall be stored on the floor where form removal is to occur under the same exposure conditions as the floor concrete. The cylinder shall be cured under field conditions in accordance with ASTM C 31. Field-cured test cylinders shall be molded at the same time and from the same samples as laboratory-
cured test specimens. The Contractor shall reimburse the Owner for the cost of making and testing these cylinders.

4) **Frequency of Testing:** A set of test cylinders shall be made according to the following minimum frequency guidelines:

a) One set for each class of concrete taken not less than once a day.
b) Piers, Underreamed Footings: One set for each 50 cubic yards or fraction thereof.
c) Spread Footings: One set for each 50 cubic yards or fraction thereof.
d) Pier Caps: One set for each 50 cubic yards or fraction thereof.
e) Floors: One set for each 150 cubic yards or fraction thereof but not less than one set for each 5,000 square foot of floor area.
f) Plinths: One set for each 50 cubic yards or fraction thereof with a minimum of two sets per floor.
g) All Other Concrete: A minimum of one set for each 150 cubic yards or fraction thereof but not less than one set for each 5,000 square foot of area for walls.
h) No more than one set of cylinders at a time shall be made from any single truck.
i) If the total volume of concrete is such that the frequency of testing as specified above would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.
j) The above frequencies assume that one batch plant will be used for each pour. If more than one batch plant is used, the frequencies cited above shall apply for each plant used.

5) The cylinders shall be numbered, dated, and the point of concrete placement in the building recorded.

6) For concrete specified on the drawings to reach the required strength at 28 days, break one cylinder of the set at seven days, two 6” by 12” cylinders or three 4” by 8” cylinders at 28 days, and keep one in reserve for testing at the Engineer’s direction.

7) For concrete specified on the drawings to reach the required strength at 56 days, break one cylinder of the set at seven days, one cylinder at 28 days, two 6” by 12” cylinders or three 4” by 8” cylinders at 56 days, and one kept in reserve for testing at the Engineer’s direction.

8) **Cylinder Storage Box:** The Contractor shall be responsible for providing a protected concrete cylinder wooden storage box at a point on the job site mutually agreeable with the Testing Laboratory for the purpose of storing concrete cylinders until they are transported to the Laboratory. The box shall be constructed and equipped to maintain the environment specified for initial curing in ASTM C 31.

9) **Transporting Cylinders:** The Testing Laboratory shall be responsible for transporting the cylinders to the Laboratory in a protected environment such that no damage or ill effect will occur to the concrete cylinders including loss of moisture, freezing temperatures or jarring.

10) **Information on Concrete Test Reports:** The Testing Laboratory shall make and distribute concrete test reports after each job cylinder is broken. Such reports shall contain the following information:
City of New Braunfels
POLICE HEADQUARTERS

August 21, 2020

POLICE HEADQUARTERS
Construction Documents

STRUCTURAL TESTING AND INSPECTIONS

01 45 29 - 1

a) Truck number and ticket number.
b) Concrete Batch Plant.
c) Mix design number.
d) Accurate location of pour in the structure.
e) Strength requirement.
f) Date cylinders made and broken.
g) Technician making cylinders.
h) Concrete temperature at placing.
i) Air temperature at point of placement in the structure.
j) Amount of water added to the truck at the batch plant and at the site and whether or not it exceeds the amount allowed by the mix design.
k) slump.
l) Unit weight.
m) Air content.
n) Cylinder compressive strengths with type of failure if concrete does not meet Specification requirements. Seven day breaks are to be flagged if they are less than 60% of the required 28 day strength. 28 day breaks are to be brought to the attention of the Architect and Engineer in writing if either cylinder fails to meet specification requirements.

b. Slump Tests: Slump Tests (ASTM C 143) shall be completed at the beginning of concrete placement for each batch plant and for each set of test cylinders made. The slump test shall be made from concrete taken from the end of the concrete truck chute. The concrete shall be considered acceptable if the slump is within the slump tolerance noted on the mix design submittal form for that class of concrete.

c. Air Entrainment: Air entrainment tests (ASTM C 231 or C 173, C 173 only for lightweight concrete) shall be made at the same time slump tests are made as cited above. Samples for air entrainment tests shall be taken at the point of placement.

d. Concrete Temperature: Concrete temperature at placement shall be measured (ASTM C 1064) at the same time slump tests are made as cited above.

e. Floor Flatness and Levelness Measuring:

1) The Testing Laboratory shall measure the floor for flatness and levelness according to ASTM E 1155.

2) Measurement of the finished concrete surface profile for any test section shall be made when requested by the Representative at his option. Notwithstanding, measurements shall be made within 24 hours after completion of finishing operations. For structural elevated floors measurement shall also be made prior to removal of forms and shores. The Contractor shall be notified immediately after the measurements of any section are complete and a written report of the floor measurement results shall be submitted within 72 hours after finishing operations are complete.

3) The concrete surface profile shall be measured using equipment manufactured for the purpose such as a Dipstick Floor Profiler as manufactured by the Edward W. Face Company in Norfolk, Virginia, F-Meters manufactured by Allen Face & Company in Norfolk, Virginia, optical, or laser means or other method specified in ASTM E 1155.

4) Each floor test section and the overall floor area shall conform to the two-tiered measurement standard as specified herein.
a) Minimum Local Value (MLV). The minimum local $F_p/F_L$ values represent the absolute minimum surface profile that will be acceptable in any one floor test section.

b) Specified Overall Value (SOV). The specified overall $F_p/F_L$ values represent the minimum values acceptable for all combined floor test sections representing the overall floor.

5) For purposes of this specification a floor test section is defined as the smaller of the following areas:

   a) The area bounded by column and/or wall lines.
   b) The area bounded by construction and/or control joint lines.
   c) Any combination of column lines and/or control joint lines.
   d) Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines as defined by ASTM E 1155.
   e) The precise layout of each test section shall be determined by the Testing Laboratory and shall be submitted for Architect/Engineer review and approval.

f. Testing of Concrete Floor Slabs for Acceptability to Receive an Adhesive-Applied, Low-Permeable Floor Covering:

   1) The following tests shall be performed by the Testing Laboratory as a part of quality assurance testing to insure that the proper moisture condition and alkalinity of the substrate has been achieved prior to installing adhesive-applied, low-permeability floor coverings such as vinyl composition tile (VCT), linoleum, sheet vinyl, vinyl-backed carpet, rubber, athletic flooring, synthetic turf, wood, acrylic terrazzo, thin-set tile, epoxy overlays and adhesives, waterproofing, et.al.

   2) Moisture Vapor Emission Rate: Perform testing according to ASTM F 1869 to determine if the moisture emission rate from the floor is below the flooring manufacturer’s maximum recommended value but not greater than five pounds per 1,000 square feet per 24 hours.

   3) Relative Humidity Determination Test: As an alternate to the Moisture Vapor Emission Rate Test, and if agreed to by the Contractor, Architect and Owner, perform testing according to ASTM F 2170 to determine if the relative humidity of the concrete slab is below the flooring manufacturer’s maximum recommended value but not greater than 75%.

   4) Alkalinity Testing: Perform testing in accordance with ASTM F 710, Paragraph 5.3, to determine if the pH level of the concrete slab surface is below the flooring manufacturer’s maximum recommended value but not greater than 10. Perform one test per 1,000 square feet with a minimum of three tests within the total area being tested.

4. Evaluation and Acceptance of Concrete:

   a. Strength Test: A strength test shall be defined as the average strength of two six inch cylinder breaks or three four inch cylinder breaks from each set of cylinders tested at the time indicated above.
b. Quality Control Charts and Logs: The Testing Laboratory shall keep the following quality control logs and charts for each class of concrete containing more than 2,000 cubic yards. The records shall be kept for each batch plant and submitted on a weekly basis with cylinder test reports:

1) Number of strength tests made to date.
2) Strength test results containing the average of all strength tests to date, the high test result, the low test result, the standard deviation, and the coefficient of variation.
3) Number of tests under specified strength.
4) A histogram plotting the number of strength test cylinders versus compressive strength.
5) Quality control chart plotting compressive strength test results for each test.
6) Quality control chart plotting moving average for strength where each point plotted is the average strength of three previous test results.
7) Quality control chart plotting moving average for range where each point plotted is the average of 10 previous ranges.

c. Acceptance Criteria: The strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:

1) The average of all sets of three consecutive strength tests equal or exceed the required f’c.
2) No individual strength test falls below the required f’c by more than the greater of 10% of f’c or 500 PSI.

d. If either of the above Acceptance Criteria requirements is not met, the Testing Laboratory shall immediately notify the Engineer by telephone. Steps shall immediately be taken to increase the average of subsequent strength tests.

D. Field Inspection: The scope of the work to be performed by the inspector on the jobsite shall be as follows:

1. Before Concrete Placement:
   a. Inspect concrete formwork per Article 3.2.
   b. Inspect concrete reinforcing per Article 3.3.
   c. Inspect bolts and rods to be embedded in concrete for proper grade, size, length, and embedment.
   d. For slabs-on-grade, verify that the moisture retarder is provided, is lapped properly, and is not torn or punctured.
   e. Verify that there is no standing water in pour area and that all debris has been removed from the area and from the formwork.
   f. Verify that openings and sleeves in slabs or walls are correct size and location. Verify that the openings are shown on the structural drawings and notify the Engineer immediately of any openings in the field that are not shown on the drawings.
   g. Verify that horizontal and vertical sleeves through girders, beams, or joists have been approved by the Engineer and that approved reinforcement is provided.
   h. Verify the tops of previously poured columns and/or walls are 1/2 inch below the deck soffit.
2. During Concrete Placement: Provide continuous monitoring to:
   a. Upon arrival of concrete, inspect the concrete to verify that the proper concrete mix number, type of concrete, concrete strength is being placed at the proper location. Verify that the mix meets the project specifications and is not over 90 minutes old at the time of placement. Report concrete not meeting the specified requirements and immediately notify the Contractor, Batch Plant Inspector, Architect, Engineer, and Owner.
   b. Inspect plastic concrete upon arrival at the jobsite to verify proper batching. Observe mix consistency and adding of water as required to achieve target slumps in mix designs. The responsibility for adding water to trucks at the job site shall rest only with the Contractor's designated representative. The Contractor is responsible that all concrete placed in the field is in conformance to the Contract Documents.
   c. Verify that the Contractor is following appropriate Hot Weather or Cold Weather concreting practices consistent with any extreme environmental conditions at the point of placement in the structure.
   d. Verify that concrete deposited is uniform and that vertical drop does not exceed six feet and is not permitted to drop freely over reinforcement causing segregation.
   e. Verify that the formwork has remained stable during the concreting operation.
   f. Verify that there are no cold joints.
   g. Verify that the concrete is properly vibrated.
   h. Inspect bolts embedded in concrete during concrete placement for verification that they have been properly installed to the specified embedment.
   i. Verify that the finishing of the concrete surface is done according to specifications.

The Testing Laboratory shall report any irregularities that occur in the concrete at the job site or test results to the Contractor, Architect, Owner, and Engineer.

3. After Concrete Placement:
   a. Verify that the curing process is according to Specifications and that any curing compound used is applied in accordance with the manufacturer’s recommendations.
   b. Verify that sawcut control joints in slab-on-grades are cut within 12 hours of placement.
   c. Post-Installed Anchors in Concrete: Provide inspection of post-installed anchor installations at the frequency noted in the specifications and in accordance with the published, currently valid, Evaluation Service Report (ESR) for each anchor product. Post-installed anchors include anchors and reinforcing steel. Inspection of post-installed anchors shall include but not be limited to the following:

   1) Periodic Inspection: Verify initial installation of post-installed anchors in concrete for each individual installer with each individual anchor product in accordance with the requirements stated below for each type of anchor. Periodically inspect anchor installation after the initial verification.

   2) Continuous Inspection: Verify each installation of post-installed anchors in concrete in accordance with the requirements stated below for each type of anchor.

   3) All Post-Installed Anchors: Verify that the anchor is installed in accordance with manufacturer’s printed installation instructions as well as the following design requirements.
a) Concrete type, concrete strength and concrete thickness are in accordance with design drawings.

b) Anchor manufacturer and product, including material, is in accordance with design drawings or approved substitution.

c) Anchor diameter, length and installed embedment depth.

d) Drill bit type and diameter.

e) Anchor edge distance and spacing.

f) Hole diameter and depth.

g) Hole cleaning procedure and cleanliness.

h) Anchor maximum tightening torque.

4) Adhesive Anchors: In addition to the requirements for All Post-Installed Anchors, verify adhesive identification and expiration date.

a) The installation of all adhesive anchors shall be continuously inspected when anchors are subject to sustained tension loads, such as anchors for shelf angles, or when anchors are installed in an upwardly inclined condition.

E. Causes for Rejection of Concrete: The Contractor shall reject concrete delivered to the site for any of the following reasons:

1. Wrong class of concrete (incorrect mix design number).

2. Environmental Conditions: Environmental condition limits shall be as follows unless appropriate provisions in concreting practices have been made for cold or hot weather:

   a. Cold Weather: Air temperature must be 40°F and rising or the average daily temperature cannot have been lower than 40°F for 3 consecutive days unless the temperature rose above 50°F for at least one-half of any of those 24 hour periods.

   b. Hot Weather: Environmental conditions must be such that cause an evaporation rate from the concrete surface of 0.2 lb./sq. ft./hr. or less as determined by Figure 2.1.5 in ACI 305R-91.

Concrete may be placed at other environmental condition ranges only with approval of the job inspector for the Testing Laboratory or other duly appointed representative.

3. Concrete with temperatures exceeding 95°F shall not be placed in the structure.

4. Air contents outside the limits specified in the mix designs.

5. Slumps outside the limits specified.

6. Excessive Age: Concrete shall be discharged within 90 minutes of plant departure or before it begins to set if sooner than 90 minutes unless approved by the Laboratory job inspector or other duly appointed representative.

F. Concrete Batch Trip Tickets: Concrete batch trip tickets shall be collected and retained by the Contractor. Compressive strength, slump, air, and temperature tests shall be identified by reference to a particular trip ticket. Tickets shall contain the information specified in ASTM C 94. Each ticket shall also show the amount of water that may be added in the field for the entire batch that will not exceed the specified water cement ratio for the design mix. The Contractor and Testing Laboratory shall immediately notify the Architect/Engineer and each other of tickets not meeting the criteria specified.
3.5 MASONRY

A. Quality Assurance:

1. Concrete Masonry Unit: For each type of concrete masonry unit indicated, verify compliance with ASTM C 90 and the strength required by design. Verification may be by reviewing certification from unit producer showing compliance.
2. Review field welder qualifications by certification or verify by retesting. Obtain welder certificates.

B. Field Testing:

1. Masonry Strength Testing:
   a. Verification Testing Frequency: Verification of masonry strength (f’m) will be performed at the beginning of masonry construction.
   b. Mortar:
      1) As construction begins, verify the proportions of the site-prepared mortar mix comply with the requirements of ASTM C 270 for the type specified.
      2) Verify the proportions of materials in premixed or preblended mortar comply with the requirements of ASTM C 270 for the type specified as delivered to the site.
   c. Grout:
      1) Prior to grouting, verify the proportions of site-prepared grout mix comply with the requirements of ASTM C 476 for each type of grout used.
      2) Verify the proportions of materials in premixed or preblended grout comply with the requirements of ASTM C 476 as delivered to the site.
      3) For grout pre-mixed at a batch plant or otherwise not prepared on site, grout shall be sampled and tested in accordance with ASTM C 1019. Prepare one set of grout samples for testing at seven days and two sets for testing at 28 days.

2. Testing of Non-Shrink Grout for Base Plates and Bearing Plates:
   a. Compressive Strength Tests: Compressive strength of grout shall be determined by testing grout cubes according to the requirements of ASTM C 109 - Modified. Test one set of three cubes at one day, and one set of three cubes at 28 days.
   b. Frequency of Testing: One set of cubes (6 cubes) shall be made for every ten base plates and bearing plates or fraction thereof but not less than one set for each day's operation. One set of cubes shall be made for each day's operation of grouting wall panels.

C. Field Inspection:

1. Mortar Joints: As construction begins, verify that mortar joints are being prepared in accordance with these specifications and ACI 530.1/ASCE 6/TMS 602.
2. Reinforcement and Connectors: Prior to grouting, verify the size, grade, type and placement of reinforcement and connectors is in compliance with specified requirements.
3. **Grouting:** Prior to any grouting procedure, the grout space shall be inspected to verify that it is clean and that cleanouts, if required, are in place and conform to requirements. Verify through continuous inspection that the placement of grout is in compliance with the requirements of the contract specifications and ACI 530.1/ASCE 6/TMS 602.

4. **Anchors:** Periodically verify the type, size and location of anchors including anchors of masonry to other structural members, frames, or construction is in compliance with specified requirements.

5. **Installed items:** Verify that installed flashing, weep holes, construction joints, control joints and wall vents are installed in accordance with specifications.

### 3.6 STRUCTURAL STEEL

**A. Scope of Work:**

1. **Contract Obligations:**
   
a. **Owner Responsibility:** The Owner shall pay for initial shop and field inspections and tests as required during the fabrication and erection of the structural steel.

b. **Testing Laboratory Responsibility:** The inspection by the Testing Laboratory of the Fabricator’s work shall be in sequence, timely, and performed in such a manner so that corrections can be made without delaying the progress of the work. Inspections shall be performed by qualified technicians with a minimum of two years of experience in structural steel testing and inspection. Refer to Paragraph 1.9B.4 for special requirements for welding inspectors. The Testing Laboratory shall provide test reports of inspections. All test reports shall indicate types and locations of defects found during inspection, the measures required and performed to correct such defects, statements of final approval of welding and bolting of shop and field connections, and other fabrication and erection data pertinent to the safe and proper welding and bolting of shop and field connections. Weld inspection reports shall be signed by an inspector with current certification as an AWS Certified Welding Inspector (CWI). In addition to the parties listed in this Specification the Fabricator and Erector shall receive copies of the test reports.

c. **Rejection of Material or Workmanship:** The Owner, Architect, Engineer, and Testing Laboratory reserve the right to reject any material or workmanship not in conformance with the Contract Documents at any time during the progress of the work. However, this provision does not allow waiving the obligation for timely, in sequence inspections.

**B. Quality Assurance:**

1. Verify the fabrication shop’s certification from AISC.
2. Verify that the fabricator’s fabrication and quality control procedures provide a sound basis for inspection control of workmanship and of the ability to conform to construction documents and industry standards. Review the procedures for completeness and adequacy relative to code requirements for the fabricator’s finished product.
3. Review field welder qualifications by certification or verify by retesting. Obtain welder certificates.

**C. Source Testing:** The Testing Laboratory shall provide the following tests at the designated fabrication shops:
1. Test welds completed in the shop according to Paragraph H “Weld Testing” below.
2. Test bolted connections completed in the shop according to Paragraph I “High-Strength Bolt Testing.”

D. Source Inspection: The Testing Laboratory shall provide the following inspections at the designated fabrication shops:

1. Shop Inspection Waiver: The requirement to perform fabricating shop inspections may be waived if the Fabricator produces evidence from the Building Official of being a registered, approved fabricating shop and if allowed by the Engineer. If these are waived, then the inspection, testing, and reporting requirements of the Owner's Testing Laboratory shall be transferred to the Fabricator.
2. An initial shop inspection prior to the start of any fabricating work shall be made to accomplish the following:

   a. Perform tasks outlined in Paragraphs G.1, G.2 and G.3 of welding inspection duties described below in Paragraph G “Weld Inspection and Process Monitoring” when shop welding is to be performed.
   b. Perform tasks outlined in paragraph J.1 of bolt inspection duties described below in Paragraph I “High-Strength Bolt Inspection and Process Monitoring” when shop bolting involves joints that are designated on the plans as Pretensioned or Slip-Critical.

3. Process Monitoring:

   a. Provide continuous or periodic monitoring of welding as described below in Paragraph G “Weld Inspection and Process Monitoring.”
   b. Provide continuous or periodic monitoring of bolting as described below in Paragraph I “High-Strength Bolt Inspection and Process Monitoring” of high-strength bolt installation in pre-tensioned or slip-critical joints using turn-of-the-nut without matchmarking or calibrated wrench method of bolt installation.
   c. Provide periodic verification of specified camber of steel beams.

E. Field Testing: The Testing Laboratory shall provide the following tests in the field:

1. Test welds completed in the field according to Paragraph H “Weld Testing;” below.
2. Test bolted connections completed in the field according to Paragraph I “High-Strength Bolt Testing.”
3. Perform bend tests on completed shear connectors attached to beams as required according to procedures outlined in AWS D1.1. In addition, perform field bend tests on an additional 2% of completed shear connectors on each beam but not less than one connector per beam.
4. Testing of Non-Shrink Grout for Base Plates, Bearing Plates, and Precast Wall Panels:
   a. Compressive Strength Tests: Compressive strength of grout shall be determined by testing grout cubes according to the requirements of ASTM C 109 - Modified. Test one set of three cubes at one day, and one set of three cubes at 28 days.
   b. Frequency of Testing: One set of cubes (6 cubes) shall be made for every ten base plates and bearing plates or fraction thereof but not less than one set for each day's operation. One set of cubes shall be made for each day's operation of grouting wall panels.
F. Field Inspection: The Testing Laboratory shall provide the following inspections in the field:

1. Inspect galvanized HSS and other cold-worked structural steel members for cracking or other damage resulting from galvanizing process. Endeavor to complete inspections prior to erection of these members. Immediately notify Contractor and Architect/Engineer of any irregularities discovered.

2. Provide continuous or periodic monitoring of field welding as described below in Paragraph G “Weld Inspection and Process Monitoring.”

3. Provide continuous or periodic monitoring of field bolting as described below in Paragraph I “High-Strength Bolt Inspection and Process Monitoring” of high-strength bolt installation in pre-tensioned or slip-critical joints using turn-of-the-nut without matchmarking or calibrated wrench method of bolt installation.

4. Inspect welded or bolted connections that were completed, but not inspected, in the shop. Perform inspections according to Paragraph G “Weld Inspection and Process Monitoring” and/or Paragraph I “High-Strength Bolt Inspection and Process Monitoring” as appropriate.

5. Obtain the planned erection procedure, and review with the Erector’s supervisory personnel.

6. Check the installation of base plates for proper leveling, grout type, and grout application.

7. Check structural steel as received in the field for possible shipping damage, workmanship, and identification marking to conform to AISC 360 for structural steel and specified ASTM standards for other steel.

8. Verify that surveys are occurring as specified to check plumbness and frame alignment as erection progresses. Review the submitted survey report.

9. Periodically inspect the steel frame for such items as bracing and stiffening details, member locations, and joint details at each connection for compliance with approved construction documents.

10. Inspect 100% of the column compression and base joints for verification that gaps in contact bearing do not exceed 1/16 inch. Gaps greater than 1/16 inch but less than 1/4 inch shall be reported to the Owner and Engineer for assessment. All gaps greater than 1/4 inch shall be shimmed according to Specification <051200> “Structural Steel Framing.”

11. Endeavor to guard the Owner against the Contractor cutting, grinding, reaming, or making any other field modification to structural steel without the prior approval of the Engineer. Report any noted unauthorized modifications to the Owner and Engineer.

G. Weld Inspection and Process Monitoring: The Testing Laboratory shall make the following inspections of the welds and welding processes. Welds performed in the fabricating shop may be inspected in the field unless continuous monitoring of the welding process is herein specified or if access in the field due to other work or shop finishes makes field inspection impractical:

1. Approve Welding Procedure Specifications submitted by the Contractor. Approve any changes submitted by the Contractor to any WPS that has already been approved. Obtain the Welding Procedure Qualification Record (WPQR) for each successful WPS qualification.

2. Periodically verify welding electrodes to be used and other welding consumables as the job progresses.

3. Periodically observe joint preparation, assembly practice, welding techniques including preheating and sequence, and the performance of welders with sufficient frequency to assure compliance with code and contract document requirements. Check preheating to assure conformance with AWS D1.1, Section 5.6. Verify procedure for control of distortion and shrinkage stresses.
4. Continuously observe joint preparation and fit up, backing strips, and runout plates for welded moment connections and column splices.

5. Periodically provide visual inspection of the root pass of partial and complete joint penetration welds.

6. Visually inspect 100% of welds for proper size, length, location, and weld quality in accordance with AWS D1.1 requirements. Unless specifically noted otherwise, all welding shall be considered statically loaded nontubular connections.

7. Visually inspect 100% of completed shear connectors on each beam.

8. Visually inspect 100% of the welds of anchors to embedded plates that are to be cast into concrete elements.

9. In addition to the inspections above, perform the following:
   a. Continuously monitor and observe joint preparation, assembly practice, welding techniques including preheating and sequence, and the performance of welders for 100% of complete and partial joint penetration welds, plug and slot welds, multiple-pass fillet welds, and single-pass fillet welds greater than 5/16 inch. Check preheating to assure conformance with AWS D1.1, Section 5.6. Verify procedure for control of distortion and shrinkage stresses.
   b. Periodically monitor welding of single-pass fillet welds that are less than or equal to 5/16 inch.
   c. Periodically monitor the welding of headed studs to floor beams.
   d. Periodically monitor the welding of anchors to embedded plates that are to be cast into concrete elements.

H. Weld Testing:

1. Perform nondestructive examination services using a qualified technician with the necessary equipment to perform the following:
   a. Nondestructive examination conducted in accordance with the specific requirements for the item being examined including radiographic (RT), ultrasonic (UT), magnetic particle (MT), or dye-penetrant inspection (PT). Nondestructive inspection procedures shall conform to AWS D1.1.
   b. Interpret, record, and report results of the nondestructive tests.
   c. Mark for repair, any area not meeting Specification requirements. Correction of rejected welds shall be made in accordance with AWS D1.1.
   d. Re-examine repair areas and interpret, record, and report the results of examinations of repair welds.
   e. Verify that quality of welds meet the requirements of AWS D1.1.

2. Fillet Welds: Provide the following:
   a. MT test a minimum of 10% of the length of each fillet weld exceeding 5/16”.
   b. Periodic MT testing of representative fillet welds 5/16” and less but need not exceed 10% of all such welds, except as required for high rejection rates as indicated in the following paragraph.
   c. Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.

3. Partial Joint Penetration (PJP) Welds, including Flare-Bevel Groove Welds: Provide the following:
a. MT test a minimum of 25% of the length of each PJP weld exceeding 5/16" effective throat.
b. Periodic MT testing of representative PJP welds 5/16” and less but need not exceed 10% of all such welds, except as required for high rejection rates as indicated in the following paragraph.
c. Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.

4. Complete Joint Penetration (CJP) Welds: Provide the following:

a. All CJP welds exceeding 5/16" thickness shall be 100% UT tested per AWS D1.1 Clause 6 Part F. The Testing Laboratory shall review the CJP joints to determine where geometry or accessibility precludes the use of standard scanning patterns per AWS D1.1 Clause 6 Part F. At these locations the testing laboratory shall develop and submit for approval a written testing procedure in accordance with AWS D1.1 Annex S.
b. Periodic MT testing of representative CJP welds 5/16” and less to not exceed 10% of all such welds, except as required for high rejection rates as indicated in the following paragraph.
c. Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.

5. Acceptance Criteria:

a. Visual, MT, PT shall be per AWS D1.1 Table 6.1.
b. UT testing shall be per AWS D1.1 6.13.1 and Table 6.2.

6. Base metal thicker than 1.5 inches, where subjected to through-thickness weld shrinkage strains, shall be UT tested for discontinuities behind and adjacent to such welds. UT testing shall occur no sooner than 24 hours after the weld has cooled to ambient temperatures. Any material discontinuities shall be recorded on the basis of ASTM A 435 or ASTM A 898 (Level 1 criteria) and reported for Engineer disposition.

7. Welds of Anchors to Embedded Plates:

a. Headed Studs: Perform field bend tests according to AWS D1.1 on 2% of the studs welded to plates, but not less than one stud per plate.
b. Deformed Bar Anchors: Perform MT testing on 10% of deformed bar anchors larger than 5/8” diameter.

8. The costs of repairing defective welds and the costs of retesting by the Testing Laboratory providing services for the Owner shall be borne by the Contractor. If removal of a backing strip is required by the Testing Laboratory to investigate a suspected weld defect, such cost shall be borne by the Contractor.

I. High-Strength Bolt Inspection and Process Monitoring: The Testing Laboratory shall perform the following inspections for connections joined with high-strength bolts. Bolting performed in the shop may be inspected in the field unless continuous monitoring of the bolting operation is specified herein:
1. Observe preinstallation verification testing of the pretensioning method to be used in accordance with the requirements of the “Specification for Structural Joints Using High-Strength Bolts”.
2. Check daily the calibration of impact wrenches used in field bolted connections.
3. Inspect bolt installation for 100% of high strength bolted connections according to inspection procedures outlined in the "Specification for Structural Joints Using High-Strength Bolts".
4. Monitoring of Bolting Installation:
   a. Continuous Monitoring: The Testing Laboratory shall be continuously present and monitor the bolting installation for compliance with the selected procedure for installation as specified in the “Specification for Structural Joints Using High-Strength Bolts" for joints using high-strength bolts that are designated on the plans as Pretensioned (PT) or Slip-Critical (SC) type joints and that are being installed using the calibrated wrench method or the turn-of-nut without matchmarking method of installation.
   b. Periodic Monitoring: All other joint types and bolt installation methods shall be monitored on a periodic basis.

J. High-Strength Bolt Testing: The Testing Laboratory shall perform the following tests for connections joined with high-strength bolts:

   1. Perform Arbitration Testing according to procedures outlined in the "Specification for Structural Joints using High-Strength Bolts" when a disagreement exists between the Testing Laboratory and the Fabricator as to the minimum tension of installed bolts that have been inspected according to paragraph below.

3.7 STEEL JOISTS

A. Scope of Work: The Testing Laboratory shall perform inspection of steel joists as described herein.

B. Quality Assurance:

   1. Verify that the fabricator maintains detailed quality control procedures that provide a basis for inspection control of workmanship and of the ability to conform to approved construction documents and industry standards. Verify that these procedures are complete and adequate relative to code requirements for fabricator’s scope of work.
   2. Verify welding procedures, welder qualifications and weld material prior to the start of work.
   3. Review field welder qualifications by certification or verify by retesting. Obtain welder certificates.

C. Field Testing:

   1. Perform Magnetic Particle testing (MT) on representative field welds not to exceed 10% of such welds unless rejection rates become high, in which case, frequency of inspection shall be increased to ensure acceptable welding.

D. Field Inspection: The duties of the Testing Laboratory shall be as follows:
1. Inspect joists for damage during shipment.
2. Visually inspect 100% of welded chord splices for compliance with SJI and project specifications.
3. Verify proper bearing of joist supports.
4. Confirm bridging size and location.
5. Visually inspect 100% of field attachment of joists to supports (welding or bolting).
6. Confirm bolting of joists to supports at column lines as required by OSHA requirements.
7. Verify that no joists have been damaged during erection.

3.8 STEEL DECKING
A. Field Inspection:
   1. Check steel deck as received in the field for possible shipping damage, workmanship, and identification marking to conform to specified ASTM standards for steel deck.
   2. Periodically monitor the method of attaching the steel floor and roof decking to the structural frame.
   3. Visually inspect 100% of the welding or other attachment method of steel deck to the structure and at sidelaps.

3.9 METAL BUILDING SYSTEMS

3.10 EARTHWORK
A. Quality Assurance:
B. Field Testing:
   1. Compacted Fill:
      a. Verification of Fill Material: Perform classification and testing to verify that the fill material to be used complies with the project specifications.
      b. Field Density Testing: Perform field density testing as described below:
         1) Field density tests shall be run according to ASTM D 2937 or ASTM D 6938 as applicable.
         2) Acceptance Criteria: The results of field density tests by the Laboratory will be considered satisfactory if the average of any three consecutive tests has a value not less than the required density with no single test falling more than 2 percent below the required density and the moisture content conforms to the requirements of the specification.
         3) Test Frequency for Paved Areas and Building Slab Subgrade:
            a) Make at least one field density test of the natural subgrade for every 2500 square feet of paved area or building slab but in no case less than three tests.
b) In each compacted fill layer or lift, make one field density test for every 2500 square feet of building slab or paved area but in no case less than three tests.

4) Test Frequency for Foundation Wall Backfill: Make at least one field density test for each 200 lineal feet of wall with a minimum of 4 tests for the basement walls around the perimeter of each building and a minimum of one test for every other type of foundation wall on the site. Tests shall be performed in random lifts along each wall.

5) Test Frequency for Compacted Fill beneath Column and Wall Footings: Make at least one field density test in each compacted fill layer or lift for each column footing, one for each twenty-five lineal feet of wall and one for each 2,500 square feet of mat foundation area or fraction thereof.

c. Report Copies: Moisture-density curves and results of field density tests shall be submitted to the parties specified earlier in this section.

d. Additional Testing: If reports by the Laboratory indicate field densities lower than specified, additional tests will be run by the Laboratory with at least the frequencies scheduled above on recompacted fill and/or natural subgrade. The Testing Laboratory shall notify the Contractor on a timely basis for any required retesting so as not to delay the work. The costs of such tests shall be liable to the Owner for repayment by the Contractor.

2. Drilled Piers and Underreamed Footings:
   a. Concrete Cylinders: Make and test concrete cylinders as specified for Cast-in-Place Concrete.

3. Spread (Excavated) Footings
   a. Concrete Cylinders: Make and test concrete cylinders as specified for Cast-in-Place Concrete.

C. Field Inspection by the Testing Laboratory:

1. The Testing Laboratory shall provide inspection of materials used in foundation elements as described below.

2. Compacted Fill:
   a. Subgrade below Compacted Fill: Observe and verify that the subgrade below compacted fill has been properly prepared before compact fill construction begins.
   b. During placement and compaction of fill, determine that the material being used and the maximum lift thickness comply with the specifications.

3. Drilled Piers and Underreamed Footings:
   a. Reinforcing Steel: Inspect reinforcing steel for proper number and size of bars and confirm dowel or anchor rod placement into top of pier.

4. Spread (Excavated) Footings:
a. Reinforcing Steel: Inspect reinforcing steel size, number of bars, and placement and confirm dowel or anchor rod placement into footing.

D. Foundation Inspection by the Geotechnical Engineer: The Geotechnical Engineer of Record shall provide inspection service for the following items before and during foundation installation as appropriate for the foundation type. The Geotechnical Engineer shall submit written field inspection reports promptly after inspection to the parties listed above and report his findings after each inspection by telephone or e-mail to the Engineer.

1. Spread (Excavated) Footing:
   a. Subgrade: Verify that foundation bearing conditions are consistent with soil report tests and that the footing is being installed in the proper soil strata at the proper elevation. Make recommendations regarding adjustment to subgrade or bearing elevation if subgrade is not adequate to support footing.

2. Drilled Piers and Underreamed Footings:
   a. Bearing Elevation: Observe that piers are founded in proper bearing strata as defined in the Geotechnical Report and that bottom of hole is clean and properly formed. Recommend appropriate action if specified bearing elevation does not provide proper strength.
   b. Bell and Shaft Sizes: Verify that the shaft and bell diameters are within specified tolerances.
   c. Shaft Stability: Observe the shaft sides as drilling proceeds and recommend appropriate action if sloughing becomes excessive.
   d. Concrete Quantities: Record quantity of concrete placed in each pier and compare against theoretical quantity required. Report discrepancies to Engineer.
   e. Placement Method: Observe that piers are placed by approved methods as defined in the Geotechnical Report and in the Specifications. Confirm that casings are being used as recommended in the Geotechnical Report. Confirm that concrete is not being contaminated by soil encroachment into pier.
   f. Report: For each drilled shaft installed, prepare and submit a report indicating the following information:

   1) Name of the Project.
   2) Name of the drilling contractor.
   3) Name of the field superintendent.
   4) Pier number and location.
   5) Pier shaft diameter.
   6) Pier underream diameter (if applicable).
   7) Bottom elevation.
   8) Top elevation.
   9) Pier length.
   10) Theoretical volume of concrete in pier.
   12) Reinforcing steel size and depth actually placed.
   13) Drilling start and finish time.
   14) Concreting start and finish time.
   15) Variation from specified tolerances including surveyed location and plumbness.
16) Construction method (dry method, casing method, or slurry displacement method).

17) Groundwater conditions (rate of water infiltration and depth of water in hole prior to concreting for dry piers; water elevation in hole for wet piers).

18) Elevation of top and bottom of any casing left in place.

19) Description of temporary or permanent casing (including purpose, diameter, wall thickness and length).

20) Description and elevation of any obstructions encountered and whether removal was obtained.

21) Description of pier bottom including amount and extent of loose material.

22) Method of concrete placement.

23) Any difficulties encountered in drilling or concreting operations.

24) Any deviations from specifications.

The report shall be signed by a licensed engineer in the state where the project is located.

END OF SECTION 014529
PART 1 - SECTION 01 50 00 – TEMPORARY FACILITIES AND CONTROLS

1.1

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for
   1. Temporary utilities;
   2. Support facilities;
   3. Miscellaneous temporary construction aids; and
   4. Security and protection facilities installation.

B. Related Requirements:
   1. Section 31 41 13 for timber shoring.

2.2 REFERENCES

A. Abbreviations and Acronyms:
   1. NECA: National Electrical GCs Association
   2. NEMA: National Electrical Manufacturers Association
   3. NFPA: National Fire Protection Association
   4. UL: Underwriters Laboratories.

2.3 SYSTEM DESCRIPTION

A. Design Requirements: Provide design and engineering for construction facilities and temporary
   controls in compliance with the requirements of the AHJ.

B. Use Charges:
   1. Include cost or use charges for temporary facilities and controls in the Contract Sum.
   2. Allow other entities to use temporary services and facilities without cost, including City, the
      Architect, testing and inspecting agencies, and the AHJ.

2.4 SUBMITTALS

A. At least 2 business days before the preconstruction conference, and before beginning construction
   of temporary facilities, submit the following to the Architect for information.
1. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
   a. Indicate proposed activity in each portion of the work area and identify the areas of limited use or non-use.
   b. Indicate proposed vehicle access routes to and from the project site and expected frequency of use on adjacent streets.

2. Shop drawings: Submit large scale dimensioned shop drawings of site fencing showing gates and site signs.

2.5 QUALITY ASSURANCE

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

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

2.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Regardless of previously assigned responsibility, the installer of each permanent service assumes the responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before City's acceptance.

PART 3 - PRODUCTS

3.1 MATERIALS

A. Unless otherwise specified, materials, facilities, and equipment utilized for temporary facilities and controls are selected by the GC.

PART 4 - EXECUTION

4.1 GENERAL

A. Locate facilities to adequately serve the project and result in minimum interference with performance of the work. Relocate and modify facilities as required by the progress of the work.

B. Provide each temporary facility in a ready-to-use condition when needed and as required avoiding delay. Do not remove temporary facilities until they are no longer needed; or until they are replaced by City authorized use of completed permanent facilities.
4.2 TEMPORARY UTILITY INSTALLATION

A. General: Either install temporary service or connect to existing services. Arrange with the utility company, City, and existing users for time when service is interrupted to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to legally remove effluent. Connect temporary sewers as required by AHJ.

C. Water Service: Install water service and distribution piping in sizes and pressures necessary for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use by construction personnel. Comply with the requirements of the AHJ for the type, number, location, operation, and maintenance of fixtures and facilities.

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

F. Ventilation and Humidity Control: Provide temporary ventilation required for construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity.
   1. Select equipment that does not have a harmful effect on completed installations or elements being installed.
   2. Coordinate ventilation requirements to produce ambient conditions required and to minimize energy consumption.

G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics to accommodate construction operations.

H. Lighting:
   1. Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   2. Install and operate temporary lighting that fulfills security and protection requirements without operating the entire system.

I. Telephone Service:
   1. Provide temporary telephone service in common-use facilities for use by all construction personnel. Install at least one telephone line for each field office.
   2. Provide additional dedicated telephone lines for each facsimile machine in each field office.
   3. At each telephone, post a list of important telephone numbers including police and fire departments, the GC's home office, the Architect's office and City's office.
   4. Provide each superintendent with cellular telephone or portable two-way radio for use away from the field office.
J. Electronic Communication Service: Provide temporary electronic communication service in each field office, including electronic mail.

4.3 SUPPORT FACILITIES INSTALLATION

A. General: Maintain support facilities until near Substantial Completion, and remove them before Substantial Completion. Personnel remaining after Substantial Completion are permitted to use permanent facilities under conditions authorized by City.

B. Temporary Paved Areas: Construct and maintain temporary paved areas adequate for construction operations.

1. Locate temporary paved areas in the same location as permanent paved areas.
2. Extend temporary paved areas as necessary for construction operations, and within the indicated construction limits.
3. Coordinate elevations of temporary paved areas with permanent paved areas.
4. Prepare subgrade and install subbase and base layer for temporary paved areas as specified in Division 31 sections.
5. Recondition base after temporary use, including removing contaminated material, re-grading, proof rolling, compacting, and testing.
6. Protect from damage all raised edges and areas around permanent drains, curbs, and similar items located within temporary paved areas.

C. Traffic Controls:

1. Determine the routing of construction vehicles before beginning work, based on restrictions indicated on the Drawings and the safeguards and procedures necessary to carry out the work.
2. Maintain all-weather temporary access to the site and to designated truck unloading area or areas; make access available to all trades.
3. Control construction traffic within and adjacent to the site.
4. Provide entrances, lifts, and safeguards required or necessary to the progress of the work, and control such traffic to limits hazards to the work and all persons.
5. Route construction equipment, trucks, and similar vehicles via existing public streets to and from the site, as approved by the AHJ.
6. Obtain and pay for permits and inspections necessary for the use of public streets, sidewalks, curbs, and paving. Post required guarantees and bonds, and repair and make good any damages thereto as required by the AHJ.
7. Construct and maintain temporary walks and bridges for pedestrians. Keep streets adjacent to the site open to vehicular and pedestrian traffic.
8. Maintain unfettered access for law enforcement agencies; and for fire and ambulance service.
9. Provide and maintain proper traffic controls for the safety of all persons.
   a. Provide necessary barricades, suitable and sufficient lights, reflectors, and danger signals.
   b. Provide warning and closure signs, directional and detour signs.
   c. Provide additional measures as necessary.
10. Indicate restricted and dangerous conditions existing on or adjacent to the site on a 24-hour basis.
    a. Illuminate barricades, danger signals, warning signs and obstructions at night.
b. Keep warning lights burning from one hour before sunset until one hour after sunrise.

D. Waste Disposal Facilities: Provide waste-collection containers sized to adequately handle waste from construction operations without being piled high or overflowing. Comply with requirements of the AHJ.

E. Lifts and Hoists:
   1. Provide facilities necessary for hoisting materials and personnel.
   2. Truck cranes and similar devices used for hoisting materials are considered “tools and equipment” and are not temporary facilities.

F. Temporary Elevator Use: See Division 14 sections for the temporary use of permanent elevators.

G. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are inadequate.

H. Temporary Use of Permanent Stairs: Cover finished, permanent stairs with protective covering of plywood or similar material so that finishes are undamaged at time of acceptance.

4.4 MISCELLANEOUS TEMPORARY CONSTRUCTION AIDS

A. Provide and maintain miscellaneous temporary construction aids necessary for proper execution of the work, including stairs, ladders, ramps, railings, canopies, scaffolds and hoists, chutes, barricades, enclosures, platforms, swing staging, and walks.

B. Locate in and about the project as practicable and where they will not interfere with the progress of the work. Relocate when necessary during construction, and remove promptly when no longer needed.

C. Provide openings where required for installing large pieces of equipment.
   1. Close openings after the equipment is in place.
   2. Restore finishes to a condition matching adjacent surfaces in a manner that does not lead to or result in any specified or other warranty becoming void, as determined by City.
   3. With respect to the acceptance or rejection of corrected work, City’s decision is final. Acceptance by City of corrected work is contingent upon
      a. corrections and repairs being performed skillfully;
      b. corrective or repaired work resulting in sound, permanent construction that is flush and seamless with adjacent surfaces;
      c. colors and textures matching adjoining and adjacent surfaces, without differentiation; and
   4. no visible evidence of correction or repair, nor any other apparent distinction or seam between original and corrected or repaired work
4.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in conformance with environmental regulations, and in a manner that minimizes possible air, waterway, and subsoil contamination or pollution, or other undesirable effects.

B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff; and to prevent airborne dust migrating to adjacent properties and walkways, in conformance with the requirements of the AHJ.

C. Storm Water Control: Comply with the requirements of the AHJ. Provide barriers in and around excavations and subgrade construction to prevent flooding by storm water runoff from rain.

D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage. Protect tree root systems from damage, flooding, and erosion.

E. Noise Control: Execute the work to minimize noise. Requirements for operations that may result in high levels of noise and vibration, odors, and other disruption.

F. Pest Control: Engage a pest-control service to recommend practices that minimize attraction and harboring of rodents, roaches, and other pests; and to perform extermination and control procedures at regular intervals so the project is free of pests and their residues at Substantial Completion.

1. Obtain an extended pest control warranty for City.
2. Perform pest control operations legally, using environmentally-safe materials and methods.

G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fencing in a manner that prevents people and animals from easily entering the project site except by entrance gates.

1. Provide the extent required to enclose the entire project site or portion determined sufficient to accommodate construction operations.
2. Obtain and pay for required permits and inspections.
3. Maintain security by limiting the number of keys and restricting distribution to authorized personnel.

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

I. Barricades, Warning Signs, and Lights: Comply with the requirements of the AHJ for erecting structurally-sound barricades, including warning signs and lighting.

J. Temporary Enclosures:

1. Provide temporary enclosures to protect in-progress and completed construction from exposure, inclement weather, and other construction operations and activities. Provide temporary weathertight enclosure for building exterior.
2. Insulate temporary enclosures where heating or cooling is required or necessary and a permanent enclosure is not complete.
K. Temporary Fire Protection:

1. Install and maintain temporary fire-protection facilities as required to protect against reasonably predictable and controllable fire losses. Comply with the requirements of NFPA 241.
2. Provide temporary standpipes and hoses for fire protection.
   a. Hang hoses with warning signs stating that hoses are for fire-protection purposes only and may not be removed.
   b. Match hose sizes with outlet sizes and equip hoses with suitable nozzles.

4.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: To minimize waste and abuse, limit the availability of temporary facilities to essential and intended uses.

B. Maintenance:

1. Maintain facilities in good operating condition until removal.
2. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where specified, where required to achieve indicated results, and to avoid damage.

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

D. Termination and Removal: Remove each temporary facility and control when need for its service has ended; when it is replaced by authorized use of a permanent facility or control; or not later than Substantial Completion.

1. Complete or restore permanent construction delayed because of interference with a temporary facility or control.
2. Either remove, reinstall or reapply, or replace; or arrange and pay costs for removing, reinstalling or reapplying, or replacing non-conforming work; or items that are deficient, damaged or that cannot be satisfactorily corrected or repaired in a manner that both matches adjacent undamaged areas and shows no evidence of correction, repair, or refinishing, as determined by City.
3. Materials and facilities that constitute temporary facilities are property of the GC. City reserves right to take possession of project identification signs.
4. At Substantial Completion, clean permanent facilities used during the construction period in conformance with Section 01 74 00.

END OF SECTION 01 50 00
SECTION 01 56 39 – TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

1.2 DEFINITIONS

A. Protection Zone: Area surrounding individual trees or groups of tree to be protected during construction, and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

1.3 ACTION SUBMITTALS

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

B. Samples: For each type of organic mulch in sealed plastic bags labeled with composition of materials by percentage of weight.

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

1.4 INFORMATIONAL SUBMITTALS

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

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

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

1.5 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA, licensed arborist in jurisdiction where Project is located, current member of ASCA, or registered Consulting Arborist as designated by ASCA.

B. Preinstallation Conference: Conduct conference at Project site.
1.6 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

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

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch in diameter; and free of weeds, roots, and toxic and other nonsoil materials.

B. Topsoil: Stockpiled topsoil from location shown on Drawings.


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

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

2. Plywood Protection-Zone Fencing: Plywood framed with four 2-by-4-inch rails, with 4-by-4-inch preservative-treated wood posts spaced not more than 8 feet apart.

3. Wood Protection-Zone Fencing: Constructed of two 2-by-4-inch horizontal rails, with 4-by-4-inch preservative-treated wood posts spaced not more than 8 feet apart, and lower rail set halfway between top rail and ground.

4. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet apart. High-visibility orange color, nonfading.
5. Height of Fencing: 4 feet.
6. Gates: Swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones.

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

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

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

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

C. Protection Zones: Mulch areas inside protection zones and other areas indicated with 4-inch average thickness of organic mulch. Do not place mulch within 6 inches of tree trunks.

3.2 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones in a manner that will prevent people from easily entering protected area except by entrance gates.

1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.

2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.


B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect.

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

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

3.3 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "Earth Moving."
B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.

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

3.4 ROOT PRUNING

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

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

B. Root Pruning at Edge of Protection Zone: Prune roots by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.5 CROWN PRUNING

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

1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
2. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
3. Cut branches with sharp pruning instruments; do not break or chop.
4. Do not apply pruning paint to wounds.

B. Chip removed branches and dispose of off-site.

3.6 REGRADING

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

B. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
C. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.7 FIELD QUALITY CONTROL

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

3.8 REPAIR AND REPLACEMENT

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

1. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
2. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
3. Perform repairs within 24 hours.
4. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

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

END OF SECTION 01 56 39
SECTION 01 58 13 – TEMPORARY PROJECT SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for temporary project signage.

1.2 REFERENCES

A. Abbreviations and Acronyms:


B. Definitions:

1. Permanent Project Signage: Means all informational, directional, specialty, and code-required signs required or necessary for identification, communication, way-finding, and safe and proper operation of the project.

2. Temporary Project Signage: Means all informational, directional, way-finding, and other signs required by law, code, ordinance, or order of the AHJ, and as required to caution, alert, warn, re-route or redirect pedestrian and vehicular traffic around or away from areas of the GC’s operations; and as necessary to provide a safe and proper job site.

1.3 ADMINISTRATIVE REQUIREMENTS

A. The GC provides permanent and temporary project signage described in this section, as indicated in the executed GC at Risk Agreement, and elsewhere in the Contract Documents.

1. The GC is solely responsible for the adequacy, conformance, and trade practices of safety related signage, and all signage required by the AHJ.

2. Temporary project signs must be produced by professional sign painters, and be of size and lettering style consistent with use; colors as required by either the AHJ or approved by City.

3. Advertising signage and signage identifying subcontractors and materials suppliers are not permitted and may not be displayed.

4. Unauthorized signs are not permitted.

B. In addition to the temporary signs required by law, code, ordinance or order of the AHJ, and as required for the safe and proper execution of the work, provide and maintain the following.

1. A project identification sign identifying the project, donor information, and names, and corporate logos, of the principal parties responsible for design and construction.

   a. The project identification sign must be painted on a surface at least 4 feet high by 8 feet wide, in not less than 4 colors.

   b. City provides camera-ready artwork for the project identification sign, including approved text and graphics. The GC may not add to, modify, or delete any artwork information without prior written approval from City.
c. The project identification sign must be mounted on framework, posts, or other structural supports designed and provided by the GC, and approved by City and the Architect. Paint all surfaces and edges of sign support structure with one coat of primer and at least one coat of exterior paint, semi-gloss finish; in a color to be determined by City.

d. The GC provides and maintains lighting of the project identification sign from at least dusk to midnight, throughout the duration of the work.

2. The GC paints and maintains graphics on temporary plywood construction barricades as directed by City.

   a. City provides camera-ready artwork for the project identification sign, including approved text and graphics. The GC may not add to, modify, or delete any artwork information without prior written approval from City.

   b. Graphics are painted on the temporary construction barricade, 8 feet high by the length of the barricade as shown in the Contract Documents, in no less than four (4) colors, and may include text, images, logos and/or other graphics as determined by City.

   c. The GC provides and maintains lighting of the temporary construction barricade from at least dusk to midnight, throughout the duration of the work.

C. The GC, including all subcontractors, vendors, fabricators, consultants, and personnel are prohibited from installing any permanent or temporary signs at or around the job site, without prior written approval from City.

1.4 SUBMITTALS

A. Submit installation criteria and a sign erection strategy for approval by City and the Architect.

B. Submit shop drawings and samples for all fabricated signs describing and detailing all project conditions, including

   1. Layout drawings, including all physical dimensions, material call-outs, notes, typeface, size of lettering and graphics, colors, joints and reveals;
   2. material samples;
   3. specifications;
   4. methods of assembly;
   5. structural design and calculation, when required or necessary;
   6. electrical services, where required or necessary;
   7. mechanical services, where required or necessary;
   8. signage locations, including location plans and schedules, and elevations and sections indicating placement and showing relationship to adjacent elements, including all potential conflicts; and
   9. methods of attachment and installation.

1.5 QUALITY ASSURANCE

A. Sign Painter Qualifications: Must have at least 10 consecutive years’ experience providing the design, execution, construction, and installation of exterior signs on a weekly basis for projects similar in material, design, complexity, and extent to this project, and whose products have resulted in applications with a record of successful in-service performance.
PART 2 - PRODUCTS

2.1 SIGNAGE MATERIALS

A. Provide materials for sign faces, framing, structure and systems that are

1. New, undamaged and unused at time of installation; and the specified finish;
2. Structurally adequate to support signs as indicated or specified; and
3. Suitable and appropriate for the environmental conditions at the place of installation.

B. Provide signs that are complete with all accessories, trim, finishes, hardware, safety guards, and other devices and details needed for installation for complete intended use and effect.

C. Unless otherwise specified, temporary signs must be fabricated from at least 3/4-inch thick exterior grade softwood plywood, with medium or high-density phenolic sheet overlay.

1. Provide standard large sizes to eliminate joints.
2. Provide sheet thickness as required to span across framing members, and to provide even, smooth surfaces without waves or buckles.
3. Connect sign panels to framework or structure with adequate and appropriate framing connectors.

D. Unless otherwise specified, temporary signs must be shop painted and field installed. Paint back of panels and edges for complete weather resistance and finished appearance.

E. Unless otherwise specified, anchors and fasteners must be of type, grade and class required for intended use, and sized and spaced as required for loads and substrate.

1. Use steel fasteners with cadmium-plating or other rust inhibitive coating in all concealed locations, except
   a. Provide stainless steel fasteners for attaching aluminum; and
   b. Use zinc-coated (galvanized) or stainless steel fasteners in all exterior installations, or where locations are exposed to moisture or humidity.

F. Unless otherwise specified, and where permitted by City and the Architect, attach signs using construction adhesive adhering to the requirements of APA Performance Specification AFG-01.

G. Unless otherwise specified, powder-driven fasteners are not permitted, and may not be used in load-bearing installations. Where specified, conform to Fed Spec FF-P-395 or Fed Spec GGG-D-777. Paint all visible surfaces to match adjacent surfaces, as required by City and the Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. For the GC-installed signs, employ individuals or companies experienced in the installation of signs to perform installation work for all temporary project signs.
1. Acquire all permits required for installation and operation of all temporary and permanent project signs.
2. Locate the project identification sign on site at a location of high public visibility, adjacent to the main entrance to the site; or as directed by City;
3. Locate all other temporary signage for optimum visibility; as required by law, code, ordinance or order of the AHJ; as required to caution, alert, warn, re-route or redirect pedestrian and vehicular traffic around or away from areas of the GC’s operations; and as necessary to provide a safe and proper job site.
4. Temporary signs must be secured using attachment methods that do not leave permanent marks, disfiguration, or discoloration on the surfaces of existing structures or the completed work.

3.2 MAINTENANCE

A. Throughout the duration of the project, the GC shall maintain all signs and supports in a neat and clean condition; and must patch, repair, or replace all surfaces, including sign faces, framing, and structural supports that become damaged, marred, scratched, distressed, faded, or weathered.

B. Remove, relocate, and reinstall all project temporary signs as required by progress of the work.

3.3 REMOVAL

A. Remove all signs, framing, supports, and foundations when directed by City.

B. Patch, repair, replace, and clean all surfaces impacted by the placement and removal of signage.

C. Remove all temporary project signs before Substantial Completion.

END OF SECTION 01 58 13
PART 1 - SECTION 01 60 00 – PRODUCT REQUIREMENTS

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for

1. Selection of products for use in the project;
2. Product delivery, storage, and handling;
3. Manufacturers' warranties; and
4. Special warranties.

2.2 REFERENCES

A. Definitions:

1. Products: Means an item obtained for incorporating into the work, whether purchased for the project or taken from previously purchased stock. The term “product” includes the terms “material,” “equipment,” “system,” and terms of similar intent.

   a. Named Products: Means those items specified by the manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature current as of date indicated on the Contract Documents.
   b. New Products: Means those items not previously incorporated into another project or facility. Products salvaged or recycled from another project are not new products.
   c. Comparable Products: Means those items that are demonstrated as having corresponding qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics to those of specified products; and are approved for use through the submittal process.
   d. Basis-of-Design Product: Means those items for which a specific manufacturer's product is named to establish the salient properties for a given material, fabrication, product, component, or accessory, for the purposes of evaluating comparable products of additional manufacturers also named in the specification.

2. Salient Properties: Means those attributes indicated in the Contract Documents that are critical to the design and integral to the original selection of a specified product, including performance, weight, size, durability, visual effect, and similar distinguishing features and requirements.

3. Manufacturer's Warranty: Means a written warranty furnished by an individual manufacturer for a particular product, and specifically endorsed by the manufacturer to City.

4. Special Warranty: Means a written warranty required by the Contract Documents to provide specific rights for City.
2.3 QUALITY ASSURANCE

A. Compatibility of Options: If the specification allow for the option of selecting between two or more products for use on the project, select the product most compatible with the products previously selected, even if previously selected products were also options.

2.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that prevent damage, deterioration, and loss, including theft and vandalism. Conform to manufacturer-prepared published and supplemental instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at the project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation to ensure a minimum amount of holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to the project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Promptly inspect products upon delivery to determine conformance with the Contract Documents, and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that does not endanger the project structure.
3. Store products subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to the extent necessary for the period during installation and concealment.
5. Conform to manufacturer-prepared published and supplemental instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage, and protect liquids from freezing.
7. Provide a secure location and enclosure at the project site for storage of materials and equipment by City's construction forces. Coordinate location with City.

2.5 PRODUCT WARRANTIES

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

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Warranty Submittals: As specified in Section 01 78 36.

PART 3 - PRODUCTS

3.1 PRODUCT SELECTION PROCEDURES

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

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. If available, and unless custom products or non-standard options are specified, provide standard products of types produced and used successfully in similar situations on other projects.
3. City may limit selection to products with warranties not in conflict with requirements of the Contract Documents.
5. Or Equal: For products specified by name, and accompanied by the phrase “or equal,” “or approved equal,” or similar terms, conform to the requirements in “Comparable Products” Article below to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where the Specifications name a single manufacturer and product, provide the named product that conforms to the requirements of the Contract Documents. Comparable products and substitutions for the CMR's convenience are not permitted.
2. Manufacturer/Source: Where the Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that conforms to the requirements of the Contract Documents. Comparable products or substitutions for the CMR's convenience are not permitted.
3. Products:
   a. Restricted List: Where the Specifications include a list of names of both manufacturers and products, provide one of the products listed that conforms to the requirements of the Contract Documents. Comparable products or substitutions for the CMR's convenience are not permitted unless otherwise indicated.

4. Manufacturers:
   a. Restricted List: Where the Specifications include a list of manufacturers' names, provide a product manufactured by one of those listed that conforms to the requirements of the
Contract Documents. Comparable products or substitutions for the CMR's convenience are not permitted unless otherwise indicated.

5. Basis-of-Design Product: Where the Specifications name a product and also include the phrase “basis of design product” or “design is based on” or similar phrases; or refer to a product indicated on Drawings, and also include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. The Drawings and Specifications indicate salient properties based on the product named. Conform to requirements in “Comparable Products” Article below for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where the Specifications require “match the Architect's design reference (target) sample” or similar phrases, provide a product that conforms to the requirements of the Contract Documents and matches the Architect's sample. The Architect's decision is final regarding a proposed product’s match.

1. If no product available within specified category matches and conforms to other specified requirements, comply with the requirements of Section 01 25 00 for proposing a product.

D. Visual Selection Specification: Where the Specifications include the phrase “as selected by the Architect from manufacturer's full range” or similar phrase, select a product that conforms to the requirements of the Contract Documents. The Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

3.2 COMPARABLE PRODUCTS

A. The Architect considers comparable products only when all of the following conditions are satisfied. If the following conditions are not fully satisfied, then the Architect returns the incomplete comparable product data without action, except to record nonconformance with these requirements. Each comparable product submittal must include

1. Evidence that the proposed comparable product does not require revisions to the Contract Documents; that it is consistent with the Contract Documents; that it produces the indicated results; and that it is compatible with all other portions of the work.
2. A detailed comparison of salient properties specified versus the proposed comparable products;
3. Evidence the proposed comparable products offer warranties equal to or better than those named in the Specifications;
4. Lists of similar installations for completed projects, with the project names and addresses, and the names and addresses of the architects and owners, when requested; and
5. Samples, when requested.

END OF SECTION 01 60 00
PART 1 - SECTION 01 64 00 – OWNER FURNISHED PRODUCTS

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for installing City-furnished or vendor-furnished products, including providing supplementary components and accessories for a complete installation.

2.2 REFERENCES

A. Abbreviations and Acronyms:

1. OCFI: Owner-Furnished GC-Installed.
2. VFCI: Vendor-Furnished GC Installed.

2.3 ADMINISTRATIVE REQUIREMENTS

A. OFCI Items: The GC coordinates delivery of City-furnished equipment. City furnishes the equipment to coincide with the contractor’s construction schedule.

1. City

a. Furnishes manufacturer's literature, shop drawings, or other appropriate information for the GC to prepare required shop drawings;
b. Furnishes the standard integral parts of the equipment; and
c. Delivers items to site, unloads, handles, and stores items.

2. The General Contractor

a. Verifies mounting and utility requirements for Owner-furnished items;
b. Receives and unloads items at the project site and, on a form acceptable to City, gives written receipt for items at the time of delivery, noting visible defects and omissions (if such declaration is not given, the GC assumes responsibility for such defects and omissions);
c. Stores items until ready for installation, and protects items from loss and damage;
d. Uncrates, assembles, and sets items in place;
e. Installs items in conformance with the manufacturer's recommendations, instructions, and shop drawings; and under the supervision of the manufacturer's representative, where specified;
f. Supplies all labor and material required for installation, and for making mechanical, plumbing, and electrical connections necessary to operate installed items;
g. Provides and installs backings for all items that weigh 20 pounds or more.
B. OFOI and VFVI Items: The GC coordinates the delivery of Owner- or vendor-furnished equipment. City or Vendor furnishes the equipment to coincide with the contractor’s construction schedule.

1. City or Vendor
   a. Furnishes manufacturer's literature, shop drawings, or other appropriate information for the GC to prepare required shop drawings;
   b. Furnishes the standard integral parts of the equipment;
   c. Delivers items to site, unloads, handles, and stores items; and
   d. Makes connections to roughed-in utilities.

2. The GC
   a. Verifies mounting and utility requirements for Owner-furnished items;
   b. Receives items at the project site and, on a form acceptable to City, gives written receipt for items at the time of delivery, noting visible defects and omissions;
   c. Provides rough-ins of utility items in conformance with the manufacturer's recommendations, instructions, and shop drawings; and under the supervision of the manufacturer's representative, where specified; and
   d. Provides and installs backings for all items that weigh 20 pounds or more.

C. Existing Item Relocation: Where indicated, existing equipment indicated as remaining and relocated is re-installed by the GC, who

1. Removes items from their original location;
2. Recaps and labels existing utilities in their original location;
3. Stores items until ready for installation, and protects items from loss and damage;
4. Verifies mounting and utility requirements for relocated items;
5. Relocates items to their new locations;
6. Installs items, supplying all labor and material required for (1) reinstallation; and (2) making new mechanical, plumbing, data, and electrical connections;
7. Patches or repairs existing surfaces to match adjacent areas where existing items are removed; and
8. Provides and installs backings for all items that weigh 20 pounds or more.

D. Existing Item Removal: Where indicated, the GC

1. Removes items from their original location;
2. Recaps and labels existing utilities in their original location;
3. Removes and disposes of existing items from the project site, unless indicated as being turned over to City; and
4. Patches or repairs existing surfaces to match adjacent areas where existing items are removed.

E. Provisions for Future Items: Where indicated, the GC

1. Provides rough-ins of utility items in conformance with the manufacturer's recommendations, instructions, and shop drawings; and under the supervision of the manufacturer's representative, where specified; and
2. Caps and labels utilities for future connections.
2.4 PRODUCT HANDLING

A. Protection: Use necessary means to protect the materials of this Section before, during, and after installation; and to protect the installed work and materials of other trades and equipment installed by others.

B. Replacements: In the event of damage, promptly repair all damaged and defective work to the satisfaction of City, at no change in Contract Time and Contract Sum.

PART 3 - PRODUCTS

3.1 OWNER- AND VENDOR-FURNISHED ITEMS

A. Items must conform to the space limitations indicated on the Drawings, and to the mechanical and electrical services indicated and specified in other Sections.

1. The GC
   a. Assembles all necessary information about City- or vendor-furnished items;
   b. Coordinates rough-in locations, sizes, and capacities; and backings, anchorage, and utility services required for installation of the work; and
   c. Brings to the attention of the Architect and City any discrepancies, conflicts, or omissions discovered.

2. GC coordination must be performed in a timely manner to avoid delaying the installation of facility services, concealed supports, and backings during the scheduled installation of that work.

B. If City substitutes an item similar to that indicated or scheduled, there is no change in rough-in cost unless (1) the substitution occurs after rough-in is completed or rough-in involves other mounting requirements; or (2) if different capacity utilities are required than those required by the originally-specified item.

C. Modify installed work as necessary to meet the space limitations, backing, anchorage, or facility service requirements at no additional cost to City.

PART 4 - EXECUTION

4.1 EXAMINATION

A. Before beginning installation, verify that work performed as part of the work of other Sections (1) conforms to the manufacturer’s installation or application tolerance requirements; (2) provides true, flat, and level surfaces; and (2) satisfies all other conditions relating to the quality of installation, durability, appearance, and performance.

B. Evaluation and Assessment: Reject work that does not conform to the manufacturer’s installation or application requirements. The GC shall either perform, or arrange for and pay all costs for
remedial work necessary to correct deficient conditions to bring them into conformance with the manufacturer’s installation or application requirements.

C. Discrepancies:

1. In the event of any discrepancy between City- or vendor-furnished items and the indicated utilities, space limitations, or conflicts with other features of work, promptly notify the Architect for resolution.
2. Do not proceed with installation until all discrepancies are resolved.

4.2 INSTALLATION

A. Where indicated, relocate and reinstall existing equipment in conformance with the approved shop drawings and the original manufacturer's instructions.

B. Install Owner-furnished equipment in conformance with the approved shop drawings and manufacturer-prepared published instructions.

4.3 ADJUSTING AND CLEANING

A. Adjust equipment as directed and required.

B. Clean all new and relocated equipment.

C. Protect equipment from damage until final acceptance of the work.

END OF SECTION 01 64 00
SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for execution of the work, including
   1. construction layout;
   2. field engineering and surveying;
   3. installation of the work;
   4. coordination of owner-installed products;
   5. starting and adjusting; and
   6. protection of installed construction.

B. Related Requirements:

1. Section 01 73 29 for cutting and patching.

1.2 SUBMITTALS

A. Certificates: Submit for information certificate signed by a qualified land surveyor certifying that
   locations and elevations of improvements conform to the Contract Documents.

B. Landfill Receipts: For hazardous waste disposal, submit for information copies of receipts issued
   by a landfill facility, licensed to accept hazardous materials.

C. Certified Surveys: Submit for information 2 copies signed by a qualified land surveyor.

D. Final Property Survey: Submit for information 10 copies showing the work performed and record
   survey data.

1.3 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor legally qualified to practice in the
   jurisdiction where the project is located, and who is experienced in providing land-surveying
   services of the kind indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.
PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Before beginning work, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to the project performed by public utilities serving the project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the work, examine substrates, areas, and conditions where indicated with the installer present. Verify conformance to the Contract Documents for installation tolerances and other conditions affecting performance. Record observations.

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

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

1. A description of the work.
2. A list of detrimental conditions, including substrates.
3. A list of unacceptable installation tolerances.
4. Recommendations for correction.

D. Proceed with installation only after unsatisfactory conditions are corrected. Proceeding with installation stipulates acceptance of existing conditions. After beginning work, the GC performs all remedial work necessary to correct deficient conditions to bring them into conformance with the Contract Documents.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to the City when necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by the work. Coordinate with the AHJ.

B. Field Measurements: Take field measurements as required to properly fit the work. Verify field measurements before installing each product. Where portions of the work are indicated to fit to other construction, verify dimensions of the other construction by field measurements before
fabrication. Coordinate fabrication schedules with construction progress to avoid delaying the work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Promptly upon discovery of a need for clarification or interpretation of the Contract Documents caused by differing field conditions outside the control of the GC, submit a request for information to the Architect in conformance with Section 01 26 13.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the work, verify layout information shown on the Drawings relative to the property survey and existing benchmarks. If discrepancies are discovered, promptly notify the Architect and the GC in writing.

B. General: Engage a land surveyor to lay out the work using established and accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction; and elsewhere as needed to locate each element of the project.
2. Establish dimensions within tolerances indicated. Do not scale the Drawings to obtain required dimensions.
3. Inform installers of lines and levels to which they must conform.
4. Check the location, level and plumb, of every major element as the work progresses.
5. Notify the Architect and the GC when deviations from required lines and levels exceed allowable tolerances.
6. Close site surveys with an error of closure equal to or less than the standard established by the AHJ.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, names and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by the Architect and the GC.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the work. Preserve and protect permanent benchmarks and control points during construction.
1. Do not change or relocate existing benchmarks or control points without prior written approval of the Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to the Architect before proceeding.

2. Promptly replace lost or destroyed permanent benchmarks and control points. Base replacements on the original survey control points.

B. Benchmarks: Establish and maintain at least 2 permanent benchmarks on the project site, referenced to data established by survey control points. Comply with the AHJ for type and size of benchmark.

1. Record benchmark locations with horizontal and vertical data on the project record documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

C. Certified Survey: Upon completion of the foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of the construction and sitework.

D. Final Property Survey: Engage a qualified land surveyor to prepare a final property survey showing significant features (real property) for the project. Include on the survey a certification, signed by a qualified land surveyor, that principal metes, bounds, lines, and levels of the project are accurately positioned as indicated on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with the AHJ as the official “property survey.”

3.5 INSTALLATION

A. General: Accurately locate the work and components of the work, in correct alignment and elevation, as indicated.

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

B. Comply with manufacturer-prepared published and supplemental instructions and recommendations for installing products.

1. Install products at the time and under conditions that will ensure the best possible results.
2. Maintain conditions required for product performance until Substantial Completion.
C. Conduct construction operations so that no part of the work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

D. Sequence the work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

E. Do not use tools or equipment that will produce harmful noise levels.

F. Obtain and distribute templates for work specified as factory-prepared and field-installed. Check the approved shop drawings of other work to confirm that adequate provisions are made for locating and installing products in conformance with the Contract Documents.

G. Provide blocking, attachment plates, and anchors and fasteners of sufficient size and quantity to securely anchor each component in place to supporting construction, accurately located and aligned with other portions of the work. Where the size and type of attachments are not indicated, verify the size and type required for load conditions.

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

H. Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Use products, cleaners, and installation materials that are not considered hazardous.

3.6 OWNER-INSTALLED PRODUCTS

A. Coordination: Coordinate construction and operations of the work with the work performed by City's construction personnel.

B. Construction Schedule: Inform City of the GC's preferred construction schedule for City's portion of the work.

1. Adjust the construction schedule based on a mutually agreeable timetable.
2. Notify City in writing if changes to schedule are required due to differences in actual construction progress.

C. Preinstallation Conferences: Include City's construction personnel at preinstallation conferences covering portions of the work that are indicated as receiving City's work. Attend preinstallation conferences conducted by City's construction personnel if portions of the work depend on City's construction.
3.7 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with the requirements in Section 01 91 13.

1. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and the retest.
2. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
3. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Manufacturer's Service: Comply with qualification requirements in Section 01 43 00.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

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

B. Comply with manufacturer-prepared published and supplementary instructions for temperature and relative humidity.

END OF SECTION 01 73 00
PART 1 - SECTION 01 73 29 – CUTTING AND PATCHING

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for cutting into existing construction to provide for installation of other components, or for the performance of other construction; and for subsequently patching as required to restore surfaces to their original condition.

2.2 REFERENCES

A. Definitions:

1. Cutting: Means the removal of existing construction as necessary to permit the installation or performance of other work.
2. Patching: Means fitting and repair work required to restore cut or otherwise damaged surfaces to original conditions after the installation of other work.

a. Cutting and patching is performed for coordination of the work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations, and for similar purposes.

b. Cutting and patching performed during the erection or installation is not considered “cutting and patching” under this definition; nor is drilling holes to install fasteners, and similar operations.

2.3 ADMINISTRATIVE REQUIREMENTS

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

1. Structural Elements: When cutting and patching structural elements, notify the Architect of locations and details of cutting and await direction from the Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that might change their load-carrying capacity or increase deflection.

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

a. Primary operational systems and equipment.

b. Fire separation assemblies, including fire resistive construction and any means of egress component.

c. Firestopping assemblies.

d. Air or smoke barriers.
e. Fire-suppression systems.
f. Mechanical systems piping and ducts.
g. Control systems.
h. Communication systems.
i. Fire-detection and -alarm systems.
j. Conveying systems.
k. Electrical wiring systems.
l. Operating systems of special construction.

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

a. Water, moisture, or vapor barriers.
b. Thermal insulation.
c. Roofing and waterproofing membranes and flashings.
d. Exterior curtain-wall construction.
e. Sprayed fire-resistive material.
f. Firestopping assemblies.
g. Expansion joint assemblies.
h. Equipment supports.
i. Piping, ductwork, vessels, and equipment.
j. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching.

a. Do not cut and patch exposed construction in a manner that reduces the building's aesthetic qualities, as determined by City, whose decision is final.
b. Remove and replace construction that is cut or patched in a manner that reduces the building's aesthetic qualities.

B. Cutting and Patching Conference: Before beginning cutting or patching, meet at the project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site the manufacturer-prepared published installation and supplemental instructions for each item or piece of equipment installed.

2.4 SUBMITTALS

A. Cutting and Patching Plan: Submit a plan describing proposed cutting and patching procedures at least 10 business days before the time cutting and patching is performed. Include the following.

1. Extent: Describe the reason for and extent of each cutting and patching occurrence.
2. Changes to In Situ Construction: Describe all anticipated results. Include proposed changes to structural elements and operating components, as well as changes in building appearance and other significant visual elements.

3. Products: Furnish a list of products proposed for patching, and the companies and personnel proposed for performing patching work.

4. Dates: Indicate when cutting and patching is scheduled.

5. Utilities and Mechanical and Electrical Systems: List facility services and systems that cutting and patching procedures might either disturb or affect.
   a. Provide a list of services and systems that must be relocated along with those that might be temporarily out of service.
   b. Indicate proposed lengths of time permanent services and systems might be disrupted.
   c. Describe proposed provisions for temporary services and systems during interruption of permanent services and systems.

B. Do not begin cutting or patching work until after the Architect’s review of the cutting and patching plan is complete; the Architect may have comments that lead to minor changes in the work.

2.5 WARRANTY

A. Remove, replace, patch, and repair materials and surfaces that are cut or damaged during cutting and patching operations, by methods and with materials that do not lead to or result in any specified or other warranty becoming void.

PART 3 - PRODUCTS

3.1 MATERIALS

A. Use materials for patching that are identical to in situ materials.

   1. For projects requiring conformance to sustainable design and construction practices and procedures, use products for patching that conform to the requirements in Section 01 81 13 and Section 01 81 23.
   2. For exposed surfaces, use materials that visually match in situ adjacent surfaces, as determined by City, whose decision is final.

B. If identical materials are unavailable or cannot be used, then furnish materials that, when installed, provide a visual and performance match acceptable to the Architect for the visual and functional performance of in situ materials.

PART 4 - EXECUTION

4.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Promptly proceed with cutting and patching and complete cutting and patching operations without delay.
1. Cut \textit{in situ} construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

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

C. Protection: Protect \textit{in situ} construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the project that might be exposed during cutting and patching operations.

D. Adjacent Occupied Areas: Where interference with the use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00.

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

F. Cutting: Cut \textit{in situ} construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. Where practicable, review proposed procedures with the original installer; comply with original installer's written recommendations.

   1. General: Use hand or small power tools designed for sawing and grinding, in lieu of those designed for hammering and chopping. Neatly cut holes and slots to minimum sizes required, and with minimum disturbance of adjacent surfaces. Temporarily cover cut openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
   5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions indicated as being removed. Cap, valve, or plug and seal remaining portions of pipe or conduit to prevent the intrusion of moisture or other foreign matter after cutting.
   6. Proceed with patching after construction operations requiring cutting are complete.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with unnoticeable and durable seams, as determined by City, whose decision is final. Provide materials and comply with installation requirements specified in other Sections, where applicable.

   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate the physical integrity of installation.
   2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that minimizes evidence of patching and refinishing.
      
   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.
3. Floors and Walls: Where walls or partitions are removed that extend one finished area into another, patch and repair floor and wall surfaces in the new area. Provide an even surface of uniform finish, color, texture, and appearance, as determined by City, whose decision is final. Remove in situ floor and wall coverings and replace with new materials, if necessary, to achieve a uniform color and appearance.

   a. Where patching occurs in a painted surface, prepare substrates and apply primer and intermediate paint coats appropriate for each substrate over the patch; and then and apply at least a final paint coat over the entire unbroken surface containing the patch. Provide additional coats until patching blends with the adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in situ ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure assemblies to a weathertight condition, and that ensures thermal and moisture integrity of the enclosure assembly.

4.2 CLEANING

A. Upon completing installation, clean areas and spaces where cutting and patching are performed.

   1. Clean all surfaces to remove dust and other foreign materials.
   2. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.
   3. Clean piping, conduit and similar features before painting or other finishing is applied.

B. Restore damaged areas to a condition matching match adjacent areas, as determined by City, whose decision is final.

C. Remove and replace materials and components that are damaged, loose, chipped, broken, have been stained, corroded, or that do not match adjacent surfaces or cannot be satisfactorily cleaned or repaired, as determined City, whose decision is final.

END OF SECTION 01 73 29
PART 1 - SECTION 01 74 00 - CLEANING

PART 2 - GENERAL

2.1 SUMMARY
   A. Section Includes: Administrative and procedural requirements for cleaning.

2.2 REFERENCES
   A. Abbreviations and Acronyms:

2.3 ADMINISTRATIVE REQUIREMENTS
   A. The CMR shall maintain the job site, City’s premises, adjacent properties, public areas and all areas of the CMR’s operations free from accumulations of waste, dust, debris, and rubbish generated during the execution of the work, or resulting from the CMR’s operations.

   B. At completion of work, the CMR shall remove all waste materials, rubbish, tools, equipment, machinery, and surplus materials from the project site and other areas of the CMR’s operations, and clean all surfaces for final inspection and acceptance of Substantial Completion by City.

PART 3 - PRODUCTS

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

      1. Use cleaning materials recommended by the manufacturer of product whose surface is cleaned.
      2. Use cleaning materials on surfaces recommended by the cleaning material manufacturer.

PART 4 - EXECUTION

4.1 GENERAL
   A. Legally conduct cleaning and disposal operations.
1. Do not burn or bury anything anywhere on project site, areas of the CMR’s operations, adjacent properties, public areas, or City’s premises.
2. Do not dispose of toxic or volatile waste materials, including mineral spirits, paint thinner, oils, and petroleum-based products in the storm sewer or sanitary drain systems.

B. Legally store and dispose of hazards materials.

1. Store volatile waste materials in clearly and appropriately marked and covered containers fabricated specifically for the purpose of storing such material.
2. Remove waste promptly to prevent accumulation of wastes that create hazardous conditions. Containers must be removed daily from the job site and other areas of the CMR’s operations.
3. Provide adequate ventilation during storage and use of volatile or noxious substances.
   a. The building’s permanent ventilation system may not be used for ventilation of volatile or noxious substances.
   b. Care must be taken to shield volatile or noxious exhaust discharge from mechanical system air intakes.

4.2 PROGRESS CLEANING

A. General: Clean the project site and work areas daily, including common areas. Lawfully dispose of materials.

2. Do not hold waste materials more than 7 calendar days during normal weather or 3 calendar days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
   a. Use containers intended for holding waste materials of type to be stored.
4. Coordinate progress cleaning for joint-use areas where the CMR and other contractors are working concurrently.

B. Site: Maintain the project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces in conformance with the manufacturer-prepared published instructions for the product installed, using only specifically-recommended cleaning materials. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 74 19.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

4.3 FINAL CLEANING

A. General: Perform final cleaning. Lawfully conduct cleaning and waste-removal operations in conformance with local laws and ordinances and federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

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

   a. Clean the project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   d. Remove tools, construction equipment, machinery, and surplus material from the project site.
   e. Remove snow and ice to provide safe access to building.
   f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   h. Sweep concrete floors broom clean in unoccupied spaces.
   i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.

k. Remove labels that are not permanent.

l. Wipe surfaces of mechanical and electrical equipment, elevator equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.


p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.

q. Leave the project clean and ready for occupancy.

C. Final cleanup also includes removal and disposal of soil that is contaminated or unsuitable for support of plant life in planting areas, including filling of resulting excavations with approved soil as directed and approved by the Architect.

1. Contaminated areas include those used for disposal of waste concrete, mortar, plaster, masonry, and similar materials, areas in which washing out of concrete and plaster mixers or washing of tools and similar cleaning operations have been performed, and all areas that are oiled, paved, or chemically treated.

2. Do not dispose of waste oil, solvents, paints, solutions, or similar penetrating materials by depositing or burying on City’s property.

D. After acceptance by City at Substantial Completion, City assumes responsibility for cleaning as of the time designated by City on the Certificate of Substantial Completion.

E. Pest Control: Comply with pest control requirements in Section 01 50 00. Prepare written report.

F. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 74 19.

END OF SECTION 01 74 00
SECTION 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous construction waste.
2. Recycling nonhazardous construction waste.
3. Disposing of nonhazardous construction waste.

B. Related Requirements:
1. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
2. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total non-hazardous solid waste generated by the Work. Facilitate recycling and salvage of materials. Retain subparagraph below with last option in "General" Paragraph above to suit Project. Verify capabilities of local recycling facilities.
1.4 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Qualification Data: For waste management coordinator.

1.6 QUALITY ASSURANCE

A. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.7 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

A. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
3.3 RECYCLING CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
   a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.

4. Store components off the ground and protect from the weather.

5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.


3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.

4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.

2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
3.5  DISPOSAL OF WASTE

   A.  General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

       1.  Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.

       2.  Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

   B.  Burning: Do not burn waste materials.

   C.  Disposal: Remove waste materials from Owner's property and legally dispose of them.

3.6  SAMPLE FORMS

END OF SECTION 01 74 19
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for contract closeout, including

1. Substantial completion procedures;
2. Final completion procedures;
3. Warranties;
4. Final cleaning; and
5. Repair of the work.

B. Related Requirements:

1. Section 01 74 00 for final cleaning requirements.
2. Section 01 78 36 for warranty and bond requirements.

1.2 SUBMITTALS

A. Informational Submittals:

1. GC's List of Incomplete Items: Initial submittal at Substantial Completion.
2. Certified List of Incomplete Items: Final submittal at Final Completion.

B. Closeout Submittals:

1. Certificates of Release: From the AHJ.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.4 SUBSTANTIAL COMPLETION PROCEDURES

A. GC's List of Incomplete Items: Prepare and submit a list of items that must be completed and corrects (GC's punch list), indicating both the value of each item on the list and the reasons the work is incomplete.

B. Submittals before Substantial Completion: Complete the following at least 10 business days before requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Obtain and submit releases from the AHJ permitting City unrestricted use of the work, and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.

3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by the Architect. Label with manufacturer's name and model number where applicable.
   a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain the Architect's signature for receipt of submittals.

5. Submit test/adjust/balance records.

6. Submit sustainable design submittals required in Section 01 81 13 and in individual Sections.

7. Submit changeover information related to City's occupancy, use, operation, and maintenance.

C. Procedures before Substantial Completion: Complete the following at least 10 business days before requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise City of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to City. Advise City's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used before Substantial Completion.
5. Instruct City's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00.
6. Advise City of utilities changeover.
7. Participate with City in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from the project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion at least 10 business days before date the work is completed and ready for final inspection and tests.
1. On receipt of request, the Architect either proceeds with inspection or notifies the GC of unfulfilled requirements.

2. The Architect prepares the Certificate of Substantial Completion after inspection; or will notifies the GC of items, either on the GC's list or additional items identified by the Architect, that must be completed or corrected before a certificate is issued.

3. Re-inspection: Request re-inspection when the work identified in previous inspections as incomplete is completed or corrected.

4. Results of the completed inspection form the basis of requirements for final completion.

1.5 FINAL COMPLETION PROCEDURES

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

1. Submit a final Application for Payment as indicated in the executed Construction Manager at Risk Agreement.

2. Certified List of Incomplete Items: Submit a certified copy of the Architect's Substantial Completion inspection list of items that must be completed or corrected (punch list), endorsed and dated by the Architect. The certified copy of the list must state that each item has been completed or otherwise resolved for acceptance.

3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance at least 10 business days before date the work is completed and ready for final inspection and testing. Upon receipt of request, the Architect either proceeds with inspection or notifies the GC of unfulfilled requirements. The Architect either prepares a final Certificate for Payment after inspection, or notifies the GC of construction that must be completed or corrected before a certificate is issued.

1. Re-inspection: Request re-inspection when the work identified in previous inspections as incomplete is completed or corrected.

1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.

2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

3. Include the following information at the top of each page.

   a. The project name.

   b. Date.

   c. Name of the Architect.
4. Submit a list of incomplete items in the following format.
   c. 3 paper copies. The Architect returns 2 copies.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CORRECTION AND REPAIR

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

C. Where damaged or worn items cannot be repaired or restored, provide replacements.

D. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

   1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
   2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.

      a. Do not paint over “UL” and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

   3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
   4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 77 00
PART 1 - SECTION 01 78 23 – OPERATION AND MAINTENANCE DATA

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for preparing operation and maintenance manuals, including

1. An operation and maintenance documentation directory;
2. Emergency manuals;
3. Operation manuals for systems, subsystems, and equipment;
4. Product maintenance manuals; and
5. Systems and equipment maintenance manuals.

2.2 ADMINISTRATIVE REQUIREMENTS

A. Manual Content: Operation and maintenance manual content is specified in individual specification Sections and reviewed at the time of each Section’s submittals.

1. Submit reviewed manual content formatted and organized as required by this Section.
2. The Architect will provide comments on whether the content of operations and maintenance submittals are acceptable.
3. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

2.3 SUBMITTALS

A. Format: Submit operations and maintenance manuals in the following format.

   a. Name each indexed document file in the composite electronic index with the applicable item name. Include a complete electronically-linked operation and maintenance directory.
   b. Enable inserted reviewer comments on draft submittals.

2. 3 paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. The Architect returns 2 copies.

B. Initial Manual Submittal: Submit a draft copy of each manual at least 30 calendar days before beginning demonstration and training. The Architect will comments on whether the general scope and content of manual are acceptable.
C. Final Manual Submittal: Submit each manual in final form before requesting an inspection for Substantial Completion, and at least 15 business days before beginning demonstration and training. The Architect will return one copy with comments.

1. Correct or revise each manual to address the Architect's comments. Submit copies of each corrected manual within 15 business days of receipt of the Architect's comments, and before beginning demonstration and training.

PART 3 - PRODUCTS

3.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location in a manner that facilitates ready-access to desired information. Include a section in the directory for each of the following.

1. A list of documents.
2. A list of system and subsystems.
3. A list of equipment.
4. A table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in a separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory, and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with the same designation used in the Contract Documents. If no designation exists, assign a designation in conformance with ASHRAE Guideline 4, “Preparation of Operating and Maintenance Documentation for Building Systems.”

3.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem; and a separate section for each piece of equipment not part of a system. Each manual must contain the following materials, in the order listed.

1. A title page.
2. A table of contents.
3. The manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of the project.
3. Name and address of City.
4. Date of submittal.
5. Name and contact information for the GC.
6. Name and contact information for GC.
7. Name and contact information for the Architect.
8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
9. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to the specification Section number in the Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include a comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize the manual contents into manageable-sized sets. Arrange contents alphabetically by system, subsystem, and equipment. Where possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.


1. Electronic Files: Where available, use electronic files prepared by the manufacturer. Where scanning paper documents is required, configure scanned files for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names.
   a. Name document files to correspond to the system, subsystem, and equipment names used in manual directory and table of contents.
   b. Group documents for each system and subsystem into individual composite bookmarked files, then create a composite manual. Resulting bookmarks must reflect the system, subsystem, and equipment names in a readily navigated file tree.
   c. Configure the electronic manual to display the bookmark panel when the file is opened.

F. Paper Copy Manuals: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Furnish heavy-duty, three-ring, vinyl-covered, post-type binders, in thicknesses necessary to accommodate contents; and sized to hold 8-1/2-by-11-inch paper; with a clear plastic sleeve on the spine to hold a label describing the contents; and with pockets inside the covers to hold folded oversize sheets.
   a. If 2 or more binders are necessary to accommodate system data, organize that data in each binder into groupings by subsystem and related components. Cross-reference other binders as necessary to provide essential information for proper operation or maintenance of equipment or system.
   b. Identify each binder on the front and spine with a printed title reading, “OPERATION AND MAINTENANCE MANUAL”. Include the project title or name, and subject matter of contents and indicate specification Section number on bottom of spine. Indicate the volume number for multiple-volume sets.
2. Dividers: Furnish heavy-paper dividers with plastic-covered tabs for each section of the manual. Identify contents on each tab. Include a typed list on each divider of the products and major components of equipment included in the section, cross-referenced to specification Section number and title of the Project Manual.

3. Protective Plastic Sleeves: Furnish transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.

4. Supplementary Text: Include supplementary text prepared on 8-1/2-by-11-inch white bond paper.

5. Drawings: Attach reinforced, punched binder tabs on the drawings and bind with text.
   
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to create foldouts, fold and place drawings in labeled envelopes and the bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of drawing contents, and drawing locations.

3.3 EMERGENCY MANUALS

A. Content: Organize emergency manual into a separate section for each of the following.

   1. The type of emergency.
   2. Emergency instructions.
   3. Emergency procedures.

B. Type of Emergency: Include emergency instructions and procedures for each system, subsystem, piece of equipment, and component where applicable for each of the following types of emergency.

   1. Fire.
   2. Flood.
   5. Power failure.
   7. System, subsystem, or equipment failure.
   8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of City's operating personnel for notification of the installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable.

   1. Instructions on stopping.
   2. Shutdown instructions for each type of emergency.
   3. Operating instructions for conditions outside normal operating limits.
   4. Required sequences for electric or electronic systems.
   5. Special operating instructions and procedures.
3.4 OPERATION MANUALS

A. Content: In addition to the requirements of this Section, include operation data required in individual specification Sections and the following.

2. Performance and design criteria if the GC has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable.

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.
3.5 PRODUCT MAINTENANCE MANUALS

A. Content: Organize product maintenance manuals into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in the product maintenance manual, identified by manufacturer’s product name and arranged to match the maintenance manual’s table of contents. For each product, list the name, address, and telephone number of installer or supplier and maintenance service agent; and cross-reference the specification Section number and title in the project manual, and the drawing or schedule designation or identifier, where applicable.

C. Product Information: Include the following, as applicable.

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following.

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that negatively affect validity of warranties or bonds.

1. Include procedures to follow, and required notifications for warranty claims.

3.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in the systems and equipment manual, identified by manufacturer’s product name, and arranged to match the system and equipment manual's table of contents. For each product, list the name, address, and telephone number of installer or supplier and maintenance service agent; and cross-reference the specification Section number and title in the project manual, and the drawing or schedule designation or identifier, where applicable.
C. Manufacturers' Maintenance Documentation: Furnish the manufacturers' maintenance documentation for each component part or piece of equipment, including the following.

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures.

1. Testing and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recordings, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotments.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include the manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to the manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with the name and telephone number of service agents.

H. Warranties and Bonds: Include copies of warranties and bonds, and lists of circumstances and conditions that negatively affect the validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 4 - EXECUTION

4.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency manuals, operation manuals, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by City's operating personnel for types of emergencies indicated.
C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

   1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
   2. Prepare a separate manual for each system and subsystem as an instructional manual for use by City's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only these sheets pertinent to the product or component installed. Mark each sheet to identify each product or component incorporated into the work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the work, and delete references to information not applicable.

   1. Prepare supplementary text if the manufacturers' standard printed data are not available, and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing the manufacturers' printed data to illustrate the relationship of component parts of equipment and systems, and to illustrate control sequences and flow diagrams. Coordinate these drawings with the information contained in the record drawings to ensure the correct illustration of completed installations.

   1. Do not use original project record documents as part of the operation and maintenance manuals.
   2. Comply with requirements of newly-prepared record drawings in Section 01 78 39.

G. Comply with the requirements of Section 01 77 00 for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23
PART 1 - SECTION 01 78 36 – WARRANTIES AND BONDS

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for specified warranties, bonds, and service and maintenance contracts.

2.2 ADMINISTRATIVE REQUIREMENTS

A. Organize warranty and bond documents into an orderly sequence based on the project manual table of contents.

1. Bind warranties and bonds into a heavy-duty, commercial-quality 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, sized to receive 8-1/2-by-11-inch paper with a clear plastic sleeve on the spine to hold labels describing the contents; and with pockets inside covers to hold folded oversize sheets.

2. Provide a title page enclosed in a transparent plastic sleeve. Include the following information.
   a. Name and address of the project.
   b. Name and address of City.
   c. Date of submittal.
   d. Name, address, and telephone number of the CMR.
   e. Name and address of the Architect.

3. Provide a typed table of contents, cross-referenced to the specifications Section number in the project manual, with the following complete information for each warranty item.
   a. The product name or assembly description.
   b. The installer name, address, and telephone number.
   c. The scope of each warranty.
   d. The beginning date of each warranty, bond or service and maintenance contract.
   e. The duration of the warranty period, bond, or service and maintenance contract.
   f. Information for the proper procedure followed in the case of failure; and for instances that may affect the validity of warranty or bond.
   g. Name, address, and telephone number of the CMR’s responsible party.

4. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark each tab to identify product or installation.

5. Identify each binder on the front and spine with the typed or printed title “WARRANTIES AND BONDS”, the project name, and name of the CMR. Indicate each volume number and the total number of volumes for multiple-volume sets.
2.3 SUBMITTALS

A. Submit 2 original written and signed warranties for the designated portions of the work where commencement of warranties other than date of Substantial Completion is indicated.

1. For equipment, or component parts of equipment put into service during construction, submit documents within 10 business days after final inspection and acceptance.
2. For items whose acceptance is delayed materially beyond the date of Substantial Completion, provide updated submittal within 10 business days after acceptance, listing date of acceptance as start of warranty period.

B. Submit 2 original, written and signed warranties within 15 business days of completion of designated portions of the work that are completed and occupied or used by City during the construction period by separate agreement with the CMR.

PART 3 - PRODUCTS

3.1 DISCLAIMERS AND LIMITATIONS

A. Manufacturer's disclaimers and limitations on product warranties do not relieve the CMR of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers and subcontractors required to countersign special warranties with the CMR.

B. City may refuse to accept work for the project where a special warranty, certification, or similar commitment is required on such work, or part of the work, until evidence is presented that entities required to countersign such commitments are willing to do so.

3.2 OWNER'S RE COURSE

A. Written warranties made to City are in addition to implied warranties, and do not limit the duties, obligations, rights and remedies otherwise available under the law; nor may warranty periods be interpreted as limitations on obligations, rights, or remedies.

B. City may reject warranties and may limit product selections to products with warranties conforming to the requirements of the Contract Documents.

PART 4 - EXECUTION

4.1 REPLACEMENT OF WORK

A. Upon determination that work covered by a warranty has failed, replace or rebuild the affected work to an acceptable condition conforming to the original Contract Documents.

B. The CMR is responsible for the cost of replacing or rebuilding defective work regardless of whether City has benefited from use of that work through a portion of its anticipated useful service life.
C. When correcting warranted work that has failed, remove and replace other work that is damaged as a result of such failure, or that must be removed and replaced to provide access for correction of warranted work.

D. When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty must be equal to the original warranty, with an equitable adjustment for depreciation.

4.2 WARRANTY FORM

A. Submit warranties on the form attached to the end of this Section. This requirement applies to the CMR and all subcontractors.

END OF SECTION 01 78 36
PART 1 - SECTION 01 78 39 – PROJECT RECORD DOCUMENTS

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for project record documents, including

1. Record drawings;
2. Record specifications;
3. Record product data; and
4. Miscellaneous record submittals.

2.2 SUBMITTALS

A. Record Drawings: Comply with the following.

1. Number of Copies: Submit two sets of marked-up record prints.
   a. Initial Submittal:
      1) Submit PDF electronic files of scanned record prints and one set of prints.
      2) The Architect indicates whether the general scope of changes, additional information recorded, and quality of drafting are acceptable.
   b. Final Submittal:
      1) Submit PDF electronic files of scanned record prints and 3 sets of prints.
      2) Print each drawing, whether or not changes and additional information were recorded.
   c. Final Submittal:
      1) Submit record digital data files and 3 sets of record digital data file plots.
      2) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of the project's specifications, including addenda and contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up product data as a component of manual.

D. Miscellaneous Record Submittals: See other specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
E. Reports: Submit written weekly reports indicating the items incorporated into project record documents concurrent with progress of the work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

PART 3 - PRODUCTS

3.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as RFIs and modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from what is originally shown. Require the individual or entity who obtained record data, whether the individual or entity is an installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
   a. Give particular attention to information on concealed elements that are difficult to identify or measure and record later.
   b. Accurately record information in an acceptable drawing technique.
   c. Record data as soon as practicable after obtaining it.
   d. Record and check markups before enclosing concealed installations.
   e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include the following.
   a. Dimensional changes to the Drawings.
   b. Revisions to details shown on the Drawings.
   c. Depths of foundations below first floor.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Modifications made as part of responses to RFIs.
   k. Changes made by Change Order or Construction Change Directive.
   l. Changes made following the Architect's written orders.
   m. Details not on the original Contract Drawings.
   n. Field records for variable and concealed conditions.
   o. Record information on the work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information for producing marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the work at same location.
5. Mark important additional information that was either shown schematically or omitted from the original Drawings.
6. Note RFI numbers, Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
B. Record Digital Data Files: Promptly before inspection for the Certificate of Substantial Completion, review marked-up record prints with the Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows.

1. Format: Furnish record information in the same digital data software program, version, and operating system as the original Contract Drawings.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to the Architect for resolution.

C. Newly Prepared Record Drawings: When the Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation, prepare new Drawings instead of preparing record Drawings.

1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
2. Consult the Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction.
   a. Integrate newly prepared record Drawings into record Drawing sets.
   b. Comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: Include the following.
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of the Architect and the GC.

3.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data is submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders, record Product Data and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file.

3.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Include significant changes in the product delivered to the project site and changes in manufacturer's written instructions for installation.
   3. Note related Change Orders, record Specifications and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file.

   1. Include record Product Data directory organized by specification Section number and title, electronically linked to each item of record Product Data.

3.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

   1. Include miscellaneous record submittals directory organized by specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 4 - EXECUTION

4.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of the project.

B. Maintenance of Record Documents and Samples: Store record documents and samples in the field office apart from the Contract Documents used for construction.

   1. Do not use project record documents for construction purposes.
   2. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss.
3. Provide access to project record documents for the Architect's and the GC's reference during normal working hours.

END OF SECTION 01 78 39
PART 1 - SECTION 01 79 00 – DEMONSTRATION AND TRAINING

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for instructing City's personnel, including

1. demonstration of operation of systems, subsystems, and equipment;
2. training in operation and maintenance of systems, subsystems, and equipment; and
3. demonstration and training video recordings.

2.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the instruction schedule with City's operations. Adjust schedule as necessary to minimize disrupting City's operations and to ensure availability of City's personnel.
2. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
3. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by the Architect.

B. Preinstruction Conference: Conduct conference at the project site in conformance with requirements in Section 01 31 00. Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize the instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

2.3 SUBMITTALS

A. Informational Submittals:

1. Instruction Program: Submit an outline of the instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time; and the instructors' names for each training module. Include learning objectives and outlines for each training module.
a. Indicate proposed training modules using manufacturer-produced demonstration and
   training video recordings for systems, equipment, and products in lieu of video
   recordings of live instructional modules.

2. Attendance Record: For each training module, submit a list of participants and the length
   of instruction time.
3. Evaluations: For each participant and for each training module, submit results and
   documentation of required performance-based tests.

B. Closeout Submittals:

1. Demonstration and Training Video Recordings: Submit 2 copies within 7 calendar days of
   end of each training module.
   a. Identification: On each copy, provide an applied label with the following information.
      1) The name of the project.
      2) The name and address of the videographer.
      3) The name of the Architect.
      4) The name of the GC.
      5) The date of the video recording.

2. Transcript: Provide prepared and bound transcripts in a format matching operation and
   maintenance manuals.
   a. Mark appropriate identification on the front and spine of each binder.
   b. Include a cover sheet with the same label information as the corresponding video
      recording.
   c. On each page, include the name of the project and the date of the video recording.

3. Transcript: Prepared transcripts in PDF electronic format. Include a cover sheet with the
   same label information as the corresponding video recording and a table of contents with
   links to corresponding training components. Include the names of the project and the dates
   of video recording on each page.
4. At completion of training, submit complete training manuals for City's use prepared and
   bound in the format matching operation and maintenance manuals.

2.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating
   maintenance personnel in a training program similar in content and extent to that indicated for
   this project, and whose work has resulted in training or education with a record of successful
   learning performance.

B. Instructor Qualifications: A factory-authorized service representative experienced in operation
   and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing
   demonstration and training events similar to those required.
PART 3 - PRODUCTS

3.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that each participant is expected to master. For each module, include instruction for the following, as applicable to the system, equipment, or component.

1. Basis of System Design, Operational Requirements, and Criteria: Include the following.
   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if the GC is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail.
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project record documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable.
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable.
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following.
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following.
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following.
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following.
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 4 - EXECUTION

4.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23.

B. Set up instructional equipment at the instruction location.
4.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to
   1. prepare instruction program and training modules;
   2. coordinate instructors; and
   3. coordinate between the GC and City for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct City's personnel to adjust, operate, and maintain systems, subsystems, and equipment that is not part of a system.
   1. The Architect furnishes an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
   2. City furnishes an instructor to describe City's operational philosophy.
   3. City furnishes the GC with the names and positions of all participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with City, through the Architect, with at least 7 calendar days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At the conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and remove from the project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

4.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
   1. At the beginning of each training module, record each chart containing the learning objective and lesson outline.

B. Video: Provide at least 640 x 480 video resolution converted to .mp4 format file type, on electronic media.
   1. Electronic Media: Read-only format compact disc, or equivalent acceptable to City, with commercial-grade graphic label.
   2. File Hierarchy: Organize folder structure and file locations according to the project manual table of contents. Provide a complete screen-based menu.
3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in the project specifications.

4. GC and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training DVD that describes the following for each the GC involved on the project, arranged according to the project table of contents:
   a. The name of the GC and Installer.
   b. Business address.
   c. Business phone number.
   d. Point of contact.
   e. E-mail address.

C. Recording: Mount the camera on a tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

   1. Film training sessions in segments not more than 15 minutes.
      a. Produce segments to present a single significant piece of equipment per segment.
      b. Organize segments with multiple pieces of equipment to follow order of the Project Manual table of contents.
      c. Where training sessions on a particular piece of equipment exceed 15 minutes, stop filming and pause the training session. Begin training session again upon commencement of new filming segment.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible before recording.

   1. Furnish additional portable lighting as required.

E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

G. Pre-produced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 01 79 00
SECTION 031000 – CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 SUMMARY
   A. Section includes formwork, shoring, reshoring, backshoring, falsework, bracing, and other temporary supports required to form and support all cast-in-place concrete shown on the drawings.
   B. Related Requirements:
      1. Specification 014000 “Quality Requirements” for requirements of material testing and inspection.
      2. Specification 014529 “Structural Testing and Inspections” for inspection requirements associated with forming and accessories.

1.3 REFERENCES
   A. Definitions:
      1. Formwork: The total system of support for freshly placed concrete, including the mold or sheathing that contacts the concrete and all supporting members, hardware, and necessary bracing.
   B. Reference Standards:
      1. Comply with the provision of the following codes, specifications, and standards except where more stringent requirements are shown or specified:
         a. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
         b. ACI 301, "Specifications for Structural Concrete for Buildings."
         c. ACI 318, "Building Code Requirements for Structural Concrete."
         d. ACI 347, “Guide to Formwork for Concrete.”
1.4 RESPONSIBILITY

A. The design, construction, and safety of all formwork shall be the responsibility of the Contractor. All forms, shores, reshores, backshores, falsework, bracing, and other temporary supports shall be engineered to support all loads imposed including the wet weight of concrete, construction equipment, live loads, lateral loads due to wind and wet concrete imbalance. The Contractor shall also be responsible for determining when temporary supports, shores, reshores, backshores, and other bracing may be safely removed.

1.5 SUBMITTALS

A. Product Data: Submit technical data and brochures for carton forms.

   1. Formwork Drawings: Formwork drawings, prepared under the supervision and sealed by the formwork design engineer, shall be submitted for Owner’s record and shall be reviewed by the Engineer for conformance to structural layout only. Such shop drawings shall indicate all dimensions and types of materials, sizes, lengths, connection details, design allowance for construction loads, anchors, form ties, shores, braces, construction joints, reveals, camber, openings, formwork coatings, and all other pertinent information.

B. Temporary Structure Design Submittals: Submit the following items for the Owner’s records:

   1. Design Calculations: Submit, for record purposes, calculations of all concrete formwork sealed by the formwork design engineer.

1.6 QUALITY ASSURANCE

A. Qualifications:

   1. Licensed Professionals: The formwork design engineer retained by the Contractor shall be a professional engineer registered in the state where the project is located and shall be experienced in the design of concrete formwork.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Unless otherwise specified, formwork for exposed concrete surfaces as defined by the Surface Finish Class noted on the drawings, shall consist of plywood, metal, metal framed plywood, or other acceptable surface. Formwork shall provide a continuous straight and smooth surface conforming to the joint system as specified on the Architect's drawings. Form material shall have sufficient thickness to withstand pressure of concrete without bow or deflection. Plywood shall be exterior grade plywood panels, suitable for concrete forms, complying with U.S. Product Standard PS-1, each piece bearing a legible inspection trademark, and as follows:

B. Non-specific formed concrete: Unless otherwise specified, the default finish for formed surfaces shall be rough-form finish constructed with plywood, lumber, metal, or other acceptable material.
Lumber shall be dressed on at least two edges and one side for tight fit. The minimum grade shall be B-C, exterior grade.

2.2 CARTON FORMS

A. Carton forms shall be manufactured using corrugated paper material with a moisture resistant exterior surface and specifically designed for foundation support. Carton forms shall be designed to support the wet weight of the concrete that is shown by the details to be poured on top of the form, but the weight assumed shall not be less than 600 pounds per square foot. Refer to the General Notes for the restriction on horizontal construction joints. The forms shall be designed in such a way that the bottom of the form will collapse when acted upon by upward movement of the soil.

1. Form Configuration: Carton forms shall be of a vertical cellular configuration only, except as permitted by Paragraph 2 below and shall be rectangular as shown on the details. The depth of the carton forms is shown on the details. Forms shall be manufactured to fit snugly against round piers and shall be baffled in such a way as to prevent concrete from flowing back into the form during the concrete pour.

2. Other types of forms using different types of paper and different configurations will be accepted if it can be shown by independent tests that the form will properly function and will deteriorate due to moisture in an appropriate period.

3. Products: Subject to requirements, acceptable manufacturers include, but are not limited to, the following:
   a. SureVoid Products, Inc.

2.3 PRECAST CONCRETE RETAINERS

A. Retainers shall be used with voids or carton forms where shown on the drawings.

B. Retainers shall have a minimum compressive strength of 2,500 PSI and be reinforced with 6x6xW1.4xW1.4 welded wire reinforcement and minimum thickness of 1 5/8”.

2.4 FORMWORK COATINGS

A. Formwork coatings shall be of a commercial formulation that will not bond with, stain, nor adversely affect concrete surfaces or impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede curing with water or curing compounds. Provide a product that has a maximum VOC (Volatile Organic Compounds) of 50 g/l but not greater than that permitted by the local government agency having jurisdiction in the area where the project is located.

B. Products: Subject to compliance with requirements, provide one of the following:

   1. Dayton Superior; Bio-Release EF.
   2. Unitex; Farm Fresh.
   3. Universal Form Clamp; Bio-Form.
   4. US Spec; Aqua Blue.
2.5 NAILS AND FASTENERS

A. Use only galvanized nails and fasteners for securing formwork in structures exposed to weather or unconditioned spaces such as garages, canopies, and porte-cochères.

2.6 FORM TIES

A. Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to minimize spalling of concrete on removal.

1. Exposed Surfaces: For surfaces designated with Surface Finish Class SF-2.x or SF-3.x, furnish units that will leave no portion of the tie closer than 3/4 inch to the plane of the concrete surface and that will leave holes not larger than one inch in diameter in concrete surface when the ends or end-fasteners have been removed.

2. Dampproofed Surfaces: Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

3. Exposed to Weather or Unconditioned Space: Provide removable, glass-fiber-reinforced plastic, stainless steel, or galvanized form ties that will leave no corrosible metal closer than 1 1/2 inches in surfaces that will be exposed to weather or in an unconditioned space in the final structure. The ties shall leave holes no larger than one inch in diameter in concrete surfaces when the ends or end-fasteners are removed.

2.7 CHAMFER STRIPS

A. Provide wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

PART 3 - EXECUTION

3.1 FABRICATION AND CONSTRUCTION

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

1. The formwork design engineer shall design the concrete formwork, formwork removal, shoring, reshoring, and backshoring.

B. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of concrete mortar.

C. Carton Forms:
1. Carton forms shall be kept dry and protected until concrete is poured. Wet, compressed, or deteriorated carton forms shall not be used. Do not wrap or cover carton forms with polyethylene sheets or permanent waterproof cover as that will prevent proper deterioration of the forms.

2. The Contractor shall use expandable foam to fill all gaps and holes between carton forms and at intersections with foundations.

3. For slab conditions, cover carton forms with a 1/4 inch masonite protection cover board to prevent puncture and other damage during construction.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

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

F. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and patch forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

G. Chamfer exposed corners and edges as indicated, using specified chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

H. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

3.2 CLEANING AND TIGHTENING

A. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and all other debris just prior to concrete placement. Retighten forms and bracing prior to concrete placement as required to prevent concrete mortar leaks and maintain proper alignment.

3.3 CLEANING AND RE-USE OF FORMS

A. Forms reused in the work shall be repaired and cleaned. Split, frayed, delaminated, or otherwise damaged facing material will not be acceptable for exposed surfaces. Forms intended for successive concrete placement shall have surfaces cleaned, fins and laitance removed, and joints tightened to avoid surface offsets. New form coating compound shall be applied to reused forms. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.
3.4 TOLERANCES

A. Unless specified otherwise, all tolerances for concrete formwork shall conform to ACI Standard 117, "Standard Tolerances for Concrete Construction and Materials". Before concrete placement the Contractor shall check lines and levels of erected formwork and make any corrections and adjustments as required to ensure proper size and location of concrete members and stability of forming systems. During concrete placement the Contractor shall check formwork and supports to ensure that forms have not displaced and that completed work will be within specified tolerances.

B. Construct forms so as to limit the offset between adjacent pieces of formwork facing material in accordance with the surface tolerance class as defined in ACI 117 corresponding to the Surface Finish Class noted on the drawings. The offset limits shall apply to both abrupt and gradual variations in the surface.

C. Prior to each concrete pour, the Contractor shall engage a qualified surveyor to verify that work is within specified tolerances. The surveyor shall report in writing to the Architect, Engineer and Contractor certifying that the work is acceptable or indicating any deviations from allowable tolerances.

3.5 REMOVAL OF FORMS AND SUPPORTS

A. Determination by Contractor's Registered Engineer: The Contractor's registered professional engineer shall determine and submit for Owner's record the time and sequence of formwork and shore removal subject to the criteria as specified below. The submittal shall clearly distinguish between reshoring and backshoring procedures.

B. Determining in situ Strength of Concrete: The General Contractor shall be responsible for making and curing concrete cylinders, cured under field conditions, for the purpose of determining concrete strength at time of form and shore removal. Such cylinders shall be made by the Contractor and tested by his testing laboratory. Alternatively, the in situ strength of concrete may be determined by the Maturity Method following the requirements of ASTM C 1074. An acceptable system for this method is the “intelliRock” system manufactured and supplied by Engius Constructive Intelligence of Stillwater, OK.

C. Records of Weather Conditions: The Contractor shall be responsible for keeping records of weather conditions to be used in the decision on when to remove forms.

D. Formwork Not Supporting Concrete: Formwork not supporting concrete, such as sides of beams, walls, columns and similar parts of the structure, may be removed after cumulatively (not necessarily consecutively) curing at not less than 50°F for 12 hours after placing concrete, provided the concrete is sufficiently hard so as not to be damaged by form removal operations and provided curing and protection operations are maintained. If ambient air temperatures remain below 50°F, if retarding agents are used, or if Type II and Type V Portland cement is used, then this specified minimum period shall be increased as required to safely remove the forms without damage to the concrete. Where such forms also support formwork for slab or beam soffits, the removal times of the latter shall govern.
3.6 FIELD QUALITY CONTROL

A. Field Inspection: Refer to Specification 014529 “Structural Testing and Inspections” for inspection requirements associated with forming and accessories.

END OF SECTION 031000
SECTION 032000 – CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 SUMMARY

A. Section includes labor, materials, hardware, equipment, transportation and services required to fabricate and place all reinforcement for cast-in-place concrete including bars, welded wire reinforcement, ties and supports shown on the drawings and as specified.

B. Related Requirements:

1. Specification 014000 “Quality Requirements” for requirements of material testing and inspection.

2. Specification 014529 “Structural Testing and Inspections” for testing and inspection requirements associated with concrete reinforcing.


1.3 PRICE AND PAYMENT PROCEDURES

A. Alternates:

1. Products Requiring International Code Council (ICC) Evaluation Service Reports:

   a. For those products listed in Part 2 as requiring Evaluation Service Reports (ESRs), alternate products that do not have ESRs will be considered by the Engineer only if valid research reports or test data from an independent and approved agency is provided and use of the product receives prior approval from the Building Official.

1.4 REFERENCES

A. Reference Standards:

1. Comply with all provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified:

b. ACI 301, "Specifications for Structural Concrete for Buildings."


d. CRSI, "Manual of Standard Practice."

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Quality Control: The Contractor is responsible for quality control, including workmanship and materials furnished by subcontractors and suppliers.

2. Document Conflict and Precedence: In case of conflict among documents, including architectural and structural drawings and specifications, notify the Architect/Engineer prior to submitting proposal. In case of conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing by the Architect/Engineer.

B. Preinstallation Meetings: The Reinforcing-Placing subcontractor shall attend the Pre-Concrete Conference conducted by the Concrete Contractor as described in Specification 033000 “Cast-in-Place Concrete.”

1.6 SUBMITTALS

A. Product Data: Submit manufacturer’s product data with application and installation instructions for proprietary materials and items including mechanical splices, hooked anchorage systems, and dowel bar sleeves. For fiber reinforcement, submit manufacturer’s product data, including application rate and mixing instructions.

B. Shop Drawings:

1. Submit shop drawings for all reinforcing steel and related accessories for the Engineer's approval. Shop drawings shall show arrangement and layout, bending and assembly diagrams, bar schedules, stirrup spacing, splicing and laps of bars and shall be prepared in accordance with CRSI Standards.

C. Certificates:

1. Submit, for record, mill certificates and/or test results signed by Producer, for all reinforcement.

2. Provide certification from fiber reinforcement manufacturer that fiber reinforcement complies with specified requirements.

D. Test and Evaluation Reports:


2. Submit test results for deformed bar material not identifiable as outlined in Part 2 below.
E. Special Procedure Submittals: Submit shop welding program for fusion welding including the type of the specific fusion welding machine and the quality control/inspection protocol for the shop welding.

F. Qualification Statements: Submit welding certificates.

1.7 QUALITY ASSURANCE

A. Testing Laboratory Requirements: The Owner’s Testing Laboratory shall:

1. Review the Welding Procedure Specification (WPS) submitted by the Contractor for any reinforcing steel other than ASTM A 706 that is proposed to be welded for consistency with acceptable welding practices and AWS.

2. Review the welder qualifications by certification or verify by retesting and shall obtain the welder certificates.

B. Welder Qualifications: Qualify procedures and personnel according to ANSI/AWS D1.4.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Reinforcement:

1. Reinforcing materials shall be delivered from the mill in bundles that are identified as to heat number and manufacturer and accompanied with mill and analysis test reports and an affidavit from the supplier stating that the material conforms to the requirements of the governing ASTM specification listed herein.

2. Use reinforcing steel made from 90% recycled material, two-thirds of which shall be post-consumer material. A minimum of 50% of the material in the reinforcement must have been extracted, harvested, or recovered as well as manufactured, within 500 miles of the project site.

3. Deformed bar material that is not identifiable according to the criteria listed above shall be tested for tensile strength and bend tests according to ASTM A 615 on a sample of two bars for each ten tons or fraction thereof of unidentified material for each bar size. The bars shall be a minimum of 24 inches long. Bend tests are not required for #14 and #18 bars. Submit the results of such tests for record.

4. Reinforcing Bars: Reinforcing bars shall conform to ASTM A 615, Grade 60 as noted on the drawings.

5. Weldable Reinforcing Bars: All reinforcing bars noted on the drawings as being required to be welded shall conform to ASTM A 706, Grade 60.

6. Deformed Bar Anchors: 3/8” to 5/8” diameter AWS Type C studs manufactured in conformance with ASTM A 1064 with a minimum yield strength of 70,000 psi and a tensile strength of 80,000 PSI. 3/4” or larger diameter, ASTM A 706 bars of equal size with welds to steel substrate that develop the full strength of the anchor. ASTM A 615 reinforcing bars may not be substituted for deformed bar anchors. Reinforcement shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted.
for Engineer review. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of intended use on the project:

b. Tru-Weld Division, TFP Corporation; Deformed Bar Anchors (ESR-2823).

7. Plain Steel Welded Wire Reinforcement: ASTM A 1064 with a yield strength of 65,000 PSI. Provide in flat sheets only.
8. Wire: Smooth wire for spiral reinforcement shall conform to ASTM A 82 with a minimum yield strength of 70,000 PSI.

B. Fiber Reinforcement:

1. Synthetic Micro Fiber Reinforcement: Collated, fibrillated, or monofilament polypropylene, cellulose, or multi-filament nylon fibers conforming to ASTM C 1116, Type III or Type IV. Reinforcement shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted for Engineer review. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of intended use on the project:

a. The Euclid Chemical Company; Fiberstrand Series.
b. Forta Corporation; Econo-Mono or Econo-Net (ESR-2720).
c. Propex Concrete Systems Corp.; Fibermesh 300 (ESR-1165).
d. W.R. Grace & Company; Grace Microfibers (ESR-1506).
e. Nycon, Inc.; Nycon RC.
f. Buckeye Technologies; UltraFiber 500 (ESR-1032).
g. BASF Construction Chemicals; MasterFiber M or F series.
h. Maccaferri; Fibromac.

2. Synthetic Macro Fiber Reinforcement: Monofilament polypropylene/polyethylene fibers conforming to ASTM C 1116, Type III having an aspect ratio between 50 and 90 and a minimum tensile strength of 90 KSI. The fiber lengths shall be between 1.5 and 2 inches long. Reinforcement shall be approved by the ICC-Évaluation Service, Inc. and shall have the Evaluation Service Report submitted for Engineer review. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of intended use on the project:

a. The Euclid Chemical Company; Tuf-Strand SF.
b. Forta Corp.; Forta-Ferro.
c. W.R. Grace; Strux 90/40.
d. Propex Concrete Systems, Corp.; Fibermesh 650.
e. Bekaert Corp.; Synmix.
f. BASF Construction Chemicals; MasterFiber MAC.

3. Steel Fibers: Provide deformed cold-drawn wire or modified cold-drawn steel fibers meeting the requirements of ASTM A 820, Types I or V, and that are listed as an acceptable product for use in the D900 series of UL Fire Rating Assemblies. The fibers shall have a minimum tensile strength of 145,000 PSI when tested in accordance with ASTM A 370. The fibers shall have a minimum aspect ratio of 50 and maximum aspect ratio of 100. Acceptable products include:
2.2 SPICES

A. Mechanical Tension Splices:

1. Mechanical splices shall conform to Type 1 splices.
   a. Type 1 splice shall develop, in tension and compression, 1.25 times the specified yield strength of the splice bar.
   b. Type 2 splice shall meet the requirements of Type 1 splice and, in addition, develop the full tensile strength of the splice bar.

2. Splices shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted for Engineer review.
3. The bar ends that are to attach to the splice shall be prepared and installed in accordance with the manufacturer’s requirements.
4. The following are acceptable mechanical tension splices (splices qualified for use with grade 75 bars are parenthetically noted), provided that their Evaluation Service Reports are still valid at the time of intended use on the project:

   a. BarSplice Products, Inc.; BPI-Grip XL System (ESR-2299). (Type 1 or Type 2)
   b. BarSplice Products, Inc.; Taper Threaded Grip-Twist System (ESR-2299). (Type 1 or Type 2)
   c. BarSplice Products, Inc.; Position Taper Threaded Grip-Twist System (ESR-2299). (Type 1 or Type 2)
   d. Headed Reinforcement Corporation; HRC 500/510 Xtender Mechanical Coupler System (ESR-2764). (Type 1 or Type 2)
   e. Dayton Superior Corporation; DBDI Reinforcing Bar Mechanical Splice System (ESR-2649). (Type 1 or Type 2)
   f. Dayton Superior Corporation; Bar-Lock Coupler Systems for Splicing Reinforcement Bars, S-Series (ESR-2495). (Type 1)
   g. Dayton Superior Corporation; Bar-Lock Coupler Systems for Splicing Reinforcement Bars, L-Series (ESR-2495). (Type 1 or Type 2)
   h. Dayton Superior Corporation; Taperlok Reinforcing Bar Mechanical Splice Couplers (ESR-2481). (Type 1 or Type 2)
   i. Dextra Manufacturing Co., Ltd.; Bartec Mechanical Splice System for Steel Reinforcing Bars in Concrete (ESR-1705). (Type 1 or Type 2)
   j. BarSplice Products, Inc.; ZAP Screwlok (qualified for use with grade 75 bars) (ER-5461). (Type 1 and Type 2)
   k. nVent Electric, plc.; Lenton Coupler (ER-3967). (Type 1 or Type 2) (for grade 75 bars #9 and larger, use only Standard Coupler).
   l. Splice Sleeve North America; NMB Splice-Sleeve (ER-5645). (Type 1 or Type 2).

B. Dowel Bar Replacement: All grade 60 reinforcing steel dowel bars shown on the drawings crossing concrete construction joint surfaces with inserts cast flush against the form and having
reinforcing bars connected to the insert in a subsequent concrete pour shall conform to the following:

1. Splice connection to the insert shall develop the 1.25 times the specified yield strength and the full tensile strength of the spliced bar.
2. Splices shall be approved by the ICC Evaluation Service, Inc. as expressed in an ICC Evaluation Service Report which shall be submitted for review.
3. The following are acceptable products (for use only with grade 60 bars), provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
   b. nVent Electric plc.; Lenton Form Saver (ER-3967).

C. Hooked Anchorage Replacement: Reinforcing bar terminations shall be manufactured out of ASTM A 576, ASTM A 615, or A 706 material and shall develop the full tensile strength of the bar when installed at the manufacturer’s recommended depth.

1. The anchorage shall be approved by the ICC Evaluation Service Inc. as expressed in an ICC Evaluation Service Report which shall be submitted for review.
2. The following are acceptable products (for use only with grade 60 bars), provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
   a. Dextra Manufacturing Co., Ltd; Bartec Mechanical Anchorages for Steel Reinforcing Bars in Concrete (ESR-2166).
   b. Headed Reinforcement Corporation; HRC 555 Headed Reinforcing Bars (ESR-2935).
   c. nVent Electric plc.; Lenton Terminator (ER-3967).

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: Smooth bars used to dowel across slab-on-grade construction joints shall conform to ASTM A 615, Grade 40 or ASTM A 36, plain-steel bars. Cut bars true to length with ends square and free of burrs.

B. Dowel Bar Sleeves: Plastic or gage metal (26 gauge minimum) sleeves with an inside diameter of 1/16 inch greater than the dowel bar that it encases, that have the strength, durability, and design to provide free movement of the dowel relative to the concrete slab and that are specifically manufactured for this purpose.

C. Tie Wire: Tie wire shall be annealed steel tie wire, minimum 16 gauge.
   a. Tie wire in architecturally exposed concrete shall be plastic coated or stainless steel.
   b. Tie wire for epoxy-coated reinforcement shall be epoxy-coated.
   c. Tie wire for galvanized reinforcement shall be galvanized.

D. Holding Wire: Holding wire shall conform to ASTM A 82 or ASTM A 1064.
E. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Use wire bar type supports complying with CRSI recommendations.

1. Slabs-on-Grade: Use precast concrete bar supports (dobies) or supports with sand plates or horizontal runners designed for use on ground.
2. Spread Footing Bottom Reinforcement: Use precast concrete bar supports (dobies) or chairs designed for soil-supported slabs.
3. Mat Foundation: Use precast concrete bar supports (dobies), chairs designed for soil-supported slabs, or cast-in-place concrete curbs.
4. Exposed to View Concrete: Provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).
5. Support of Epoxy-Coated Reinforcement: Provide epoxy-coated or other dielectric-polymer-coated wire bar supports to support epoxy-coated reinforcement.

PART 3 - EXECUTION

3.1 FABRICATION AND DELIVERY

A. Bending and Forming: Fabricate bars of indicated sizes and accurately form to shapes and lengths indicated and required, by methods not injurious to materials. Do not heat reinforcement for bending. Bars shall be free from injurious defects, have a workman-like finish with no excessive rust and/or pitting, and have no unusual kinks or bends.

B. Marking and Shipping: Bundle reinforcement and tag in accordance with Section 7.4.5 of the CRSI “Manual of Standard Practice.” Transport and store at site so as not to damage material. Keep sufficient supply of tested, approved, and proper reinforcement at the site to avoid delays. Maintain reinforcing bars free of mud, dirt, grease, or other coating.

3.2 PLACING REINFORCEMENT

A. Comply with CRSI recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports and as herein specified.

B. Before placing reinforcement and again before concrete is placed, clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by chairs, runners, bolsters, spacers, and hangers as required. Exercise particular care to maintain proper distance and clearance between parallel bars and between bars and forms. Provide spreaders and spacers to hold steel in position. Support steel at proper height upon approved chairs.

D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set tie wires so ends are directed into concrete, not toward exposed concrete surfaces.
E. Support of Wall Reinforcing Steel:

1. It is the responsibility of the contractor to ensure that all reinforcing assemblies have adequate strength and stability to resist loads imposed during construction.

F. Install welded wire reinforcement in as long lengths as practicable. Provide lap splice for wires of adjoining pieces per ACI 318 Chapter 25.5.3 or 25.5.4 and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

G. Coordinate with other trades and expedite materials and labor to avoid omissions and delay.

H. Install waterproof membrane or vapor retarder as specified prior to placing steel for concrete slabs-on-grade.

I. Extend reinforcement continuous through construction joints unless otherwise shown on the drawings.

J. Slab-on-Grade Joint Dowel Bars: Support slab-on-grade joint dowel bars independently of support for slab reinforcement on soil supported slab bolsters or specially manufactured cradles such that dowel bar remains parallel to slab surface and at right angles to joint during concreting operations. Lightly coat the exposed end of the dowel with a paraffin-base lubricant, asphalt emulsion, form oil, or grease or use a dowel bar sleeve.

K. Alternate Slab-on-Grade Joint Load Transfer Systems: Install the alternate load transfer system in accordance with the manufacturer’s instructions such that the largest plane of the flat plate is parallel to the plane of the subgrade on which the slab is bearing.

L. Provide and place additional reinforcing steel at all sleeves and openings in beams, slabs, and walls as specified on the drawings. Where sleeves or openings not shown on the drawings interrupt the reinforcement, consult with Engineer for instructions for placing and splicing of bars. Provide required additional reinforcing steel at no additional cost to the Owner.

M. Do not bend reinforcement that is embedded partially in concrete except in locations noted on the drawings or approved by the Engineer.

3.3 SPLICING REINFORCING STEEL

A. Provide splices as indicated on the drawings. Splice reinforcing bars only at locations shown on the structural drawings and approved shop drawings. Unauthorized or unscheduled splices not approved by the Engineer in writing will not be accepted.

B. All lap splices in reinforcing steel shall be contact lap splices unless detailed otherwise on the drawings.

C. Maintain proper cover and spacing between reinforcing bars at splices.

D. Lap unscheduled reinforcing bars not otherwise specified with a Class B lap splice. Lap welded wire reinforcement per ACI 318 Chapter 25.5.3 or 25.5.4.

E. Reinforcing Steel Placement in Mat Foundations:
1. Size, length, spacing, and location of all mat reinforcing steel is shown on the mat plans and details. See details on the drawings for required stagger pattern of top and bottom bar splices and for sequence of placing mat reinforcing steel layers.

2. The number of splices shall be minimized by using bar runs of 60'-0" as much as possible. Unless noted otherwise, continuous top reinforcing bars shall be spliced along column centerlines. Continuous bottom reinforcing bars shall be spliced mid-way between columns.

3. Provide Class B tension lap splices for all bars #11 and smaller. Stagger splices as shown in the typical details.

4. Avoid splices of #14 and #18 bars where possible. Where required, a mechanical tension splice as specified shall be provided. No more that 50% of such bars shall be spliced in any 5'-0" width of mat cross-section. Spliced bars shall be staggered with un-spliced bars.

F. Manufacturer of mechanical tension splice shall be present for first day's installation.

3.4 SHRINKAGE AND TEMPERATURE REINFORCEMENT

A. Provide shrinkage and temperature reinforcement as indicated on the drawings at right angles to main top and bottom bars for all structural slabs unless detailed otherwise on the drawings.

3.5 PLACEMENT OF WELDED WIRE REINFORCEMENT

A. Wherever welded wire reinforcement is specified as reinforcement in pan-formed beams or slabs, it shall be continuous and properly lapped per ACI 318 Chapter 25.5.3 or 25.5.4 across the entire concrete surface and not interrupted by beam or girders.

3.6 REINFORCEMENT IN COMPOSITE STEEL DECK SLAB

A. Composite steel deck slabs shall be reinforced as indicated on the drawings.

B. Extra Reinforcement over Girders: Provide additional reinforcing steel over interior girders as shown on the drawings.

C. Placement of Slab Reinforcement: Provide bolsters, high chairs, and/or additional reinforcing as shown in details on the drawings to support the reinforcing with the clear cover shown on the drawings.

D. Fiber-Reinforced Concrete in Composite Steel Deck Slabs:
   1. Provide fibers of the type and at the dosage rate shown on the drawings in concrete cast over composite steel deck.
   2. The fiber-reinforced concrete shall be produced in accordance with ASTM C 1116 and have a residual strength of 80 PSI when tested in accordance with ASTM C 1399.

3.7 REINFORCEMENT AROUND OPENINGS IN COMPOSITE STEEL DECK SLABS

A. For all openings in steel deck not framed with structural steel and greater than 10" in width in either direction, provide additional reinforcing steel as shown in details on the drawings.
3.8 REINFORCEMENT IN GRADE BEAMS

A. Provide reinforcing in grade beams as shown on the drawings.

B. Bar Support for Grade Beam Cages: Grade beam bottom steel shall be supported at 5'-0" maximum centers using beam bolsters that provide bottom cover to the reinforcing steel as noted on the drawings. Beam bolsters used shall be designed and manufactured for support on soil.

3.9 REINFORCEMENT IN TOPPING SLABS

A. Provide welded smooth wire reinforcement minimum 6 x 6 W1.4 x W1.4 in all topping slabs unless specified otherwise on the drawings.

3.10 REINFORCEMENT IN HOUSEKEEPING PADS

A. Provide welded smooth wire reinforcement 6 x 6 W2.9 x W2.9 minimum in all housekeeping pads supporting mechanical equipment unless detailed otherwise on the drawings.

3.11 MECHANICAL AND PLUMBING REQUIREMENTS

A. Refer to Mechanical and Plumbing Drawings for concrete requiring reinforcing steel. Such reinforcement shall be furnished as part of the work of this section.

3.12 FIELD QUALITY CONTROL

A. Field Testing and Inspection: Refer to Specification 014529 “Structural Testing and Inspections” for testing and inspection requirements associated with concrete reinforcing.

END OF SECTION 032000
SECTION 033000 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 SUMMARY

A. Section includes all labor, materials, services, equipment, and hardware required in conjunction with or related to the forming, delivery, and pouring of all cast-in-place concrete work. Concrete paving and walks are specified in Division 32. Architectural Concrete, Precast Concrete, Post-Tensioned Concrete and special requirements for Tilt-Up Concrete are specified in other Division 03 sections.

B. Related Requirements:

1. Specification 014000 “Quality Requirements” for requirements of material testing and inspection.


1.3 REFERENCES

A. Reference Standards:

1. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:

   b. ACI 301, “Specifications for Structural Concrete.”
   c. ACI 305.1, “Specification for Hot Weather Concreting.”
   d. ACI 318, “Building Code Requirements for Structural Concrete.”
   e. ACI 355.4, “Qualification of Post-Installed Adhesive Anchors in Concrete.”

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Quality Control: The Contractor is responsible for quality control, including workmanship and materials furnished by subcontractors and suppliers.

2. Document Conflict and Precedence: In case of conflict among documents, including architectural and structural drawings and specifications, notify the Architect/Engineer prior to submitting proposal. In case of conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing by the Architect/Engineer.

3. Materials and installed work may require testing and retesting, as directed by the governing building code or the Architect/Engineer, at any time during progress of work.
   a. The Contractor shall provide adequate notification to the Owner’s Testing Agency of construction operations including the project schedule to allow the Testing Agency to schedule inspections. Failure to notify sufficiently may result in additional costs incurred by the Testing Laboratory that may be back-charged to the Contractor by the Owner.
   b. The Contractor shall cooperate with laboratory personnel, provide access to the work, and provide access to manufacturer's operations.
   c. The Contractor shall make adequate arrangement with the Owner’s Testing Agency for inspection of material stockpiles and facilities.
   d. The Contractor shall provide to the laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.
   e. The Contractor shall furnish casual labor, equipment, and facilities as required for sampling and testing by the laboratory and otherwise facilitate the required inspections and tests.
   f. Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents. Tests not specifically indicated to be done at the Owner’s expense, including retesting of rejected materials and installed work, shall be done at the Contractor’s expense. See Structural Testing and Inspections section of the Specifications.

4. Responsibility for Selection and Use of Concrete Admixtures and Chemical Treatments: The Contractor shall be responsible for selecting admixtures and surface treatments that are compatible with the intended use of the concrete including all final surface treatments called for within this or other specifications or on the structural or architectural drawings. The Contractor is responsible for following the manufacturer’s instructions for the use of their product including abiding by any limitations placed by the manufacturer on the use of any of its products.

B. Preinstallation Meetings:

1. Pre-Concrete Conference:
   a. At least seven days prior to beginning concrete work, the Contractor shall conduct a meeting to review the proposed design mixtures and to discuss required methods and procedures to produce concrete construction of the required quality. Also, review requirements for submittals, status of coordinating work and availability of materials. Establish work progress schedule and procedures for materials inspection, testing, and certifications. The contractor shall send a pre-concrete conference agenda to all attendees seven days prior to the scheduled date of the conference.
b. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:

   1) Contractor’s Superintendent.
   2) Laboratory responsible for the concrete design mix.
   3) Laboratory responsible for field quality control.
   4) Concrete Subcontractor.
   5) Ready-Mix Concrete Producer.
   6) Owner’s and Architect’s/Engineer’s Representative.

c. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by him to all parties concerned within five days of the meeting. One copy of the minutes shall be transmitted to the following for information purposes:

   1) Owner’s Representative.
   2) Architect.
   3) Engineer-of-Record.

d. The Engineer shall be present at the conference. The Contractor shall notify the Engineer at least seven days prior to the scheduled date of the conference.

C. Sequencing:

   1. Provide for installation of inserts, hangers, metal ties, anchors, bolts, angle guards, dowels, thimbles, slots, nailing strips, blocking, grounds, and other fastening devices required for attachment of work. Properly locate in cooperation with other trades and secure in position before concrete is poured. Do not install sleeves in any concrete slabs, beams, or columns except where shown on the drawings or upon written approval of the Architect/Engineer.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer’s product data with application and installation instructions for proprietary materials and items, including admixtures, patching compounds, epoxies, grouts, waterstops, joint systems, curing compounds, dry-shake finish materials, hardeners, sealers, and others as requested by Architect/Engineer.

B. Shop Drawings:

   1. Construction Joints: Submit drawings of proposed construction joint locations in concrete for structural. Submit any additional or changed reinforcing that is required at construction joints that differs from that shown on the drawings.
   2. Openings, Sleeves, and Cores: Submit drawings of all openings to be formed, sleeved, cored, or sawcut in cast-in-place elements. Drawings shall indicate size and location of openings, sleeves, or cores.
   3. Penetrations in Beams and Joists: Submit drawings locating all horizontal and vertical penetrations in beams and joists. Drawings shall indicate location, size, orientation, and type of penetrations.
4. Embedded Items: Submit drawings showing all items to be embedded in concrete elements, including plates, angles, bolts, and any non-structural items, such as conduit. Drawings shall indicate location, size, orientation, and type of embedded item.

C. Samples: Submit samples of materials specified if requested by Architect/Engineer, including names, sources, and descriptions.

D. Certificates:
   1. Material and Mill Certificates:
      a. Provide material and mill certificates as specified herein and in the Testing Laboratory section of the Specifications. The Manufacturer and Contractor shall sign the material and mill certificates certifying that each material item complies with specified requirements.
      b. Provide certification from admixture manufacturers that chloride ion content complies with specified requirements.

E. Design Mixtures: Submit for each concrete mixture as specified herein.

F. Field Quality Control Submittals:
   1. Surveys: Submit report certifying that all anchor rods and reinforcing dowels into columns above are in their proper location prior to placing of concrete.

G. Special Procedure Submittals:

H. Qualification Statements: Submit certifications for adhesive anchor installers.

I. Minutes of Preinstallation Meetings: Submit for review.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Refer to the drawings for classes and strengths of concrete required.

B. Hydraulic Cement:
   1. Use ASTM C 150, ASTM C 1157, or ASTM C 595 (excluding Type IS) unless otherwise specified. Do not use Type III cement in slabs-on-grade unless approved in advance by the Engineer.
   2. Use one brand of cement, for each class of concrete, throughout the project, unless approved otherwise by the Architect/Engineer and the Owner’s Testing Laboratory. Submit mill certificates certifying conformance to this specification for each brand and type of cement.
   3. Testing of cement in lieu of mill certificate submittal will be required if:
      a. The cement has been in storage at the mixing site for over 30 days.
b. It is suspected by the Owner, Architect, Engineer, or Owner’s Testing Laboratory that the cement has been damaged in storage or in transit or is in any way defective.

C. Low-alkali cement: Cement that has the additional requirement that equivalent alkalis (Na₂O + 0.658K₂O) do not exceed 0.60% according to ASTM C 150-00, Table 2.

D. Fly Ash: ASTM C 618, Class C or F.

E. Normalweight Aggregates: ASTM C 33, and as herein specified. Submit material certificates from aggregate supplier or test results from an independent testing agency certifying conformance to this specification for each source of aggregate.

1. For concrete identified on the drawings as exposed to Exposure Classes C1 and C2, submit certification that aggregate does not contain any deleterious materials that react with alkalis in the concrete mix to cause excessive expansion of the concrete for concrete that is exposed to wetting, has extended exposure to humid atmosphere, or is in contact with moist ground unless low-alkali cement is used.

F. Water: Comply with the requirements of ASTM C 1602.

2.2 ADMIXTURES


1. Subject to compliance with requirements, provide one of the following products and manufacturers:
   a. GCP Applied Technologies; Darex or Daravair series.
   b. BASF Corporation; MasterAir VR 10, MasterAir AE 90, MasterAir AE 200.
   c. Sika Corporation; Sika AER.
   d. The Euclid Chemical Company; Air Mix, AEA-92, Eucon Air 30 or Eucon Air 40.

2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.

B. Water-Reducing Admixture: ASTM C 494, Type A. See maximum permissible chloride ion content in concrete specified below.

1. Subject to compliance with requirements, provide one of the following products and manufacturers:
   a. BASF Corporation; MasterPozzolith Series.
   b. Sika Corporation; Plastocrete 161.
   c. The Euclid Chemical Company; Eucon WR-75, Eucon WR-91, Eucon NW or Eucon LW.
   d. GCP Applied Technologies; WRDA series, Zyla Series.

2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.
C. Mid-Range Water-Reducing Admixture: ASTM C 494, Type A and Type F. See maximum permissible chloride ion content in concrete specified below.

1. Subject to compliance with requirements, provide one of the following products and manufacturers:
   a. BASF Corporation; MasterPolyheed Series.
   b. The Euclid Chemical Company; Eucon MR, Eucon X-15 or Eucon X-20.
   c. Sika Corporation; Sikament HP.
   d. GCP Applied Technologies; Daracem or Mira series.

2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.

D. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F or Type G. See maximum permissible chloride ion content in concrete specified below.

1. Subject to compliance with requirements, provide one of the following products and manufacturers:
   a. GCP Applied Technologies; ADVA or Daracem Series.
   b. BASF Corporation; MasterRheobuild 1000; MasterGlenium Series, PS 1466.
   c. Sika Corporation; Sikament.
   d. The Euclid Chemical Company; Eucon 37/1037, Plastol series, Eucon SP or Eucon RD2.

2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.

E. Water-Reducing, Accelerator Admixture (Non-Corrosive, Non-Chloride): ASTM C 494, Type C or E. See maximum permissible chloride ion content in concrete specified below.

1. Subject to compliance with requirements, provide one of the following products and manufacturers:
   a. GCP Applied Technologies; Polarset, Lubricon NCA, Daraset 400, or DCI.
   b. BASF Corporation; MasterSet FP 20, MasterSet AC 534.
   c. The Euclid Chemical Company; Accelguard 80/90, Accelguard NCA, or Accelguard AcN.
   d. Sika Corporation; Plastocrete 161FL.

2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.

F. Water-Reducing, Retarding Admixture: ASTM C 494, Type D. See maximum permissible chloride ion content in concrete specified below.

1. Subject to compliance with requirements, provide one of the following products and manufacturers:
   a. GCP Applied Technologies; Daratard series, or Zyla R.
b. BASF Corporation; MasterPozzolith R series, or MasterSet DELVO series.
c. Sika Corporation; Plastiment.
d. The Euclid Chemical Company; Eucon Retarder series.

2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.

G. Calcium Chloride: Calcium chloride is not permitted.

H. Certification: Written conformance to all the above-mentioned requirements and the chloride ion content of the admixture as tested by an accredited laboratory will be required from the admixture manufacturer at the time of design mixture review by the Engineer.

2.3 WATERSTOPS

A. Provide waterstops at all construction joints and other joints in all foundation walls below grade and where shown on the drawings. Size to suit joints and factory fabricate corners, intersections, and directional changes. The selected waterstop products shall be appropriate for the specific joint condition as specified by the manufacturer, including number of layers of reinforcement, minimum concrete thickness and minimum concrete cover.

1. Products:
   a. Swell Hydrophilic Waterstops:
      1) Manufacturers: GCP Applied Technologies; ADCOR ES or ADCOR 500S.
      1) Manufacturers: Henry Corporation; Synko-Flex Waterstop
   c. Bentonite Waterstops:
      1) Manufacturers: CETCO; Bentonite Waterstop-RX.

2.4 VAPOR RETARDERS

A. Provide vapor retarder cover chosen from products specified below over prepared base material where indicated. Vapor retarders shall be a complete system, including all materials and accessories as recommended by the manufacturer for specific installation and assembly.

1. Plastic Vapor Retarder under slabs-on-grade: Provide a flexible, preformed sheet membrane conforming to ASTM E 1745 with the following properties:
   a. Class A material.
   b. Minimum of 15 mils thick.
   c. Maximum water vapor permeance rating of 0.01 perms after mandatory conditioning as tested by ASTM E 96 or ASTM F 1249.
   d. Manufacturer’s recommended penetration boots, joint tape and mastic.
e. Acceptable products include the following:
   
   1) Stego Industries, LLC; Stego Wrap Vapor Barrier (15 mil).
   2) Epro Waterproofing Systems; Ecoshield-E (15 mil).
   3) Insulation Solutions; Viper Vapor Check II (15 mil).
   4) Raven Industries; VAPORBLOCK VBLP15 (15 mil).
   5) W.R. Meadows, Inc; Perminator (15 mil)
   6) Tex-Trude, LP, Xtreme (15 mil)

2. Plastic Vapor retarder under structural slabs on carton forms: Provide a flexible, preformed sheet membrane that adheres to concrete and conforms to ASTM E 1745 with the following properties.
   
   a. Class A Material.
   b. Minimum of 15 mils thick.
   c. Maximum water vapor permeance rating of 0.01 perms after mandatory conditioning as tested by ASTM E 96 or ASTM F1249.
   d. Manufacturer’s recommended penetration boots, joint tape and mastic.
   e. Acceptable products include the following:
      
      1) Barrier Bac; BarrierBac VBC-350 (31 mil).
      2) GCP Applied Technologies; Florprufe 120 (21 mil).

3. Tape for Plastic Vapor Retarders: High-density polyethylene tape with pressure sensitive adhesive having a minimum width of 3.75" having a maximum water vapor transmission rate of 0.3 perms.

2.5 CURING MATERIALS

A. Liquid Membrane-Forming Curing and Curing and Sealing Compounds:

1. Water-Based Dissipating Resin Type Curing Compound: Curing Compound shall be a dissipating resin type, which chemically breaks down after approximately four weeks. Membrane forming compound shall meet ASTM C 309, Types 1 or 1D, Class B with a VOC content less than 350 grams per liter.
   
   a. Products: Subject to compliance with requirements, provide one of the following:
      
      1) The Euclid Chemical Company; Kurez DR VOX.
      2) L&M Construction Chemicals; L&M Cure R.
      3) Dayton-Superior Company; Clear Resin Cure J11W.
      4) W.R. Meadows, Inc; 1100-Clear.
      6) SpecChem LLC; SpecRez.

b. Submit manufacturer’s certification that product conforms to the requirements specified and is compatible with any covering or surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments and floor coverings.
2. High Solids, Water-Based Acrylic Curing and Sealing Compound with Moderate Yellowing Characteristics: Water-Based membrane-forming curing and sealing compound conforming to ASTM C 1315, Type 1, Class B, classified as low odor with a VOC content less than 350 grams per liter. Do not apply to surfaces that are to receive subsequent cementitious toppings, sealers, hardeners, ceramic tile, resilient flooring, vinyl-backed carpet, wood, terrazzo, epoxy overlays or adhesives, or other coating or finishing products.

   a. Products: Subject to compliance with above requirements, provide one of the following products or equivalent products:

      1) Dayton-Superior; Cure & Seal 1315 J22WB.
      2) The Euclid Chemical Company; Super Aqua-Cure VOX.
      3) L&M Construction Chemicals; Dress & Seal, 30 WB.
      4) BASF Corporation; Masterkure CC 1315.
      5) SpecChem LLC; Cure & Seal WB 25.

   b. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with any covering or surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments.

3. High Solids, Water-Based, Non-Yellowing Curing and Sealing Compound: Water based membrane-forming curing and sealing compound, acrylic type, complying with ASTM C 1315, Type 1, Class A classified as low odor with a VOC content less than 350 grams per liter. Do not apply to surfaces that are to receive subsequent cementitious toppings, sealers, hardeners, ceramic tile resilient flooring, vinyl-backed carpet, wood, terrazzo, epoxy overlays or adhesives, or other coating or finishing products.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) The Euclid Chemical Company; Super Diamond Clear VOX.
      2) L&M Construction Chemicals; Lumiseal WB Plus.
      3) BASF Corporation; MasterKure CC 1315.
      4) Dayton-Superior Corporation; Cure & Seal 1315EF
      5) W.R. Meadows, Inc; Vocomp 30.
      6) SpecChem LLC; Cure & Seal WB 30.

   b. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with any covering or surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments.

B. Evaporation Control: Monomolecular film forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss in hot, dry, or windy weather conditions.

   1. Products: Subject to compliance with requirements, provide one of the following:

      a. The Euclid Chemical Company; Eucobar.
      b. L&M Construction Chemicals; E-Con.
      c. BASF Corporation; MasterKure ER 50.
d. Dayton-Superior Corporation; Aqua Film (J74).
e. Sika Corporation; SikaFilm.
f. W.R. Meadows, Inc; Sealtight Evapre.
g. US Mix Co.; US Spec Monofilms ER.
h. SpecChem LLC; SpecFilm RTU.

2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all coverings and surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments.

C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately nine ounces per square yard, complying with AASHTO M 182, Class 2.

D. Moisture-Retaining Cover: One of the following, complying with ANSI/ASTM C 171:

1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene-coated burlap.
4. Polyethylene-coated natural cellulose fabric such as Greenstreak Group, Inc.; Aquacure.
5. Cover for Industrial Slab: Provide a low permeance moisture-retaining cover that allows a moisture loss of no more than one pound per square yard in 72 hours when tested in accordance with ASTM C 156 for industrial slabs. The material shall be non-staining and meet with requirements of ASTM C 171.

2.6 LIQUID FLOOR TREATMENTS

A. Moisture Vapor Reduction Sealer: ASTM C 1315 Type 1 Class A, ASTM C 309 Type 1 Class A, penetrating product to have no less than 34% solids content, leaving no sheen. Acceptable products include:


2.7 RELATED MATERIALS

A. Post-Installed Anchors:

1. Qualified Products:

a. Mechanical Anchors: Only anchors having passed Acceptance Criteria 193 for use in cracked concrete and resisting wind and seismic loads shall be approved for use. Reports from the following organizations are acceptable:

2) IAPMO Uniform Evaluation Services.

b. Adhesive Anchoring Systems: Only adhesive anchor systems that comply with the latest revision of ICC-ES Acceptance Criteria 308 for use in cracked concrete and resisting wind and seismic loads shall be approved for use. Reports from the following organizations are acceptable:
2) IAPMO Uniform Evaluation Services.

2. Alternate Anchor Approval: Install only anchors identified on the drawings by manufacturer and product. Substitutions using products approved by this Specification may be permitted provided complete design calculations are signed and sealed by a registered professional engineer licensed in the state where the project is located and furnished to the Engineer for review and approval prior to commencement of work. The Contractor shall request design criteria for all conditions where a product substitution is considered. Failure to obtain approval for an anchor substitution may result in the request by the Engineer to remove installed anchors and replace with the product specified on the drawings at the Contractor’s expense.

3. Installation: All installation of post-installed anchors shall be in accordance with the Manufacturer’s Printed Installation Instructions (MPII).

4. Interior Use: All anchors for use in interior conditioned environments free of potential moisture shall be manufactured from carbon steel zinc plated in accordance with Federal Specification QQ-Z-325C, Type II, Class 3.

5. Exterior or Exposed Use: All anchors for use in exposed or potentially wet environments or for attachment of exterior cladding materials shall be galvanized or stainless steel. Galvanized anchors shall conform to ASTM A 153. Stainless steel anchors shall be manufactured from 300 series stainless steel.

6. Nuts and Washers: Nuts and washers shall be furnished from the manufacturer and used with the anchors.

7. Anchor Types:
   a. Expansion and Undercut Anchors in Concrete:
      1) Type: All expansion and undercut anchors in concrete shall be wedge type expansion, sleeve type expansion, or undercut type anchors.
      2) Acceptable Products and Manufacturers – Normalweight and Sand-Lightweight Concrete Not on Corrugated Steel Deck:
         a) Hilti, Inc.; Kwik Bolt TZ (ESR-1917).
         b) Hilti, Inc.; HDA Undercut Anchor (ESR-1546).
         c) Hilti, Inc.; HSL-3 Heavy Duty Sleeve Anchor (ESR-1545).
         d) Simpson Strong-Tie Co., Inc.; Strong-Bolt Wedge Anchor (ESR-1771).
         e) Simpson Strong-Tie Co., Inc.; Strong-Bolt 2 Wedge Anchor (ESR-3037).
         f) USP Structural Connectors; DUC Undercut Anchor (ESR-1970).
         g) Dewalt; Power Stud+ SD1 Expansion Anchor (ESR-2818).
         h) Dewalt; Power Stud+ SD2 Anchor (ESR-2502).
         i) Dewalt; Atomic+ Undercut Anchor (ESR-3067).
         j) Dewalt; Power-Bolt+ Sleeve Anchor (ESR-3260)
      3) Acceptable Products and Manufacturers – Normalweight and Sand-Lightweight Concrete on Corrugated Steel Deck:
         a) Hilti, Inc.; Kwik Bolt TZ (ESR-1917).
b) Simpson Strong-Tie Co., Inc.; Strong-Bolt Wedge-Anchor (ESR-1771).
c) Dewalt; Power Stud+ SD1 Expansion Anchor (ESR-2818).
d) Dewalt; Power Stud+ SD2 Anchor (ESR-2502).

b. Screw and Insert Anchors in Concrete:

1) Acceptable Products and Manufacturers:

   a) Hilti, Inc.; KWIK HUS-EZ Anchor (ESR-3027).
   b) Simpson Strong-Tie Co., Inc.; Titen HD (ESR-2713).
   c) Dewalt; Snake+ Anchor (ESR-2272).
   d) Dewalt; Screw-Bolt+ (ESR-3889).

c. Adhesive Anchoring Systems in Concrete:

1) Chemical anchoring of anchors, rods, or reinforcing steel is not allowed for fire-rated assemblies, unless specified provided for in the drawings.
2) Consult with the manufacturer for the minimum temperature of the concrete substrate allowed.
3) Only personnel trained to install adhesive anchors and certified in accordance with the ACI/CRSI Adhesive Anchor Installer Certification Program shall install adhesive anchors, including reinforcing steel.
4) All anchors installed horizontally or upwardly inclined require continuous inspection.
5) All adhesive anchors shall be installed in concrete having a minimum age of 21 days at the time of anchor installation.
6) Acceptable Products and Manufacturers:

   a) Hilti, Inc.; HIT-HY 200 (ESR-3187).
   b) Hilti, Inc.; HIT-RE 500 V3 (ESR-3814)
   c) ITW Red Head; EPCON G5 (ESR-1137).
   d) ITW Red Head; EPCON S7 (ESR-2308).
   e) Dewalt; PE 1000+ (ESR-2583).
   f) Dewalt; Pure110+ (ESR-3298).
   g) Dewalt; AC200+ (ESR-4027).
   h) Simpson Strong-Tie; SET-3G Adhesive (ESR-4057).
   i) Simpson Strong-Tie; AT-XP (IAPMO ER-263).

7) These products may not be used in concrete cast over corrugated deck.
8) Threaded Rods chemically anchored in concrete:

   a) Type: Threaded rods installed in holes using a chemical anchoring process shall have a 45° chiseled end on the embedded end.
   b) Interior Application: Meet the requirements of ASTM A 307, A 36 or A 193, grade B7.
   c) Exterior Application: Meet the requirements of ASTM A 153 galvanized steel, or F 593, Group 1 or 2, condition CW stainless steel.
9)  Steel Reinforcing Bars:
   
a)  Reinforcing steel installed shall comply with ASTM A 615 or ASTM A 706 unless noted otherwise in the structural drawings. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust, mud, oil and other coatings that may impair the bond with the adhesive.
   
b)  Reinforcing bars must not be bent after installation except as permitted in the structural drawings. Heating of reinforcing bars to facilitate field bending is not permitted.

B.  Bonding Compound: Polyvinyl acetate or acrylic base, for use in cosmetic and/or nonstructural repairs.

1.  Products: Subject to compliance with requirements, provide one of the following:
   
a.  Acrylic or Styrene Butadiene:
       
       1)  Dayton-Superior Corporation; Acrylic Bonding Agent J40.
       2)  The Euclid Chemical Company; SBR Latex, Akkro-7T.
       3)  GCP Applied Technologies; Daraweld C.
       4)  BASF Corporation; MasterEmaco A 400
       5)  Sika Corporation; SikaLatex.
       6)  W.R. Meadows, Inc; Acry-Lok.
       8)  SpecChem, LLC; Strong Bond Acrylic Bonder.

   b.  Polyvinyl Acetate (Interior Use Only):
       
       1)  The Euclid Chemical Company; Tammsweld.
       2)  L&M Construction Chemicals; Primer One.
       3)  Dayton-Superior Corporation; PVA Bonding Agent J41.
       4)  SpecChem, LLC; SpecWeld.
       5)  W.R. Meadows, Inc; Intralok.

C.  Epoxy Products: Two-component material suitable for use on dry or damp surface, complying with ASTM C 881.

1.  Products for Crack Repair:
   
a.  Sika Corporation; Sikadur 35 Hi Mod LV – injection type.
   b.  Sika Corporation; Sikadur 52 – injection type.
   c.  Sika Corporation; Sikadur 55 SLV – gravity feed.
   d.  The Euclid Chemical Company; Dural Injection Gel.
   e.  Dayton-Superior Corporation, Inc; Sure-Inject (J56 or J56SLV).
   f.  BASF Corporation; MasterInject 1000.
   g.  Simpson Strong-Tie Co., Inc.; ETI-LV or ETI-GV – injection type.
   h.  Unitex; Pro-Poxy 100 or Pro-Poxy 50.
   i.  Adhesives Technology; Crackbond LR 321 or Crackbond LR 321 LPL.
   j.  W.R. Meadows, Inc; Rezi-Weld LV.
   k.  SpecChem LLC; SpecPoxy 1000.
2. Products for Epoxy Mortar Patches:
   a. Sika Corporation; Sikadur Lo-Mod LV.
   b. Dayton-Superior Corporation; Sure Patch.
   c. BASF Corporation; MasterInject 1500.
   d. Unitex; Pro-Poxy 2500.
   e. W.R. Meadows, Inc; Rezi-Weld 1000.
   f. SpecChem, LLC; SpecPoxy Binder.

3. Products for Epoxying Steel Plates to Concrete: Conform to ASTM C 881-13, Type IV, Grade 3, Class A, B, & C except gel times.
   a. Sika Corporation; Sikadur 31 Hi-Mod Gel.
   b. Dayton-Superior Corporation, Inc; Sure Anchor J50 or Sure Bond J58
   c. BASF Corporation; MasterEmaco ADH 1420.
   d. Unitex; Pro-Poxy 300.
   e. The Euclid Chemical Company; Duralcrete Gel.
   f. SpecChem, LLC; SpecPoxy 3000.

D. Bondbreaker for Construction Joints in Slabs-on-Grade: A dissipating bondbreaking compound containing no silicones, resins, or waxes, and that conforms to ASTM C 309. Subject to compliance with requirements, acceptable manufacturers include the following:
   1. Dayton-Superior Corporation, Inc.; Sure-Lift J6WB.
   2. SpecChem, LLC; SpecTilt 100.

E. Rigid-Cellular-Polystyrene Boards use as Fill under Topping Slabs or Slabs-on-Grade: Provide rigid, expanded (EPS) or extruded (XPS) cellular polystyrene boards that conform to ASTM D 6817 or ASTM C 578 with a minimum density of 12, 15, 19, 26, 29, 35 or 48 kilograms per cubic meter; a flame spread index of not more than 75 and a smoke-develop index of not more than 450 where tested for use in accordance with ASTM E 84 or UL 723. Subject to compliance with requirements, acceptable manufacturers include the following:
   1. Dow Chemical Company; STYROFOAM Brand.
   2. Therma Foam; Foam-Control EPS Geofoam.
   3. Carpenter Co.; EPS Envirogreen Geofoam.
   4. Insulfoam; Insulfoam GF (EPS Geofoam).

2.8 REPAIR MATERIALS

A. Self-Leveling Mortars, Underlayment Compound: Freeflowing, self-leveling, pumpable cementitious base compound. Follow manufacturer’s instruction regarding the use of a bonding agent.
   1. Products: Unless specified otherwise, provide one of the following:
      a. BASF Corporation; MasterTop 110 SL.
      b. The Euclid Chemical Company; Flo-Top,Super Flo-Top.
      c. Dayton-Superior Corporation, Inc; Levelayer.
e. The Euclid Chemical Company; Level Magic Lightweight.
f. SpecChem, LLC; SpecFlow.

B. Polymer Patching Mortar: Polymer and microsilica modified cementitious-based compounds.

1. Products:

a. Horizontal Application:

    1) The Euclid Chemical Company; Thin Top Supreme, Concrete Top Supreme.
    2) Sika Corporation; Sikatop 121 Plus or Sikatop 122 Plus.
    3) BASF Corporation; MasterEmaco T 310CI.
    4) BASF Corporation; MasterEmaco N424 or N423 RS.
    5) US Mix Co.; US Spec H2 or NuTop.
    6) The Euclid Chemical Company; Speed Crete PM.
    7) SpecChem, LLC; RepCon H.
    8) Dayton-Superior Corporation; Thin Resurfacer or Special Patch.

b. Upwardly Inclined Application:

    1) The Euclid Chemical Company; Verticoat or Verticoat Supreme.
    2) Sika Corporation; Sikatop 123 Plus.
    3) BASF Corporation; MasterEmaco N 350CI.
    4) BASF Corporation; MasterEmaco N423 RS.
    5) US Mix Co.; US Spec V/O Patch CI.
    6) The Euclid Chemical Company; Speed Crete PM.
    7) SpecChem, LLC; RepCon V/O.
    8) Dayton-Superior Corporation; Civil/Structural VO.

C. High Strength Flowing Repair Mortar: For forming and pouring structural members, or large horizontal repairs, provide flowable one-part, high strength microsilica polymer modified repair mortar with 3/8” aggregate. The product shall achieve 9,000 PSI at 28-days at a nine inch slump.

1. Products:

a. BASF Corporation; MasterEmaco T 1060.


c. The Euclid Chemical Company; Eucocrete.

d. The Euclid Chemical Company; Tamms Form and Pour.

e. SpecChem, LLC; RepCon 928.

f. Dayton-Superior Corporation; Civil/Structural FPX.

D. Anti-Corrosive Epoxy/Cementitious Adhesive: Water-based epoxy/cementitious compound for adhesion and corrosion protection of reinforcing members (20 hour maximum open time).

1. Products:

a. The Euclid Chemical Company; Duralprep A.C.

b. Sika Corporation; Sika Armatec 110 Epocem.

c. BASF Corporation; MasterEmaco P 124.

d. Dayton-Superior Corporation; Perma Prime 3C.
2.9 PROPORTIONING AND DESIGN OF CONCRETE MIXTURES

A. The Contractor shall submit design concrete mixtures for each class of concrete indicated on the structural drawings and in the Specifications for approval by the Engineer and Owner's Testing Laboratory at least 15 working days prior to the start of construction. If required, the Contractor shall engage the services of an independent Testing Laboratory to assist in preparing the design mixtures. The Contractor shall not begin work with a particular mixture until that design mixture has been approved.

B. The Contractor, acting in conjunction with his Concrete Supplier and his Testing Laboratory, shall submit in writing, with his design mixtures, the method used to select mixture proportions. Either of the following methods, as outlined in ACI 301, may be used:

1. Field Experience Method.
2. Laboratory Trial Mixture Method.

C. Required types of concrete and compressive strengths shall be as indicated on the Structural Drawings.

D. All design mixtures shall state the following information:

1. Design mixture number or code designation by which the Contractor shall order the concrete from the Supplier.
2. Identify design mixture usage (i.e., columns, shear walls, footings, slab-on-grade, etc.).
3. Wet and dry unit weights.
4. Compressive strength and associated age (28-day, 56-day, etc.).
5. Aggregate type, source, size, gradation, fineness modulus.
6. Cement type and brand.
7. Fly ash or other pozzolan type and brand (if any).
8. Admixtures including air entrainment, water reducers, high-range water reducers, accelerators, and retarders.
9. Design slump or slump/flow.
10. Proportions of each material used.
11. Water/cementitious ratio and maximum allowable water content.
12. Method by which the concrete is intended to be placed (bucket, chute, or pump).
13. Required average strength qualification calculations per ACI 301 4.2.3.3a and 4.2.3.3b. Submit separate qualification calculations for each production facility that will supply concrete to the project.
14. Documentation of Average Strength (Trial Mixture Data or Field Test Data) per ACI 301: When field test data is used to qualify average strength, submit separate documentation for each production facility that will supply concrete to the project.
15. Field test data submitted for qualification of average strength under ACI 301 shall include copies of the Concrete Testing Agency's reports from which the data was compiled.

E. Low Alkali Concrete: For concrete identified on the drawings as Exposure Classes C1 and C2, the total alkali contribution from cementitious materials in the concrete mix shall not exceed 4.0 pounds per cubic yard of concrete unless the aggregate used is certified to contain no deleterious materials that react with alkalis in the concrete mix as defined in ASTM C 33. This requirement may be met by the use of low-alkali cement.
F. Supplementary Cementitious Materials: Fly ash and/or ground granulated blast-furnace slag replacement of Portland cement shall be within percentage replacement levels listed on the drawings unless noted otherwise. Every effort should be made to reduce the amount of cement to the minimum practical amount, and still achieve performance requirements contained in the Contract Documents.

1. Cement replacement shall not exceed a percentage level that has been shown by experience on other projects to exhibit satisfactory performance using materials from identical sources as proposed for this project. As an alternate, trial concrete batches can be performed to identify design mixtures that maximize cement replacement while meeting strength requirements per ACI 301 and finishability criteria.
2. The use of fly ash or slag in architecturally exposed structural concrete shall be coordinated with the Architect, Engineer, and Contractor.
3. Overall replacement percentages with combined fly ash and slag shall not exceed the maximum identified with slag or be less than the minimum identified with fly ash for each type of element. In addition, the replacement percentage of fly ash within the combined mixture shall not exceed the maximum identified with fly ash alone.
4. Replacement percentages exceeding the maximum may be permitted at the discretion of the Architect, Engineer of Record, and Contractor.
5. For concrete identified on the drawings as being subject to Exposure Class F3, the maximum amount of supplementary cementitious materials shall not exceed the limits noted in Table 4.2.2.7.b.2 “Maximum cementitious materials requirements for concrete exposed to deicing chemicals” of ACI 301.
6. Except for Mass Concrete, the Contractor may submit for approval a revised design mixture with lower supplementary cementitious material percentages than herein specified should finishability or other issues arise due to changing weather conditions.

G. Aggregate: Comply with the following special requirements:

1. For exposed concrete, provide aggregates from a single source.
2. For exposed surfaces subject to Exposure Class C1 or C2, do not use aggregates containing spalling-causing deleterious substances.
3. For slabs and other designated concrete, combined aggregate gradation shall be 8% - 18% for large top size aggregates (1 1/2 inches) or 8% - 22% for smaller top size aggregates (1 inch or 3/4 inch) retained on each sieve below the top size and above the No. 100. Deviations from this gradation may be allowed upon the approval of the Engineer subject to the following limitations:
   a. The percent retained on two adjacent sieves shall be not less than 5%.
   b. The percent retained on three adjacent sieves shall be not less than 8%.
   c. If the percent retained on two adjacent sieves is less than 8%, the total percent retained on either of those sieves and the adjacent outside sieve shall be not less than 13%.

H. Admixtures:

1. Admixtures to be used in concrete shall be subject to the approval of the Engineer and Owner's Testing Laboratory and shall be used for the purpose intended by the manufacturer to produce concrete to meet the specified requirements.
2. Quantities of admixtures to be used shall be in strict accordance with the manufacturer’s instructions.
3. Air Content Requirements: For concrete subject to Exposure Class F1, F2 or F3 as noted on the drawings, use air-entrainment admixtures to provide concrete such that the air content at the point of placement shall conform to the requirements of ACI 301 Table 4.2.2.7.b “For Exposure Category F: Freezing and thawing exposures” within plus or minus 1.5%. Required air content levels may be reduced by 1.0 percent for concrete strengths above 5,000 PSI.

   a. Interior steel troweled surfaces shall not have more than 3% total air content.
   b. Surfaces scheduled to receive hardeners shall not have more than 3% total air content.
   c. Air-entraining admixtures are not permitted in industrial slabs.

I. Adjustments of Concrete Mixtures: Design mixture adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Such adjustments shall be provided at no additional cost to the Owner. Any adjustments in approved design mixtures including changes in admixtures shall be submitted in writing to the Engineer and Owner's Testing Laboratory for approval prior to field use.

J. Chloride Ion Content:

1. Unless noted otherwise, the maximum water soluble chloride ion concentration in hardened concrete measured at ages from 28 to 42 days contributed from all ingredients including water, aggregates, cementitious materials, and admixtures shall not exceed the limits specified in ACI 318-14 Table 19.3.2.1 “Requirements for concrete by exposure class” depending on to which Corrosion Exposure Class (C0, C1 or C2) the concrete is subject as noted on the drawings. Water-soluble chloride ion tests shall conform to ASTM C 1218. One test shall be run for each class of concrete before the design mixture submittal and each time a change is made to the design mixture (such as change in aggregate type or source).

2. The chloride ion content in all concrete used for prestressed or post-tensioned concrete shall not exceed 0.06 percent by weight of cement.

3. The Concrete Supplier shall certify that the chloride ion content in all concrete design mixtures used on the project does not exceed the limits stated above.

2.10 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with requirements of ANSI/ASTM C 94 and the Structural Testing and Inspections section of the specifications.

PART 3 - EXECUTION

3.1 SLUMP LIMIT

A. The slump, as measured in the field where concrete cylinders are taken, shall be within plus or minus 1-1/2 inches of the design slump noted in the approved Design Mixture submittal. Self-Consolidating Concrete shall have a slump/flow of plus or minus two inches of the design slump/flow noted on the approved Design Mixture submittal. Water may be added to the concrete in the field only to the extent that the prescribed water/cementitious ratio noted in the approved
Design Mixture submittal is not exceeded. The responsibility for adding water to trucks at the job site shall rest only with the Contractor’s designated representative. The Contractor is responsible that all concrete placed in the field is in conformance with the Contract Documents.

3.2 VAPOR RETARDER INSTALLATION

A. Install and repair damaged vapor retarder in accordance with ASTM E 1643 and manufacturer’s instructions.

B. Lap all seams per manufacturer’s instruction (6” minimum lap) and seal all joints in the field with the specified pressure sensitive tape. Heat-welded joints done in a shop prior to delivery is an acceptable method to minimize the number of field joints.

C. Seal all pipe penetrations through the vapor retarder with a boot made from the vapor retarder material and tape or mastic.

3.3 JOINTS IN CONCRETE

A. Construction Joints: Locate and install construction joints as indicated on the drawings or if not shown on drawings, located so as not to impair strength and appearance of the structure, as acceptable to Architect/Engineer.

1. Keyways: Provide keyways with a depth of one tenth of the member thickness (1 1/2” minimum or as shown on the drawings) in construction joints only where shown on the drawings.

2. Joint Construction: Place construction joints in the center one third of suspended spans and grade beams and as shown on the drawings for slabs-on-grade and walls unless shown otherwise. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise shown on the drawings. Dowels that cross construction joints shall be supported during concreting operations so as to remain parallel with the slab or wall surface and at right angles to the joint. Submit all construction joint locations as a shop drawing submittal.

3. Waterstops: Provide waterstops in construction joints as indicated on the Architectural and Structural Drawings. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer’s printed instructions. Waterstops shall be installed with a minimum of 3” of concrete cover.

4. Isolation Joints in Slabs-on-Grade: Construct isolation joints (without dowels) in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces only where specifically detailed on the drawings. Install joint-filler strips at joints where indicated. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated on the drawings. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together. Provide construction joints with dowels at all locations unless isolation joints are detailed.

B. Contraction Joints in Slabs-on-Grade and Unbonded Topping Slabs: Install contraction joints at locations and spacings as indicated on the drawings or if not shown on drawings, located so as
not to impair strength and appearance of the structure, as acceptable to Architect/Engineer. Maximum joint spacing shall be per the drawings and be perpendicular to the slab surface. Use one of the two following methods (sawed or formed) to create the joints. Do not use the formed joint in areas subject to vehicular traffic or in industrial slabs.

1. Sawed Joints:
   a. Primary Method: Early-Entry, dry-cut method, using Soff-Cut saws. Finisher must have documented successful experience in the use of this method prior to this project. Install cuts within one to four hours, depending on air temperature, after final finish as soon as the concrete surface is firm enough to not be torn or damaged by the blade at each saw cut location. Use 1/8 inch thick blade, cutting to a depth of one quarter of the slab thickness but not less than one inch. Cut to a depth of one third of the slab thickness for slabs reinforced with steel fibers or synthetic fibers.
   b. Optional Method (where Soff-Cut System method equipment is not available, subject to limitations): This method may not be used when there is no dowel passing through the contraction joint. Use a conventional saw to cut joints within four to 12 hours after finishing as soon as the concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses become sufficient to produce cracking. Use 1/8 inch thick blade, cutting to a depth of one quarter of the slab thickness but not less than one inch. Cut to a depth of one third of the slab thickness for slabs reinforced with steel fibers.

2. Formed Joints: Form contraction joints by inserting premolded plastic hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. The depth is to be one quarter of the slab thickness, but not less than one inch. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.

3. The Contractor shall protect the joints from damage caused by wheeled traffic or other sources during construction until a joint-filler material (if specified) has been installed.

3.4 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto unless directed otherwise by these specifications. Install reglets to receive top edge of foundation sheet waterproofing where specified by the Architect, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles and other conditions.

B. Anchor Rods: Furnish anchor rods and other connectors required for securing structural steel to foundations and other in-place work as shown on the drawings. Furnish 1/8" minimum steel templates for presetting rods and other anchors to accurate locations as shown on the drawings in keeping with the tolerances noted in ACI 117 for embedded anchor rods.

C. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.
D. Do not install sleeves in any concrete member except where shown on the structural drawings or approved by the Architect and Engineer.

E. Securely fasten embedded plates, angles, anchor rods and other items to be built into the concrete to the formwork or hold in place with templates. Insertion of these items into concrete after concrete placement is prohibited.

3.5 CONCRETE PLACEMENT

A. Pre-placement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

B. Concrete Batch Trip Tickets: The Contractor shall collect and retain concrete batch trip tickets. Compressive strength, slump, air content, and temperature tests shall be identified by reference to a particular trip ticket. Tickets shall contain the information specified in ASTM C 94. Each ticket shall also show the amount of water that may be added in the field for the entire batch that will not exceed the specified water cement ratio for the design mixture. The Contractor and Testing Laboratory shall immediately notify the Architect/Engineer and each other of tickets not meeting the criteria specified.

C. Causes for Rejection of Concrete: The Contractor shall reject concrete delivered to the site for any of the following reasons:

1. Wrong class of concrete (incorrect design mixture number).
2. Environmental condition limits shall be as follows unless appropriate provisions in concrete practices have been made for cold or hot weather:
   a. Cold Weather: Air temperature must be 40°F and rising or the average daily temperature cannot have been lower than 40°F for three consecutive days unless the temperature rose about 50°F for at least one-half of any of those 24 hour periods.
   b. Hot Weather: Environmental conditions must be such that cause an evaporation rate from the concrete surface of 0.2 pounds per square foot per hour or less as determined by the figure “NRMCA Nomograph for Estimating Evaporation Rate on the Basis of Menzel Formula” in Appendix A of ACI 305.1.
   c. Concrete may be placed at other environmental condition ranges only with the approval of the job inspector for the Testing Laboratory or other duly appointed representative.

3. Concrete with temperatures exceeding 95°F.
4. Air contents outside the limits specified in the design mixtures.
5. Slumps outside the limits specified.
6. Water added to the mix that exceeds the maximum allowed water-to-cementitious material ratio.
7. Excessive Age: Concrete shall be discharged within 90 minutes of plant departure or before it begins to set if sooner than 90 minutes and it shall be discharged before the drum has revolved 300 revolutions, unless approved by the Testing Laboratory job inspector or other duly appointed representative.
D. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

E. Comply with ACI 301 and as herein specified:

1. Concrete Temperature: The maximum acceptable concrete temperature at the truck discharge point shall be 95°F.

2. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation. Spread concrete using short-handed, square-ended shovels, or come-alongs.

3. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

4. Consolidate placed concrete by mechanical vibrating equipment supplemented by handspading, rodding or tamping. Use internal vibrators of the largest size and power that can properly be used in the work.

5. Do not vibrate Self-Consolidating Concrete.

6. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to penetrate rapidly placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

7. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed. Place concrete for beams, girders, brackets, column capitals, haunches, and drop panels at the same time as concrete for slabs. Do not place concrete over columns and walls until concrete in columns and walls is no longer plastic and has been in place at least one hour.

8. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners of forms, eliminating air and stone pockets that may cause honeycombing, pitting, or planes of weakness.

9. Bring slab surfaces to correct level with straightedge and strikeoff. Use highway straightedges, bull floats, or darbies to smooth surface free of humps or hollows before excess moisture or bleedwater appears on the surface. Do not disturb slab surfaces prior to beginning finishing operations.

10. Maintain reinforcing in proper position during concrete placement operations.

11. Protect adjacent finish materials against damage and spatter during concrete placement.

12. Placing Concrete by Pump: If concrete is placed by using a pump, the grout used for pump priming must not become a part of the completed structure unless an engineered grout design mix and grout location are approved in advance by the Engineer.

3.6 FINISH OF FORMED SURFACES

A. General: Formed surfaces shall have the finishes as described below and as shown on the drawings after formwork is removed and repairs made.
B. Matching Mockup Finish: In all areas where a special finish is required or a mock-up is required below, Contractor shall prepare a 100 square foot mock-up to match the required finish. The mock-up should match the finish on a sample panel furnished to the Contractor. If a sample is not furnished, provide finish to match SF2.0 or any other finish specified for the project. Protect mock-up from damage for the duration of project. Approval of mock-up by Architect is required before proceeding with application of finish in project.

C. Classifications and Finish Requirements:

1. Surface Finish 1.0 (SF-1.0):
   a. No formwork facing material is specified.
   b. Patch voids larger than 1-1/2 inch wide or 1/2 inch deep.
   c. Remove projections larger than 1.0 inch.
   d. Provide surface tolerance Class D as specified in ACI 117.
   e. Tie holes need not be patched.

2. Surface Finish 2.0 (SF-2.0):
   a. Provide specified formwork-facing material.
   b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
   c. Patch tie holes.
   d. Remove projections larger than 1/4 inch.
   e. Provide surface tolerance Class B as specified in ACI 117.
   f. Provide mock-up of concrete surface appearance.

D. Standard Finish: Provide SF-1.0 on all concrete surfaces not exposed to view in the final condition unless otherwise specified.

E. Exposed Finishes: Provide SF-2.0 on all concrete surfaces exposed to view in final condition unless otherwise specified.

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

3.7 MONOLITHIC SLAB FINISHES

A. Place, consolidate, strike off, and level concrete, eliminating high spots and low spots, before proceeding with any other finish operation. Do not add water to the surface of the concrete during finishing operation.

B. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo and other bonded applied cementitious finish flooring material, and as otherwise indicated. After placing slabs, plane surface to tolerance specified below. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms, or rakes.
C. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated. After screeding, consolidating and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using a hand float, a bladed power float equipped with float shoes, or a powered disk float, when the bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit the operation. Check and level surface plane to a tolerance as specified below. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

D. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thin film finish coating system. After floating, begin first trowel finish operation by hand or power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a level surface to a tolerance as specified below. Grind smooth surface defects that would telegraph through applied floor covering system.

E. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply initial trowel finish as specified above, then immediately follow with slightly scarifying surface by fine brooming.

F. Slip-Resistive Broom Finish: Apply slip-resistive broom finish to garage floors and ramps less than 6% slope, exterior concrete platforms, steps, and ramps and elsewhere as indicated. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application. For concrete containing fibers, broom once only in one direction.

3.8 CONCRETE FINISH MEASUREMENT AND TOLERANCES

A. Testing Procedure: ASTM E 1155.

B. Tolerance on Floor Elevations: Construction tolerance on absolute floor elevation from the specified elevation as shown on the drawings shall be as specified below, taken from ACI 117:

1. Slab-on-Grade Construction: ±3/4".
2. Top Surfaces of Formed Slabs Measured Prior to Removal of Supporting Shores: ±3/4".
3. Top Surfaces of All Other Slabs: ±3/4".

C. Random Traffic Floor Finish Tolerances:

1. Specified overall values for flatness (SOF_F) and levelness (SOF_L) shall conform to the values listed below for the floor surface classification noted for each slab category noted.

   a. Conventional:

      1) SOF_F: 20.
      2) SOF_L: 15.

   b. Moderately Flat:
1) SOF_F: 25.
2) SOF_L: 20.

c. Flat:

1) SOF_F: 35.
2) SOF_L: 25.

2. Minimum local values for flatness (MLF_F) and levelness (MLF_L) shall equal 3/5 of the SOF_F and SOF_L values, respectively, unless noted otherwise. The MLF_F and MLF_L values shall apply to the minimum areas bounded by the column lines and half-column lines, or the minimum areas bounded by the construction and contraction joints, whichever are the smaller areas.

3. The SOF_L and MFL_L tolerance values shall apply only to level slabs-on-ground or to level, uncambered suspended slabs that are shored such that it cannot deflect from the time the floor is placed to the time it is measured.

4. Slabs specified to slope shall have a tolerance from the specified slope of 3/8” in 10 feet at any point.

D. Construction Requirements to Achieve Specified Floor Finish Tolerances:

1. Forms shall be properly leveled, in good condition, and securely anchored including special attention to ends and transitions.

2. Bearing surfaces for straightedges such as form edges or previously poured slabs shall be kept clean of laitance, sand, gravel, or other foreign elements.

3. Screeds shall be maintained in good condition with true round rolling wheels and level cutting edges. The use of optical sighting equipment such as lasers is recommended for checking levelness and straightness. The Contractor shall promptly adjust or replace equipment when test results indicate substandard work.

4. Highway straightedges are recommended for use in lieu of bullfloats for all slab placement and finishing operations. If mineral, non-oxidizing metallic, or metallic floor hardeners are used, the slab shall be wood bullfloated immediately after the straightedge.

E. Contractor Responsibility for Concrete Floor Finish Requirements: Floor finish requirements shown below (flatness and levelness tolerances) are minimum requirements that apply unless stricter requirements are contained in instructions for installation of applied floor products in which case the Contractor is responsible for attaining the values prescribed by the manufacturer of such products.

F. Concrete Floor Finish Tolerance for Slab-on-Grade Construction:

1. Concrete Placement: Concrete shall be placed and screeded to predetermined marks set to elevations prescribed on the drawings.

2. Finish Tolerances of Random Traffic Floor Surfaces:

a. Slabs in nonpublic areas, mechanical rooms, surfaces to received raised computer flooring, and surfaces to have thick-set tile or a topping: Conventional.
b. Carpeted Areas: Moderately Flat.
c. Exposed Slabs in Public Spaces, Slabs to Receive Thin-Set Flooring: Flat.

G. Concrete Floor Finish Tolerance for Shored, Cast-in-Place Suspended Slab Construction:
1. **Concrete Placement:** Formwork shall be set and securely braced so that soffits are positioned to allow scheduled concrete member sizes and thicknesses within tolerances specified in ACI 117. Concrete shall be placed and screeded to predetermined marks on the form surface conforming to elevations prescribed on the drawings.

2. **Finish Tolerances of Random Traffic Floor Surfaces:**
   a. Slabs in Nonpublic Areas, Mechanical Rooms, Surfaces to Receive Raised Computer Flooring, Surfaces to Have Thick-Set Tile or a Topping, and Parking Structures: Conventional.
   b. Carpeted Areas: Moderately Flat.
   c. Exposed Slabs in Public Spaces, Slabs to Receive Thin-Set Flooring: Flat.

3. **Extra Concrete:** The contractor shall include in his bid any additional concrete required to achieve the specified slab surface finish tolerance.

**H. Concrete Floor Finish Tolerance – Unshored Steel Deck on Shored or Unshored Steel Beam or Steel Joist Floor Construction:**

1. **Concrete Placement:** Concrete over steel deck shall be placed and screeded level and flat to the tolerance specified below, maintaining at least the minimum slab thickness at all locations as specified on the drawings. The Contractor shall increase the slab thickness as required to compensate for steel deck deflection, and in unshored beam construction, residual beam camber and beam deflection in order to achieve a level and flat floor within specified tolerances.

2. **Finish Tolerance of Random Traffic Floor Surfaces:**
   a. Slabs in Nonpublic Areas, Mechanical Rooms, Surfaces to Receive Raised Computer Flooring, Surfaces to Have Thick-Set Tile or a Topping, and Parking Structures: Conventional.
   b. Carpeted Areas: Moderately Flat.
   c. Exposed slabs in public spaces, slabs to receive thin-set flooring: Flat.
   d. Eighty percent (80%) of the final floor surface shall fall within an envelope of 0.75" centered about the mean elevation of all the readings. The mean elevation of all readings shall not deviate from the specified design grade by more than ± 0.375".

3. **Extra Concrete:** The Contractor shall include in his bid any additional concrete required to achieve the specified slab surface finish tolerance and to compensate for steel deck deflection, beam camber and beam deflection.

**I. Remedial Measures for Slab Finish Construction Not Meeting Specified Tolerances:**

1. **Application of Remedial Measures:** Remedial measures specified herein are required whenever either or both of the following occur:
   a. The composite overall values of $F_F$ or $F_L$ of the entire floor installation measure less than specified values.
   b. Any individual test section measures less than the specified absolute minimum $F_F$ or $F_L$ value.

2. **Modification of Existing Surface:**
a. If, in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work can be repaired without sacrifice to the appearance or serviceability of the area, then the Contractor shall immediately undertake the approved repair method.
b. The Contractor shall submit for review and approval a detailed work plan of the proposed repair showing areas to be repaired, method of repair, and time to affect the repair.
c. Repair method(s), at the sole discretion of the Architect/Engineer or Owner's Representative, may include grinding (floor stoning), planing, retopping with self-leveling underlayment compound or repair topping, or any combination of the above.
d. The Architect/Engineer or Owner's Representative maintains the right to require a test repair section using the approved method of repair for review and approval to demonstrate a satisfactory end product. If, in the opinion of the Architect/Engineer or Owner's Representative, the repair is not satisfactory an alternate method of repair shall be submitted or the defective area shall be replaced.
e. The judgment of the Architect/Engineer or Owner's Representative on the appropriateness of a repair method and its ability to achieve the desired end product shall be final.
f. All repair work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

3. Removal and Replacement:

a. If, in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work cannot be satisfactorily repaired without sacrifice to the appearance or serviceability of the area, then the Contractor shall immediately commence to remove and replace the defective work.
b. Replacement section boundaries shall be made to coincide with the test section boundaries as previously defined.
c. Sections requiring replacement shall be removed by sawcutting along the section boundary lines to provide a neat clean joint between new replacement floor and existing floor.
d. The new section shall be reinforced the same as the removed section and doweled into the existing floor as required by the Engineer. No existing removed reinforcing steel may be used. All reinforcing steel shall be new steel.
e. Replacement sections may be retested for compliance at the discretion of the Architect/Engineer or Owner's Representative.
f. The judgment of the Architect/Engineer or Owner's Representative on the need for replacement shall be final.
g. All replacement work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

3.9 CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of concrete.
Limit moisture loss to a maximum of 0.05 pounds per square foot per hour for concrete containing silica fume and 0.2 pounds per square foot per hour for all other concrete before and during finishing operations. If using an evaporation retarder, apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

2. Curing shall commence as soon as free water has disappeared from the concrete surface after placing and finishing. The curing period shall be seven days for all concrete except high early strength concrete that shall be cured for three days minimum.

3. Alternatively, curing times may be reduced if either of the following provisions is complied with:
   a. If tests are made of cylinders kept adjacent to the structure and cured by the same methods, curing measures may be terminated when the average compressive strength has reached 70% of the specified compressive strength.
   b. If the temperature of the concrete is maintained at a minimum of 50°F for the same length of time required for laboratory cured cylinders of the same concrete to reach 85% of the specified compressive strength, then curing may be terminated thereafter.

4. Curing shall be in accordance with ACI 301 procedures. Avoid rapid drying at the end of the curing period.

B. Curing Formed Surfaces: Where wooden forms are used, cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. When forms are removed, continue curing by one or a combination of the methods specified below, as applicable:

1. Columns and Shear Walls Exposed to View: Moist cure in forms or by one or a combination of Methods 1, 2, or 3 specified below. Use a high solids, non-yellowing, liquid membrane-forming curing and sealing compound conforming to ASTM C 1315, Type 1, class A for Method 3.
2. Sides and Soffits of Beams and Pan-Joist Ribs, Soffits of Slabs: Moist cure in forms or by one or a combination of Methods 1, 2, or 3 specified below. Use a liquid membrane-forming dissipating resin curing compound conforming to ASTM C 309, Type 1, class A or B for Method 3.
3. Basement Walls, Sides of Exterior Retaining Walls: Moist cure in forms or by one or a combination of Methods 1, 2, or 3 specified below. Use a liquid membrane-forming dissipating resin curing compound conforming to ASTM C 309, Type 1, class A or B for Method 3.

C. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by one or a combination of the methods specified below, as applicable. The Contractor shall choose a curing method that is compatible with the requirements for subsequent material usage on the concrete surface.

1. Floors Directly Exposed to Vehicular or Foot Traffic [Not in Parking Areas] and Not Otherwise Receiving a Chemical Hardener or Penetrating Sealer Finish: Apply two coats of a high solids, water-based, non-yellowing, liquid membrane-forming curing and sealing compound conforming to ASTM C 1315, Type 1, Class A in accordance with Method 3 as specified below.
2. Floors in Non-Public Spaces that are Left Exposed to View and Not Receiving Sealers or Hardeners, Floors Involved in Under-Floor Air Distribution Systems: Apply one coat of a high-solids, water-based, non-yellowing, liquid membrane-forming curing and sealing compound conforming to ASTM C 1315, Type 1, Class A or B in accordance with Method 3 as specified below.

3. Floors that are to Receive Subsequent Cementitious Toppings, Sealers, Hardeners, Ceramic Tile, Acrylic Terrazzo, Vinyl Composition Tile, Sheet Vinyl, Linoleum, Vinyl-Backed Carpet, Rubber, Athletic Flooring, Synthetic Turf, Wood, Epoxy Overlay or Adhesive, or Other Coating or Finishing Products: Cure using Methods 2 or 3 as specified below. Use a water-based dissipating resin type curing compound conforming to ASTM C 309, Type 1, class A or B for Method 3.

4. All Other Surfaces: Cure using Methods 1, 2, or 3 as specified below. Use a water-based dissipating resin type curing compound conforming to ASTM C 309, Type 1, class A or B for Method 3.

D. Curing Methods:

1. Method 1 – Moisture Curing: Provide moisture curing by one of the following methods:
   a. Keep concrete surface continuously wet by covering with water.
   b. Continuous water-fog spray.
   c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water, and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4” lap over adjacent absorptive covers.

2. Method 2 – Moisture-Retaining Cover Curing: Provide moisture-retaining cover curing as follows:
   a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3” and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Water may be added to concrete surface to prevent drying before the cover is installed, but the surface shall not be flooded with water if a non-absorptive cover is used.

3. Method 3 – Curing or Curing and Sealing Compound: Provide curing, liquid membrane-forming curing, or curing and sealing compound as follows:
   a. Apply specified compound to concrete slabs as soon as final finishing operations are complete (within two hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Do not allow to puddle. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period. Apply second coat for sealing two to three hours after the first coat was applied.
   b. Do not use membrane-forming curing and sealing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glued-down carpet, vinyl composition tile, linoleum, sheet vinyl, rubber, athletic flooring, synthetic turf, or wood), paint, or other coatings and finish materials. Dissipating resin type cures are acceptable in these locations.
3.10 HOT WEATHER CONCRETING

A. Definition:

1. Conditions warranting hot weather concreting practices are defined as any combination of high air temperature, low relative humidity, and wind velocity tending to impair the quality of fresh or hardened concrete or otherwise result in abnormal properties. If conditions cause an evaporation rate of 0.2 pounds per square foot per hour or greater as calculated by the figure “NRMCA Nomograph for Estimating Evaporation Rate on the Basis of Menzel Formula” in Appendix A of ACI 305.1, then precautions shall be taken to prevent plastic shrinkage cracks from occurring.

B. Specification: Follow hot weather concreting practices specified below when required to limit the concrete temperature at the truck discharge point to the stated maximum acceptable temperature.

C. Records: Under hot weather conditions, the Contractor shall keep records of outside air temperature, concrete temperature at truck discharge and general weather conditions.

D. Hot Weather Concreting Requirements: The following items, all or in part as required, shall be followed to limit the concrete temperature to the stated maximum acceptable temperature and to minimize the possibility of plastic shrinkage cracks from developing.

1. Design the concrete mixture specifically for hot weather conditions replacing some cement with fly ash or other pozzolan and using a water reducing retarding admixture (ASTM C 494 Type D).
2. Use the largest size and amount of coarse aggregate compatible with the job.
3. Use sunshades and/or windbreaks.
4. Delay construction of indoor slabs-on-grade until the walls and roof are constructed.
5. Cool and shade aggregate stockpiles.
6. Use ice as part of the mixing water or cool the water with liquid nitrogen. Do not place concrete that contains unmelted ice.
7. Limit the number of revolutions at mixing speed to 125 maximum.
8. Reduce time between mixing and placing as much as possible.
9. Do not add water to ready-mixed concrete at the job site unless it is part of the amount required initially for the specified water-cement ratio and the specified slump.
10. Schedule concrete placement for early morning, late afternoon, or night.
11. Have all forms, equipment, and workers ready to receive and handle concrete.
12. Maintain one standby vibrator for every three vibrators used.
13. Keep all equipment and material cool by spraying with water including exteriors of forms, reinforcing steel, subgrade, chutes, conveyors, pump lines, tremies, and buggies.
14. Protect slab concrete at all stages against undue evaporation by applying a fog spray or mist above the surface or applying a monomolecular film. Where high temperatures and/or placing conditions dictate, use water-reducing retarding admixture (Type D) in lieu of the water-reducing admixture (Type A) as directed by the Owner's Testing Laboratory.
15. Provide continuous curing, preferably with water, during the first 24 hours using wet burlap, cotton mats, continuous spray mist, or by applying a curing compound meeting ASTM C 1315. Continue curing for three days minimum.
16. Cover reinforcing steel with water soaked burlap so that steel temperature will not exceed ambient air temperature immediately before placement of concrete.
17. As soon as possible, loosen forms and run water down the inside. When forms are removed, provide a wet cover to newly exposed surfaces.

3.11 COLD WEATHER CONCRETING

A. Definition:

1. Concrete shall not be placed when the outside air temperature is 40°F or less unless cold weather concreting practices are followed as specified below.

2. Cold weather concreting practices should also be followed whenever the average daily air temperature is expected to be less than 40°F for more than three successive days. The average daily air temperature is the average of the highest and lowest temperature occurring during the period from midnight to midnight. The requirement for adhering to these cold-weather concreting practices may be terminated when the air temperature is above 50°F for more than half of any 24 hour duration.

3. Cold weather concreting practices invoked shall keep the temperature of the concrete immediately after placing within the following temperature ranges:

   a. 55°F to 75°F for sections less than 12 inches in the least dimension.
   b. 50°F to 70°F for sections 12 to 36 inches in the least dimension.
   c. 45°F to 65°F for sections 36 to 72 inches in the least dimension.
   d. 40°F to 60°F for sections greater than 72 inches in the least dimension.

4. Concrete Protection: Protect the concrete immediately after placing and during the defined protection period such that the concrete does not freeze nor fall below the temperature levels stated in the above paragraph. For concrete not loaded during construction, the protection period shall be for a minimum of three days if cold-weather conditions persist. The time may be reduced to a minimum of two days if Type III cement or an accelerating admixture is used or if an additional 100 pounds of cement per cubic yard is added to the concrete mix. Concrete fully loaded during construction shall be protected during cold weather conditions for whatever time is required to obtain the required strength as determined by nondestructive strength tests (Windsor probe, Swiss Hammer Test) on the in-place concrete. Protect concrete surfaces from freezing for the first 24 hours even if cold-weather conditions do not officially exist due to high volatility in ambient temperatures.

5. Protection Deficiency: If the temperature requirements during any portion of the protection period are not met but the concrete surface did not freeze, the protection period shall be extended until twice the deficiency expressed in degree-hours is made up. Deficiency degree-hours are defined as the average deficiency in temperature below the required value times the number of hours the deficiency persisted. Make-up degree hours are the average increase in temperature above the minimum value times the hours required to make up twice the deficiency degree-hours. Contact the Architect/Engineer if the concrete surface was allowed to freeze during the protection period.

6. Protection Removal: As the protection is being removed the decrease in temperature measured at the surface of the concrete in a 24 hour period shall not exceed the following:

   a. 50°F for sections less than 12 inches in the least dimension.
   b. 40°F for sections 12 to 36 inches in the least dimension.
   c. 30°F for sections 36 to 72 inches in the least dimension.
   d. 20°F for sections greater than 72 inches in the least dimension.
7. The maximum concrete temperature heated by artificial means at point of placement shall not exceed 90°F.

B. Records: Under cold weather conditions, the Contractor shall keep records of outside air temperature, concrete temperature as placed and general weather conditions. The temperature record shall be taken no less than two times per 24 hour duration.

C. Cold Weather Concreting Requirements: The following items, all or in part as required, should be followed to assure acceptable concrete in cold weather conditions:

1. Design the concrete mixture to obtain high early strength by using higher cement content, a high early strength cement (Type III), or a specified non-chloride accelerator (ASTM C 494 Type C or E).
2. Protect the concrete during curing period using insulating blankets, insulated forms, enclosures, and/or heaters.
3. Concrete cured in heated enclosures shall have heaters vented to prevent exposure of concrete and workmen to noxious gases.
4. Frozen subgrade shall be thawed prior to concrete placement and snow and ice shall be removed from forms.
5. Temperature of embedments in concrete must be heated to above 32°F prior to placing concrete.
6. Heat the mixing water and then blend hot and cold water to obtain concrete no more than 10°F above the required temperature.
7. Heat the aggregates by circulating steam in pipes placed in the storage bins for air temperatures consistently below 32°F. When either water or aggregate is heated to over 140°F, combine them in the mixer first to obtain a maximum temperature of the mixture not to exceed 140°F in order to prevent flash set of the concrete.
8. Uniformly thaw aggregates far in advance of batching to prevent moisture variations in the stockpile.
9. Cover warmed stockpiles with tarps to retain heat.
10. Place air entraining admixture in the batch after the water temperature has been reduced by mixing with cooler solid materials.
11. Use wind screens to protect concrete from rapid cooling.
12. Place vertical pump lines inside the building, if possible, for concrete being pumped.
13. Maintain artificial heat as low as possible to reduce temperature stresses during cooling.
14. Avoid water curing of concrete except for parking garage structures. Apply the required curing compound to unformed surfaces as soon as possible to prevent drying of concrete from heated enclosures.
15. Delay form stripping as long as possible to help prevent drying from heated enclosures and to reduce damage to formed surfaces caused by premature stripping.
16. Provide triple thickness of insulating materials at corners and edges vulnerable to freezing.
17. Wrap protruding reinforcing bars with insulation to avoid heat drain from the warm concrete.
18. Gradually reduce the heat at the end of the heating period to reduce likelihood of thermal shock.

3.12 MISCELLANEOUS CONCRETE ITEMS

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

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

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor rods for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp and finish concrete surfaces as scheduled.

E. Adhesive Anchors: All drilled holes for adhesive anchors shall be within six degrees of perpendicular to the surface of the concrete member.

3.13 INVESTIGATION OF LOW CONCRETE STRENGTH TEST RESULTS

A. Contractor Responsibility for Low Strength Concrete:

1. If the average of any three consecutive strength tests falls below the required f’c for a class of concrete but no individual strength test is more than 500 PSI below the required f’c, the Contractor shall immediately notify the Engineer by telephone or email and take immediate steps to increase the average of subsequent strength tests.
2. If any individual strength test falls more than 500 PSI below the required f’c, the Contractor shall immediately notify the Engineer by telephone or e-mail and take immediate steps to assure that the load-carrying capacity of the structure is not jeopardized.

B. Additional Field Tests to Confirm Low Concrete Strengths:

1. The cost of all investigations of low-strength concrete, as defined by any individual strength test being more than 500 PSI below the required f’c, shall be borne by the Contractor.
2. Code-Prescribed Acceptance: The only accepted field-test methods of determining actual in-situ concrete strength is by the way of core tests as prescribed by ACI 318.
3. Non-Destructive Tests: If any individual strength test falls more than 500 PSI below the required f’c, the Engineer may request that non-destructive field tests be performed on the concrete in question using Swiss Hammer, Windsor Probe, or other appropriate methods as approved by the Engineer. Report the comparative test results of the suspect concrete under consideration with identical tests done on concrete of known strength and of the same class. The Engineer considers these test results as only approximate indicators of strength and may not necessarily, by themselves, resolve the low concrete strength issue. These test results will be considered as additional information by which to make an informed judgment. The Engineer reserves the right to accept the concrete based on the results of these approximate tests or order that core tests be taken as prescribed below. At the Contractor’s option, the approximate non-destructive field-tests may be waived and core tests immediately initiated.
4. Core Tests: If, in the opinion of the Engineer, the likelihood of low-strength concrete is confirmed and it has been determined that the load-carrying capacity of the structure is significantly reduced as a result, the Engineer may request that core tests be taken from the area in question as directed by the Engineer. There shall be a minimum of three cores taken for each strength test more than 500 PSI below the required f’c in accordance with ASTM C 42. If concrete in the structure will be dry under service conditions, cores shall be air dried (temperature 60° to 80°F, relative humidity less than 60 percent) for seven days before test and shall be tested dry. If concrete in the structure will be more than superficially wet under service conditions, cores shall be immersed in water for at least 40 hours and tested wet. The Contractor shall fill all holes made by drilling cores with an approved drypack concrete.

5. Acceptance Criteria for Core Test: Concrete in an area represented by core tests shall be considered adequate if the average of three cores is equal to at least 85% of the required f’c and no single core is less than 75% of the required f’c. If approved by the Engineer, locations of erratic core strengths may be retested to check testing accuracy.

6. Load Test: If the concrete strength is not considered adequate based on core tests and the structural adequacy remains in doubt, the Engineer may order a load test as specified in ACI 318 be conducted for the questionable portion of the structure.

7. Strengthening or Demolition of the Structure: If the structural adequacy of the affected portion of the structure remains in doubt following the load test, the Engineer may order the structure to be strengthened by an appropriate means or demolished and rebuilt at the Contractor’s expense.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Areas:

1. Formed Surfaces: Concrete surfaces requiring repairs shall include all cracks in excess of 1/64” in width and any other defects that affect the durability or structural integrity of the concrete. Voids, including honeycombing and rock pockets, and tie holes shall be repaired as required by the specified Surface Finish.

2. Unformed Surfaces: Concrete surfaces requiring repair shall include all surface defects such as crazing, cracks in excess of 1/64” in width or cracks that penetrate to reinforcement or through the member, popouts, spalling, and honeycombs.

B. Classification:

1. Structural Concrete Repair: Major defective areas in concrete members that are load carrying (such as shear walls, beams, joists and slabs), are highly stressed, and are vital to the structural integrity of the structure shall require structural repairs. Structural concrete repairs shall be made using a two-part epoxy bonder, epoxy mortar, or specified polymer repair mortar. The Engineer shall determine the locations of required structural concrete repairs.

2. Cosmetic Concrete Repair: Defective areas in concrete members that are non-load carrying and minor defective areas in load carrying concrete members shall require cosmetic concrete repair when exposed to view and not covered up by architectural finishes. Cosmetic concrete repairs may be made using a polymer repair mortar and compatible bonding agent. The Architect/Engineer shall determine the locations of required cosmetic concrete repairs. Stains and other discolorations that cannot be removed by cleaning and
are exposed to view will require cosmetic repair. Cosmetic concrete repair in exposed-to-view surfaces will require Architect’s approval prior to patching operation.

3. Slab Repairs: High and low areas in concrete slabs shall be repaired by removing and replacing defective slab areas unless an alternate method, such as grinding and/or filling with self-leveling underlayment compound or repair mortar is approved by the Architect/Engineer. Repair of slab spalls and other surface defects shall be made using epoxy products as specified above and as determined by the Engineer. The high strength flowing repair mortar may be used for areas greater than one inch in depth.

3.15 FIELD QUALITY CONTROL

A. Field Testing and Inspection: Refer to Specification 014529 “Structural Testing and Inspections” for testing and inspection requirements associated with cast-in-place concrete.

END OF SECTION 033000
SECTION 04 20 00 – UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:

1. Concrete masonry units (CMUs).
2. Face Brick
4. Mortar and grout.
5. Reinforcing steel.
7. Ties and anchors.
8. Embedded flashing.
9. Miscellaneous masonry accessories.

B. Related Sections include the following:

1. Division 07 Section "Water Repellents" for water repellents applied to unit masonry assemblies.
2. Division 07 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing.
3. Division 07 Section "Joint Sealants" for sealing control and expansion joints in unit masonry.

C. Products furnished, but not installed, under this Section include the following:

1. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Division 05 Section "Structural Steel Framing."

D. Products installed, but not furnished, under this Section include the following:

1. Steel lintels and shelf angles for unit masonry, furnished under Division 05 Section "Metal Fabrications."
2. Manufactured reglets in masonry joints for metal flashing, furnished under Division 07 Section "Sheet Metal Flashing and Trim."

1.3 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.
1.4 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths ($f'_m$) at 28 days.

B. Determine net-area compressive strength ($f'_m$) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

C. Determine net-area compressive strength ($f'_m$) of masonry by testing masonry prisms according to ASTM C 1314.

1.5 SUBMITTALS

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

B. Shop Drawings: For the following:
   1. Masonry Units: Show 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."
   3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type of the following:
   1. Accessories embedded in masonry.

D. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
   1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

E. Qualification Data: For testing agency.

F. Material Certificates: 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. Include material test reports substantiating compliance with requirements.
      b. 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. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   4. Grout mixes. Include description of type and proportions of ingredients.
   5. Reinforcing bars.
7. Anchors, ties, and metal accessories.

G. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

H. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

I. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

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.

D. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

1. Concrete Masonry Unit Test: For each type of unit required, per ASTM C 140.
2. Mortar Test (Property Specification): For each mix required, per ASTM C 780.
3. Grout Test (Compressive Strength): For each mix required, per ASTM C 1019.
4. Prism Test: For each type of construction required, per ASTM C 1314.

E. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
1.7 DELIVERY, STORAGE, AND HANDLING

A. 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.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
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.


PART 2 - PRODUCTS

2.1 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 uses 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.

2.2 CONCRETE MASONRY UNITS (CMUs)

A. Shapes: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners, unless otherwise indicated.

B. Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
2. Weight Classification: Lightweight, unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Size (Width): Manufactured to the following dimensions:
   a. As shown.

C. Decorative CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
2. Density Classification: Lightweight.
3. Pattern and Texture:

2.3 BRICK

A. General: Provide shapes indicated and as follows:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: Facing brick complying with ASTM C 216 or hollow brick complying with ASTM C 652, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area).

1. Products: Subject to compliance with requirements, provide the following:
   a. BR01: Acme 137 “Burgundy”.
   b. BR02: Acme Texas Quarries “Cordova Crème” (Rough/broken face)

2. Grade: MW or SW.
3. Type: FBS.
4. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3350 psi.
5. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
6. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
7. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet.

2.4 STONE TRIM UNITS

A. Limestone: ASTM C568/C568M, Classification I Low, Classification II Medium, Classification III High Density.

1. Variety and Sources: Texas limestones quarried in Texas
   a. Grade and Color: Match Architects sample according to grade and color classification established by local industry standard

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S or N as recommended by the Masonry Institute.

C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S or N as recommended by Masonry Institute.
D. Colored Cement Product: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:
   
a. **Products**: Subject to compliance with requirements, provide one of the following:
   
   1) **Capital Materials Corporation**: Riverton Portland Cement Lime Custom Color.
   2) **Holcim (US) Inc.**: Rainbow Mortamix Custom Color Cement/Lime.
   3) **Lafarge North America Inc.**: Eaglebond Portland & Lime.
   4) **Lehigh Cement Company**: Lehigh Custom Color Portland/Lime Cement.

E. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

F. Aggregate for Grout: ASTM C 404.

G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. **Products**:
   
a. Addiment Incorporated; Mortar Kick.
   b. Euclid Chemical Company (The); Accelguard 80.
   d. Sonneborn, Div. of ChemRex; Trimix-NCA.

H. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951.

1. Exterior Walls: Hot-dip galvanized, carbon steel.
2. Wire Size for Side Rods: W2.8 or 0.188-inch diameter.
3. Wire Size for Cross Rods: W2.8 or 0.188-inch diameter.
4. Wire Size for Veneer Ties: W2.8 or 0.188-inch diameter.
5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Multiwythe Masonry:
1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

2.7 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with eight subparagraphs below, unless otherwise indicated.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
   1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units or hollow units laid with cells horizontal.
   2. Where wythes do not align, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.

D. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
   1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire.
   2. Tie Section for Steel Frame: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.25-inch-diameter, hot-dip galvanized steel wire.

E. Partition Top anchors: 0.097-inch-thick metal plate with 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins, unless otherwise indicated.
   1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

G. Partition Top anchors: 0.105-inch-thick metal plate with 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
H. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

I. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:

   a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.

2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch-thick steel sheet, galvanized after fabrication.

3. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-inch-diameter, hot-dip galvanized steel wire.

4. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) Dayton Superior Corporation, Dur-O-Wal Division; D/A 213 or D/A 210 with D/A 700-708.
      2) Heckmann Building Products Inc.; 315-D with 316.
      3) Hohmann & Barnard, Inc.; DW-10HS or DW-10-X.
      4) Wire-Bond; 1004, Type III or RJ-711.

   b. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, having slotted holes for inserting wire tie.

2.8 MISCELLANEOUS ANCHORS

A. Anchor Bolts: Headed steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

B. Postinstalled Anchors: Provide chemical anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
2.9 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing: For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:

1. Copper-Laminated Flashing: 7-oz./sq. ft. copper sheet bonded with asphalt between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
   a. Products:
      1) Advanced Building Products Inc.; Copper Fabric Flashing.
      2) AFCO Products Inc.; Copper Fabric.
      3) Hohmann & Barnard, Inc.; H & B C-Fab Flashing.
      4) Phoenix Building Products; Type FCC-Fabric Covered Copper.
      5) Polytite Manufacturing Corp.; Copper Fabric Flashing.
      6) Sandell Manufacturing Co., Inc.; Copper Fabric Flashing.
      7) York Manufacturing, Inc.; York Copper Fabric Flashing.

B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.
   1. Products:
      a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
      c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
      d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

E. Weep/Vent Products: Use the following unless otherwise indicated:
1. Vinyl Weep Hole/Vent: T-shaped units made from flexible PVC, consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.

   a. **Products:** Subject to compliance with requirements, provide one of the following:

      1) [Hohmann & Barnard, Inc.; #343 Louvered Weep Hole](#).
      2) [Williams Products, Inc.; Williams-Goodco Brick Vent](#).
      3) [Wire-Bond; Louvered Weepholes](#).

   F. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

   1. **Products:** Subject to compliance with requirements, provide one of the following:

      a. [Advanced Building Products Inc.; Mortar Break](#).
      b. [Archovations, Inc.; CavClear Masonry Mat](#).
      c. [Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop](#).
      d. [Mortar Net USA, Ltd.; Mortar Net](#).

      2. Provide one of the following configurations:

         a. Strips, full-depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep.
         b. Strips, not less than [3/4 inch] [1-1/2 inches] thick and 10 inches high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
         c. Sheets or strips full depth of cavity and installed to full height of cavity.

2.11 CAVITY-WALL INSULATION

A. Polyisocyanurate Board Insulation: ASTM C 1289, Type I (aluminum-foil-faced), Class 2 (glass-fiber-reinforced).

B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.12 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

   1. Manufacturers:

      a. Diedrich Technologies, Inc.
      b. EaCo Chem, Inc.
      c. ProSoCo, Inc.
2.13 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Limit cementitious materials in mortar to portland cement and lime.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type N.
2. For reinforced masonry, use Type S.
3. For cast stone masonry, use Type N.
4. For brick masonry, use Type N.
5. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

2.14 SOURCE QUALITY CONTROL

A. Owner will engage a qualified independent testing agency to perform source quality-control testing indicated below:

1. Payment for these services will be made by Owner.
2. Retesting of materials failing to comply with specified requirements shall be done at Contractor’s expense.

B. Concrete Masonry Unit Test: For each type of unit furnished, per ASTM C 140.
PART 3 - EXECUTION

3.1 EXAMINATION

A. 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.
   3. Verify that reinforcing dowels are properly placed.

B. 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 INSTALLATION, GENERAL

A. 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.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. 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.

E. 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.

F. 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, 1/4 inch in 20 feet, or 1/2 inch maximum.
   2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch 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, 1/4 inch in 20 feet, or 1/2 inch maximum.
   4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.3 LAYING MASONRY WALLS

A. 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 corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. 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.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.

G. 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.

H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section "Fire-Resistive Joint Systems."

3.4 MORTAR BEDDING AND JOINTING
A. Lay hollow concrete masonry units as follows:
   1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
   2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
   3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
   4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.5 MASONRY JOINT REINFORCEMENT
A. General: 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. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
      a. Reinforcement above is in addition to continuous reinforcement.
B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
C. Provide continuity at wall intersections by using prefabricated T-shaped units.
D. Provide continuity at corners by using prefabricated L-shaped units.
E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.
3.6 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

1. Assume control joints every 25 feet of elevation; see Drawings for initial layout; final layout to be coordinated/verified with contractor and masonry sub-contractor.

B. Form control joints in concrete masonry as follows:

1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.

C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.8 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.9 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows, unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on
sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

2. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.

3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.

4. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.

5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.

6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.

7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.10 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

2. Limit height of vertical grout pours to not more than 60 inches.

3.11 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 1.77 sq. ft. of wall area spaced not to exceed 16 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.

   a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
   b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.
   c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Apply air barrier to face of backup wythe to comply with Section 072726 "Fluid-Applied Membrane Air Barriers."

D. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

3.12 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.

1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.

B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:
1. Payment for these services will be made by Owner.
2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

D. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.

E. Mortar Test (Property Specification): For each mix provided, per ASTM C 780. Test mortar for mortar air content and compressive strength.

F. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.

G. Prism Test: For each type of construction provided, per ASTM C 1314 at 7 days and at 28 days.

3.13 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
3.14 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove excess clean masonry waste and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 20 00
SECTION 042213 – STRUCTURAL REINFORCED CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 CODES AND STANDARDS

A. All concrete masonry construction shall conform to the requirements of the local building code and the Specification for Concrete Masonry Structures, ACI 530.1/ASCE 6/TMS 602.

1.3 DESCRIPTION OF WORK

A. Extent of each type of reinforced unit masonry work is indicated on the architectural and structural drawings and in schedules. Provide all labor, materials, equipment, and services necessary for and incidental to the installation of all reinforced masonry construction as indicated on the drawings and specified herein and in Section 04 22 00.

B. Reinforced unit masonry construction includes reinforced concrete masonry including concrete filled masonry beams, columns, pilasters, lintels, and soffits.

C. Accessories include, but are not necessarily limited to ties, horizontal and vertical reinforcement, anchors to the structure, and control joints.

D. The masonry contractor shall install all accessory items that are required in the work and supplied by others, including: bolts, nailing blocks, inserts, anchors, flashing, steel lintels, expansion joints, conduits, cast-stone trim, hollow-metal door frames, etc.

E. Types of masonry work required include Concrete unit masonry (CMU).

1.4 QUALITY ASSURANCE

A. Fire Performance Characteristics: Where indicated, provide materials and construction which are identical to those of assemblies whose fire endurance has been determined by testing in compliance with ASTM E 119 by a recognized testing and inspecting organization or by another means, as acceptable to authority having jurisdiction.

B. Single Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.
C. Single Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

D. Masonry Preconstruction Testing Service: Employ and pay for the services of an independent testing laboratory acceptable to Architect and experienced in performing types of preconstruction masonry tests indicated. The testing laboratory shall meet the basic requirements of ASTM E 329 and have current accreditation from either the American Association for Laboratory Accreditation, the AASHTO Accreditation Program, or the “NIST” National Voluntary Laboratory Accreditation Program.

1. Preconstruction Verification by Unit Strength Method
   a. Concrete Masonry Units: For each type of concrete masonry wall construction shown on the structural or architectural drawings, submit results of tests conducted in accordance with ASTM C140 that demonstrate that the strength of the concrete masonry units are consistent with required compressive strength of the masonry construction shown on the drawings.
   b. Mortar: Submit the proportions of the mortar mix to verify compliance with the specified type.

2. Preconstruction Tests for Shear.
   a. Test masonry assemblages for diagonal tension (shear) per ASTM E 519.

3. Preconstruction Strength Tests
   a. Test building panels for strength per ASTM E 72.

4. Grout Demonstration Panel: If the proposed grouting procedures, construction techniques, and grout space geometry, including such items as maximum grout pour and grout lift heights and consolidation techniques, do not conform to the requirements of ACI 530.1/ASCE 6/TMS 602, construct a grout demonstration panel prior to masonry construction.

5. Masonry work will not begin until test results are submitted to and approved by the Architect/Engineer.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements. Provide certification of pull-out strength of all masonry ties and anchors. Submit certification of compliance with required standards for all masonry units.

B. Shop Drawings: Show fabrication and installation details for the following:
   1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars and for templates for layout of dowels for columns and pilasters. Comply with the fabrication tolerances of ACI 315, “Details and Detailing of Concrete Reinforcement.” Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and
assemblies as required for fabrication and placement of reinforcement for unit masonry work.

C. Mix Designs:

1. Mortar mix proportions for type of mortar required to achieve specified compressive strength of masonry.
2. Mix designs and mortar tests performed in accordance with ASTM C 270
3. Grout mix proportions according to ASTM C476 for the types of grout required for the work.
4. Mix designs and grout tests performed in accordance with ASTM C 476.

D. Certificates: Prior to delivery, submit to Architect/Engineer certificates attesting compliance with the applicable specifications for grades, types or classes of all products included in these specifications.

1. All materials required for mortar and grout including type, source, brand, and name of manufacturer.
2. Each combination of masonry unit type and mortar type. Include statement of net area compressive strength of masonry units, mortar type and net compressive strength of masonry determined according to Table 2 in ACI 530.1/ASCE 6/TMS 602.
3. Mill Certificates: Steel producer’s certificates of mill analysis, tensile and bend test for reinforcing steel required for project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry materials to project in undamaged condition.

B. Store and handle masonry units to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes. During freezing weather, protect masonry units with tarpaulins or other suitable material. If units become wet, do not install until they are dry.

C. At the time of delivery, the linear shrinkage of masonry units shall not exceed 0.065 percent.

D. Store cementitious materials and masonry units off the ground, under cover and in dry location. All materials must be protected from wetting by capillary action, rain, or snow, and protected from mud, dust, or other materials and contaminants likely to cause staining or defects.

E. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying in dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

F. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

G. Store masonry accessories, including metal items, in such a way as to prevent corrosion or accumulation of dirt and oil.
1.7 PROJECT CONDITIONS

A. Protection of Work: The Contractor shall construct and maintain temporary protection as required to permit continuous progress of the work. During erection, cover top of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of the other wythes, secure cover a minimum of 24 inches down the face next to unconstructed wythe and hold cover in place.

B. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

C. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.

1. When ambient temperature exceeds 100 degrees F or 90 degrees F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.
2. Comply with hot-weather preparation and construction provisions of ACI 530.1/ASCE 6/TMS 602

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. See Section 042200 for the specifications for concrete masonry units.

2. Unit Compressive Strength: Provide units with a minimum average net-area compressive strength of «COMPRESSIVE STRENGTH» psi.
3. Size: Manufacturer's standard units with nominal face dimensions of 16” long x 8” high (15-5/8" x 7-5/8" actual) x thicknesses indicated unless shown otherwise on the drawings.

2.2 CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following consistent with the span and reinforcing tables on the drawings:

1. Manufactured Concrete Masonry Lintels: ASTM C 1623, matching Concrete Masonry Units in color, texture and density classification.
2. Precast Concrete Lintel Units: Solid or U-shaped, grout-filled. Comply with the requirements of Division 03, “Cast-in-Place Concrete”, reinforced with mild reinforcing steel or prestressed with prestressing cables.
3. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam Concrete Masonry Units with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.3 STRUCTURAL STEEL LINTELS
   A. Wide-flange: ASTM A 992.
   B. Channels: ASTM A 36.
   C. Plates: ASTM A 36.
   D. Rectangular HSS: ASTM A 500, Grade B.

2.4 MORTAR AND GROUT MATERIALS
   A. Do not use calcium chloride in mortar or grout.
   B. Mortar: ASTM C 270, Proportion Specification, Type S, limiting cementitious materials to those described below:
      1. Portland Cement-Lime
   C. Grout: Provide grout that conforms to either of the two requirements below:
      1. ASTM C 476, Proportion Specification
      2. The material requirements of ASTM C 476; attains the specified compressive strength or 2000 psi, whichever is greater, at 28 days when tested in accordance with ASTM C 1019; has a slump flow of 24 in. to 30 in. as determined by ASTM C 1611; and has a Visual Stability Index (VSI) less than or equal to 1 as determined in accordance with ASTM C1611.
      3. Grout consistency is to be coarse grout unless fine grout is required by ACI530.1/ASCE6/TMS602 based on minimum grout space dimensions coupled with maximum pour heights or unless a stricter requirement is defined by the local code.

2.5 REINFORCING STEEL
   A. Uncoated Steel Reinforcing Bars: ASTM A 615, Grade 60.
   B. Epoxy-Coated Steel Reinforcing Bars: ASTM A 615, Grade 60, epoxy coated to comply with ASTM A 775.
   C. Galvanized Steel Reinforcing Bars: ASTM A 767, Grade 60.
2.6 JOINT REINFORCEMENT, TIES AND ANCHORING DEVICES

A. General:

1. Comply with requirements indicated below for basic materials and with requirements indicated under each form of joint reinforcement, tie and anchor for size and other characteristics.

2. Manufacturers:

   a. Subject to compliance with requirements, provide products of one of the following:
      
      1) AA Wire Products Co.
      2) Dur-O-Wall, Inc.
      3) Hohmann & Barnard, Inc.
      4) National Wire Products Corp.
      5) Heckman Building Products

   b. Other manufacturers shall be used only with Engineer approval. The Contractor shall submit technical literature for all reinforcing units.

3. Finishes: Provide reinforcement, ties, and anchors specified in subsequent paragraphs that are made from materials or that have the finishes that comply with the subparagraphs below, depending on the finish specified, unless otherwise indicated.

   a. Mill Galvanized Finishes
      
      1) Joint Reinforcement: ASTM A 641 (0.1 oz/ft²).
      2) Sheet-metal ties and anchors: ASTM A 653 G60.

   b. Hot-Dip Galvanized Finishes
      
      2) Sheet-metal Ties and Anchors: ASTM A 153, Class B.
      3) Steel Plates and Bars: ASTM A 123 or ASTM A 153, Class B.

   c. Epoxy Coatings:
      
      1) Joint Reinforcement: ASTM A 884, Class A, Type 1 ≥ 7 mils.
      2) Wire Ties and Anchors: ASTM A 889, Class C = 20 mils.
      3) Sheet-metal Ties and Anchors: 20 mils per surface or manufacturer’s specification.

B. Joint Reinforcement: ASTM A 951: Welded-wire units prefabricated with deformed continuous side rods and plain cross rods in straight lengths of not less than 10 feet, with prefabricated corner and tee units, and complying with the requirements indicated below:

1. Materials and Finishes:

   a. Galvanized: ASTM A 82.
   b. Epoxy: ASTM A 82.
2. Width: Fabricate joint reinforcement in units with widths a minimum of 2” less than nominal width of walls. Provide mortar coverage over joint reinforcement of not less than 5/8” on joint faces exposed to exterior and 1/2” elsewhere.

3. Wire Size for Side and Cross Rods:
   a. 9 ga. diameter for both side rods and cross rods.
   b. 0.1875” diameter (W2.8) for side rods and 9 ga. diameter for cross rods.
   c. 0.1875” diameter (W2.8) diameter for both side and cross rods.

4. For single-wythe masonry provide either ladder or truss type with single pair of side rods and cross wires in ladder-type or points of connection in truss-type reinforcement spaced no more than 16 inches o.c. horizontally.

5. For multi-wythe masonry provide ladder type with cross rods spaced not more than 16" o.c., horizontally, and number of side rods as follows:
   a. One side rod for each face shell of concrete masonry units in either wythe more than
      4 inches in thickness plus one side rod for each wythe of concrete masonry units 4
      inches or less in width.
   b. Adjustable (two-piece) type, ladder design, with one side rod at each face shell of
      backing wythe and with separate ties that extend into facing wythe. Ties have two
      hooks that engage eyes or slots in reinforcement and resist movement perpendicular
      to wall. Ties extend at least halfway through facing wythe but with at least 5/8-inch
      cover on outside face. The maximum clearance between connecting parts of the ties
      is 1/16”.

C. Bent Wire Ties: Provide individual prefabricated bent-wire units complying with requirements indicated below:

   1. Materials and Finishes:
      a. Galvanized: ASTM A 82.
      b. Epoxy: ASTM A 82.

   2. Wire Size: 0.1875” diameter.

   3. Length: Provide units of length indicated but not less than that required for embedment of
      at least 1 ½ " into the mortar bed of solid units or solid grouted hollow units and for a
      minimum of 1/2” embedment of tie end into outer face shells of hollow units, with not less
      than 5/8” mortar cover on exterior face joints, 1/2” elsewhere.

   4. Tie Shape for Hollow Masonry Units Laid with Cells Vertical: Rectangular with ends
      welded closed and not less than 4” wide.

   5. Tie Shape for Solid Masonry Units or hollow units laid with cells horizontal: Z-shaped
      ties with ends bent 90° to provide hooks not less than 2” long.

   6. Type for Masonry Where Coursing Between Wythes Align: Unit ties bent from one piece
      of wire.

   7. Type for Masonry Where Coursing Between Wythes Does Not Align: Adjustable ties with
      pintle-and-eye connections having a maximum adjustment of 1-1/4 “. The maximum
      clearance between connecting parts of the tie shall be 1/16”.

D. Adjustable Anchors: Where adjustable anchors are indicated for connecting masonry to structural
framework, provide 2-piece assemblies as described below which permit vertical or horizontal
differential movement between wall and framework parallel to, but resist tension and compression forces perpendicular to, plane of wall.

1. Materials and Finishes:

2. For anchorage to concrete framework, provide manufacturer's standard anchors with dovetail anchor section formed from 0.0966" thick sheet metal and triangular-shaped wire tie section sized to extend within 1" of masonry face.

3. For anchorage to steel framework provide manufacturer's standard anchors with crimped 1/4" diameter wire anchor section for welding to steel and triangular-shaped wire tie section sized to extend within 1" of masonry face.

4. Wire Size for triangular section: 0.1875" diameter.

E. Rigid Anchors: Provide straps of form and length indicated, fabricated from sheet metal strips of following width and thickness, unless otherwise indicated. Typical length to be 24" plus 2" long, 90° bends at ends.

1. Material and Finishes:
   b. Epoxy: ASTM A 1008.

2. Width: 1-1/2".

3. Thickness: 1/4".

F. Unit Type Masonry Inserts in Concrete: Furnish cast iron or malleable iron inserts of type and size indicated.

G. Dovetail Slots: Furnish dovetail slots, with filler strips, of slot size indicated, fabricated from 0.0336" (22 gage) sheet metal, ASTM A 1008, Hot-dip galvanized.

H. Anchor Bolts: Provide steel bolts with hex nuts and flat washers complying with ASTM A 307, Grade A, hot-dip galvanized to comply with ASTM A 153, Class C, in sizes and configurations indicated.

I. Post-installed Anchors:

1. ICC Approval: Only anchors evaluated by the ICC Evaluation Service, Inc. (ICC-ES) with a published Evaluation Report specifically addressing anchorage to hollow or fully grouted concrete masonry shall be approved for use.

2. Type:
   a. Hollow Concrete Masonry: Anchors into or through hollow concrete masonry units shall be the chemical type used with a galvanized or stainless steel screen tube that allows the chemical adhesive to create a key within the hollow cell of the unit.
b. Fully Grouted Concrete Masonry: Anchors into fully grouted masonry shall be either chemical anchors or expansion anchors specifically approved by ICC-ES for use in fully-grouted concrete masonry.

3. Finish:
   a. Interior Exposure: All anchors, nuts and washers for use in interior environments free of potential moisture shall be manufactured from carbon steel, zinc plated in accordance with Federal Specification QQ-Z-325C, Type II, Class 3.
   b. Exterior or Exposed Use: All anchors, nuts, and washers for use in exposed or potentially wet environments, or for attachment of exterior cladding materials shall be galvanized or stainless steel. Galvanized anchors, nuts and washers shall conform to ASTM A 153. Stainless steel anchors shall be manufactured from 300 series stainless steel and nuts and washers from 300 series or Type 18-8 stainless steel.

2.7 MISCELLANEOUS MASONRY ACCESSORIES
   A. Non-Metallic Expansion Joint Strips: Premolded, flexible cellular neoprene rubber filler strips complying with ASTM D 1056, Grade RE 41E1, capable of compression up to 35%, of width and thickness indicated.
   B. Premolded Control Joint Strips: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
      1. Premolded PVC Control Joint Strips. Strips shall be polyvinyl chloride complying with ASTM D 2287, Type PVC 654-4 with a durometer hardness of 90.
   C. Weepholes: Cotton Cord: Sash cord of length required to produce 2” exposure on exterior and 18” in cavity between wythes.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL
   A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Inspect surfaces that are to support masonry work to assure completion to proper lines and grades and are free of dirt and other deleterious material. Do not begin work until surfaces not properly prepared have been satisfactorily corrected.
      1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
      2. Verify that foundations or other supporting surfaces are within specified tolerances.
      3. Verify that reinforcing dowels are properly spaced.
      4. Examine rough-in and built-in construction to verify actual locations of piping connections.
   B. The horizontal and vertical spacing between anchors tying the masonry wall to the structural frame shall be as indicated on the drawings. Intersecting walls may substitute for an anchor.
C. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.

D. Installation of Masonry, General:

1. Build cavity and composite walls, floors and other masonry construction to the full thickness shown. Build single-wythe walls (if any) to the actual thickness of the masonry units, using units of nominal thickness indicated.
2. Build chases and recesses as shown or required for the work of other trades. Provide not less than 8" of masonry between chase of recess and jamb of openings, and between adjacent chases and recesses.
3. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.
4. Cut masonry units using motor-driven dry-cutting or water-cooled saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous patterns and to fit adjoining work. Use full-size units without cutting where possible.
5. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Do not install cracked, broken, or chipped masonry units exceeding ASTM allowances.

F. Protect sills, ledges, and offsets from mortar droppings or other damage during construction. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface. Remove misplaced mortar or grout immediately. Protect face materials against staining. Protect door jambs and corners from damage during construction.

G. Prevent grout or mortar or soil from staining the face of masonry to be left exposed or painted. Immediately remove grout or mortar in contact with such masonry.

H. Mixing Mortar and Grout: Comply with the requirements of ACI 530.1/ASCE 6/TMS 602.

3.2 CONSTRUCTION TOLERANCES

A. Comply with tolerance in ACI 530.1/ASCE 6/TMS 602 and the following.

B. For conspicuous vertical lines such as external corners, reveals, expansion and control joints, do not exceed 1/4" in any story or 20 feet maximum, nor 1/2" maximum.

C. For vertical alignment of exposed head joints do not vary from plumb by more than 1/4" in 10 feet, nor 1/2" maximum.

D. Variation from Level: For conspicuous horizontal lines such as exposed lintels, sills, parapets, and reveals, do not exceed 1/4" in any bay or 10 feet maximum, nor 1/2" maximum. For top surface of bearing walls do not exceed 1/8" between adjacent floor elements in 10 feet or 1/16" within width of a single unit.

3.3 LAYING MASONRY WALLS

A. Do not wet concrete masonry prior to laying up units unless written permission is obtained from the Engineer.
B. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate location of openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units, particularly at corners, jambs and wherever possible at other locations.

C. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.

D. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern. Do not use units with less than nominal 4” horizontal face dimensions at corners or jambs.

1. One-half running bond with vertical joint in each course centered on units in courses above and below.
2. One-third running bond.
3. As indicated on Drawings.

E. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2”. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4” horizontal face dimensions at corners or jambs.

F. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third unit for one-third running bond. Do not tooth. Clean exposed surfaces at set masonry and remove loose masonry units and mortar prior to laying fresh masonry.

G. Built-in Work: Install bolts, anchors, nailing blocks, inserts, frames, vent flashings, conduit, and other built-in items specified under this and other sections of these specifications as masonry work progresses. Avoid cutting and patching. Solidly grout spaces around built-in items. Provide joints around exterior framed openings 1/4” to 3/8” wide, raked and tooled smooth to a uniform depth of 3/4”, ready for caulking by others. Build chases, do not cut. Consult other trades in advance and make provisions for installation of their work to avoid cutting and patching. Install chases minimum of one full masonry unit length from jambs.

1. Fill in space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core, unless detailed otherwise.
3. Fill cores in hollow concrete masonry units with grout to supporting beam or slab below under bearing plates, beams, lintels, posts and similar items, unless otherwise indicated.

H. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.

1. For horizontally reinforced masonry, provide continuity at corners with prefabricated "L" units, in addition to masonry bonding.

I. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:

1. Provide individual metal ties at not more than 16” o.c. vertically.
2. Provide continuity with horizontal joint reinforcement using prefabricated "T" units.
J. Intersecting Load-bearing Walls: If carried up separately, block or tooth vertical joint with 8" maximum offsets and provide rigid steel anchors spaced not more than 4'-0" o.c. vertically, or omit blocking and provide rigid steel anchors at not more than 2'-0" o.c. vertically. If used with hollow masonry units, embed ends in mortar-filled cores.

3.4 MORTAR BEDDING AND JOINTING

A. Provide uniform nominal joint thickness of 3/8" for concrete masonry units, unless noted otherwise on the drawings.

B. Lay solid masonry units and fully-grouted hollow CMU with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not furrow bed joints or slush head joints.

C. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells of cavities to be reinforced or filled with concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

D. Joint Profile: Provide weather-proof, concave, tooled joints in exposed surfaces when mortar is thumbprint hard, using round jointing tool. Strike joints flush in surfaces to be plastered, stuccoed, or covered with other material or surface-applied finish other than paint. Concave tool exterior joints below grade. Remove mortar protruding into cells or cavities to be grouted. Do not permit mortar droppings to block weep holes. Do not fill horizontal joints between top of masonry partitions and undersides of concrete or steel construction with mortar unless specifically shown on the drawings. If not shown otherwise, provide 1" clear joint to be filled with caulk. Keep movement joints clean of all mortar and debris. For tuckpointing, rake mortar joints to a depth of 1/2 to 3/4 in., saturate with clean water, fill solidly with pointing mortar, and tool to match existing joints.

E. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners of jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

F. Collar Joints: Unless otherwise required, After each course is laid, fill the vertical longitudinal joint between wythes solidly with mortar (grout if walls are grouted) for the following masonry work:

1. All multi-wythe walls of concrete masonry units in which the collar joint between wythes is less than 3/4".
2. All below grade conditions.

3.5 CONSTRUCTION STABILITY

A. Design, provide and install bracing that will assure stability of masonry during construction.
B. Allow 16 hours to elapse after completion of masonry columns and walls before placing floor or roof construction loads. Allow an additional 48 hours before applying concentrated loads such as girders, beams, or trusses.

3.6 STRUCTURAL BONDING OF MULTI-WYTHE MASONRY

A. Where Horizontal Joints Align:

1. Tie wythes together with continuous horizontal joint reinforcing, installed in mortar joints at not more than 16” o.c. vertically.
2. Alternatively, use bent wire ties, providing one for every 4.5 sq. ft. of wall area but spaced no greater apart than 36” horizontally and 24” vertically.

B. Where Horizontal Joints do not Align:

1. Tie wythes together with adjustable, two-piece, ladder-type horizontal joint reinforcing placed in the mortar joint of the thicker wall at no more than 16” vertically.
2. Alternatively, use adjustable bent wire ties, providing one for every 1.77 sq. ft. and spaced no greater than 16” horizontally and vertically.
3. Bed joints of opposing wythes shall not be farther apart vertically than 1-1/2” either direction.

C. Openings: Provide additional ties around openings greater than 16’ in either direction within 12” of the opening and around the perimeter at a maximum of 3’-0” on center.

D. Provide ties within 12” of unsupported edges at a maximum of 24” vertically.

3.7 CAVITY WALLS

A. Keep cavity clean of mortar droppings and other materials during construction. Strike joints facing cavity flush.

B. Provide weep holes in head joints in first course immediately above all flashing. Leave head joint free and clean of mortar or install weep hole tube in head joint. Space weep holes 32” on center maximum for concrete unit masonry. Keep weep holes and area above

3.8 HORIZONTAL JOINT REINFORCEMENT

A. General:

1. Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8” on exterior side of walls, 1/2” elsewhere. Lap reinforcing a minimum of 6” at splices.
2. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
3. Reinforce walls with continuous horizontal joint reinforcing unless specifically noted to be omitted.
4. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

5. Space continuous horizontal reinforcement as follows:
   a. For multi-wythe walls (solid or cavity) space horizontal reinforcement 16" o.c. vertically.
   b. For single-wythe walls, space reinforcement at 16" o.c. vertically, unless otherwise indicated.
   c. For parapets, space reinforcement at 8" o.c. vertically, unless otherwise indicated.
   d. For perforated masonry screen walls, space reinforcement at every other course vertically, not to exceed 16" o.c., unless otherwise indicated.
   e. For concrete masonry cantilever walls and fences, space reinforcement at 8" o.c. vertically, unless otherwise indicated.
   f. For walls utilizing a stack bond pattern, space reinforcement at 8" o.c. vertically, unless otherwise indicated.

6. Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcement placed in two horizontal joints approximately 8" apart, immediately above the lintel and immediately below the sill. Extend reinforcement a minimum of 2'-0" beyond jambs of the opening except at control joints. Horizontal joint reinforcement interrupted by the jamb of an opening shall have the cross rod or side rod bent and hooked at the jamb. Provide an additional rectangular adjustable tie at the jamb for each joint not containing the normal horizontal reinforcing unit.

7. Provide reinforcement at openings in addition to other specified wall reinforcement.

3.9 PLACING REINFORCEMENT

A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.

B. Position reinforcement accurately at the spacing indicated. Prior to grouting, support and secure vertical bars against displacement. Vertical bars shall be held in position at the top and bottom and at intervals not exceeding 8'-0" with a minimum clearance of 1/4" if fine grout is used or 1/2" if coarse grout is used from the face of the masonry and not less than one bar diameter or 1" ( whichever is greater) between adjacent bars.

C. For columns, piers and pilasters, provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 1-1/2", whichever is greater. Provide lateral ties as indicated.

D. All dowels shall be grouted into a cell even if the dowel is in an adjacent cell to the vertical steel. Unless detailed otherwise on the drawings, dowels shall be the same size and number as the vertical steel. Unless noted otherwise provide a lap length of dowels to vertical reinforcement equal to 50 times the nominal dowel diameter.

E. All horizontal reinforcing steel shall be placed in continuous bond beam or lintel block units and shall be solidly grouted in place. Maintain a minimum of one bar diameter or 1" ( whichever is
greater) clearance between adjacent bars and a minimum of 1/4" clearance if fine grout is used or 1/2" if coarse grout is used from the face of the masonry. Horizontal reinforcement may be placed as the masonry work progresses.

F. Splice reinforcement bars where shown; do not splice at other points unless acceptable to the Engineer. Where splices occur, adjacent splices shall be staggered so that no more than 25% of the total number of bars is spliced at any one point with a minimum stagger between splices in adjacent bars of at least the lap length. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie. Minimum lap splice length shall be 50 bar diameters unless indicated otherwise.

G. Where reinforcement is prefabricated into cage units before placing, fabricate units with vertical reinforcement bars and lateral ties of the size and spacing indicated.

3.10 FORMWORK AND SHORES

A. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.

B. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar, grout, or concrete (if any). Brace, tie and support as required to maintain position and shape during construction and curing of reinforced masonry.

C. Formwork shall be designed and shop drawings prepared by a registered professional engineer in the state where the project is located.

D. Formwork shall not be removed until the reinforced masonry member has cured sufficiently to carry its own weight and any other loads that may be placed on it during construction. Allow not less than the following minimum time to elapse after completion of the member before removing shores or forms provided adequate curing conditions have been obtained during the curing period:

1. Lintels and beams: 10 days.
2. Reinforced masonry soffits: 7 days.

3.11 GROUTING


B. Specification: Comply with the requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts, grout space preparation, and grout placement, including minimum grout space, maximum pour height, maximum lift height and consolidation.

1. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
2. Place grout in lintels or beams over openings in one continuous pour.
3. Where bond beam occurs more than one course below top of pour and vertically reinforced cells are present above the bond beam, fill bond beam course to within 1-1/2" of the top of the bond beam.
4. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 1-1/2" of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.

3.12 CONTROL AND EXPANSION JOINTS

A. General: Provide vertical and horizontal expansion, control and isolation joints in masonry where shown. Build-in related items as the masonry work progresses.

B. Where control joints are not indicated on the drawings the Contractor shall submit a proposed control joint layout for Architect and Engineer approval. General guidelines for control joint locations are as follows:

1. At major changes in wall height.
2. At changes in wall thickness.
3. At corresponding control joints in foundations, floor, or roof construction.
4. At one or both sides of wall openings (masonry veneer only).
5. Near wall intersections.
6. At column centerlines.

C. Maximum Spacing: Maximum control joint spacing in concrete masonry construction shall be such that the ratio of wall length to height shall not exceed 1.5 with a maximum spacing of 25 feet.

D. Form control joints in concrete masonry as follows:

1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake joints in exposed faces.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake joint.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete.

E. Build in horizontal pressure relieving joints where indicated; construct joints by inserting non-metallic compressible joint filler of width required to permit installation of sealant and backer rod.

F. Provide continuous bond break at steel columns and members.

G. Provide pressure-relieving joints by adhering a continuous 3/8" thick neoprene pad below shelf angles supporting masonry veneer.

H. Leave joints around outside perimeters of exterior doors, window frames and other wall openings:

2. Width: 1/4 in. (6.4 mm) to 3/8 in. (9.5mm).
3.13 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and wherever openings of more than 2'-0" for block size units are shown without structural steel or other supporting lintels.
   1. For hollow concrete masonry unit walls, use specially formed U-shaped lintel units with reinforcement bars placed as shown filled with coarse grout.

C. Provide minimum bearing as noted on the drawings.

3.14 PARGING

A. Parge walls where indicated with Type S or N mortar, in thickness indicated. Thickness: Not less than 1/2".

B. Trowel finish to a smooth, dense surface. Form a wash at top of parging and a cove at bottom. Where parging is applied in 2 coats, roughen first coat when partially set, let harden for 24 hours and moisten prior to application of second coat.

C. Damp cure parging for at least 24 hours and protect until cured.

3.15 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing:
   1. During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Pointup all joints including corners, openings and adjacent work to provide a neat, uniform appearance, prepared for application of sealants. If the repairs must be made after the mortar has hardened, the joint must be raked or chiseled out to a depth of about 1/2" thoroughly wetted, and repointed with fresh mortar.
   2. To prehydrate mortars, thoroughly mix all ingredients except water in proportions used for original mortar mix; then mix again, adding only enough water to produce a damp unworkable mix which will retain its form when pressed into a ball. After 1 to 2 hours, add sufficient water to bring it to the proper consistence; that is conventional masonry mortars.

C. Final Cleaning: After mortar is thoroughly set and cured, clean masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave 1/2 panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film or waterproof masking tape.
4. Saturate wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clean water.
5. Clean concrete unit masonry to comply with masonry manufacturer's directions and NCMA Tek 8-2 bulletin.

D. Protection and Cleanup:

1. Provide final protection and maintain conditions in a manner acceptable to Installer, which ensure unit masonry work being without damage and deterioration at time of substantial completion.
2. Leave work area and surrounding surfaces clean and free of mortar spots, droppings, and broken masonry.

3.16 QUALITY ASSURANCE TESTING AND INSPECTION DURING CONSTRUCTION

A. See Testing Laboratory Services section of these Specifications for masonry work inspection and test requirements.

END OF SECTION 042213
Section 04 42 00 EXTERIOR STONE

PART 1 – GENERAL

1.01 Summary

A. Section Includes: Natural Stone Honeycomb Reinforced Wall Cladding System(s) including installation anchors and accessories.
   1. Basis of Design Product: Stone Panels Inc. StoneLite® honeycomb reinforced natural stone wall cladding system(s)
      a. Exterior Natural Stone Honeycomb Reinforced Wall Cladding System – 1” nominal total thickness dimension
      b. Interior Natural Stone Honeycomb Reinforced Wall Cladding System – 5/8” nominal total thickness dimension

B. Related Sections:
   1. Section 04 20 00 – Unit Masonry
   2. Section 05 40 00 – Cold Formed Metal Framing
   3. Section 07 21 00 – Insulation
   4. Section 07 62 00 – Sheet Metal Flashing and Trim
   5. Section 07 92 00 – Joint Sealant

1.02 References (Industry Standards)

A. ASTM E 283 Test Method for Rate of Air Leakage
B. ASTM E 331 Test Method for Water Penetration
C. AAMA 501.1 Test Method for Dynamic Water Penetration
D. ASTM E-84 Test Method for Measuring Flame Spread
E. UFC 4-010-01 Unified Facilities Criteria (UFC) - DoD Minimum Antiterrorism Standard for Buildings

1.03 System Description

A. Panel System Performance Requirements:
   2. Accelerated Aging by Acid Freeze Thaw by Wiss, Janney, Elstner Assoc. Test Method: Flexural strength loss not to exceed 20% following 100 cycles + 170 (F) to -10(F) while immersed in 4-pH sulfuric acid solution.
   3. Large Missile Impact in accordance with Dade County Protocol PA 201-94: Resists large missile impact when fired at 50 ft. per second.
   4. Cyclic Wind Pressure Loading in accordance with Dade County Protocol PA 203-94: Resist 1342 repetitions of positive – negative 90 psf design wind pressure.
5. ASTM E-84 Flame Spread: 5 maximum smoke development: 5 maximum. Fuel contributed: 0.

6. Toxicity evaluation according to the University of Pittsburgh test method: No more toxic than Douglas fir wood.


8. UBC 17-6 Multi –Story fire evaluation: Meet acceptance criteria.


10. Flat wise tension bond capacity: 385 psi following accelerated aging by rapid temperature cycling from -40 degrees (F) to +160 degrees (F).

11. Flat wise tension bond tests following ASTM C-67, section 8 freeze – thaw: 290 psi flat wise tension bond following 100 cycles freeze thaw consisting of 20 hours freezing at 0 degrees (F) and 4 hours thawing in water at 75 degrees (F).

12. ASTM E-72 Transverse load test: Average 215 lbs. per sq. ft. uniform load on 35.5 inch simple span causing 0.49 inch deflection average.

13. Racking shear load tests: No disengagement or major damage following application of 4,000 lb. load and 0.05” to 1.5” deflection on an 8 ft x 8ft specimen.

14. Air Infiltration: The test specimen shall be tested in accordance with ASTM E 283. Air infiltration rate shall not exceed 0.06 cfm/ft² at a static air pressure differential of 6.24 psf.

15. Water Resistance: The test specimen shall be tested in accordance with ASTM E 331. There shall be no leakage at a minimum static air pressure differential of 10 psf as defined in AAMA 501.

1.04 Submittals

A. General: Prepare, review, approve, and submit specified submittals in accordance with “Conditions of the Contract” and Division 1. Submittals Sections. Product data, shop drawings, samples, and similar submittals are defined in “Conditions of the Contract.”

B. Quality Assurance/Control Submittals:
   1. Test Reports: Submit independent laboratory certified test reports showing compliance with specified performance characteristics.
   2. Building Authority Acceptance: Submit documentation confirming Building Code Authority Acceptance.

1.05 Warranty

A. Project Warranty: Refer to “Conditions of the Contract” for project warranty provisions.

B. Manufacturer’s Product Warranty: Submit, for Owner’s acceptance, manufacturer’s warranty as follows:
   1. Warranty Period: Ten (10) years from Date of Substantial Completion that the panel will be free from defects in lamination or separation of panel components.
1.06 Quality Assurance

A. Qualifications:
   1. Manufacturer Qualifications: Manufacturer shall have a minimum of 10 years demonstrated
capability to produce reinforced stone veneer panels of the quality and scope required.
Manufacturer shall have completed independent laboratory tests verifying performance
capabilities and shall be able to furnish a list of references and previous projects of similar size
and scope. Manufacturer must have acceptance by the appropriate building code authority with
established ongoing building authority quality control. Manufacturer shall be capable of
providing detailed shop drawings, field service representation during construction, and approval
of acceptable installers and approval of application method.

   2. Installer Qualifications: Installer to demonstrate experience (as determined by contractor) to
perform work of this section and who has specialized in the installation of work similar to that
required for this project and is deemed acceptable to product manufacturer.

B. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements,
substrate conditions, manufacturer’s installation instructions, and manufacturer’s warranty
requirements.

1.07 Delivery, Storage, and Handling

A. Ordering: Comply with manufacturer’s ordering instructions and lead-time requirements to avoid
construction delays.

B. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer’s original, unopened,
undamaged containers with
identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful weather conditions.
Handle material and components to avoid damage. Protect material against damage from elements,
construction activities, and other hazards before, during and after installation.

PART 2 – PRODUCTS

2.01 Manufacturers (Acceptable Manufacturers/Products)

A. Basis of Design  Manufacturer: Stone Panels, Inc.
   1. Basis of Design Product:
      a. StoneLite®
      b. Equivalent Products acceptable if specifications met.

C. Substitutions:
   1. General: Refer to Division 1 Substitutions for procedures and submission requirements.
a. Pre-Contract (Bidding Period) Substitutions: Submit written requests ten (10) days prior to bid date.

b. Post-Contract (Construction Period) Substitutions: Submit written request in order to avoid installation and construction delays.

2. Substitution Documentation:
   a. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.
   b. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for system performance criteria, and (2) has been engaged in the design, manufacture and fabrication of natural stone honeycomb reinforced wall cladding system for a period of not less than ten (10) years, and (3) able to provide a list of previous projects of similar size and scope with references. (Company Name and Contact Information) and (4) confirm acceptance by the controlling building code authority.
   c. Test Reports: Submit independent laboratory test reports verifying compliance with each test requirement for Exterior Natural Stone Honeycomb Reinforced Wall Cladding System required by the project.
   d. Product Sample and Finish: Submit product sample, representative of panel system for the project with specified stone type and finish.

3. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification and documented by a formal change order signed by the Owner and Contractor.

2.02 Materials

A. Natural Stone Honeycomb Reinforced Wall Cladding System:
   1. Material Standard: Natural stone bonded to lightweight (aircraft quality) aluminum honeycomb having epoxy impregnated glass cloth skins.
   2. Facing: 3/16” (4.8mm) ± 1/16” (1.6 mm) natural stone.
   3. Reinforcing: 3/4” (19mm) aluminum honeycomb bonded by high strength epoxy impregnated reinforced glass cloth.

2.03 Accessories

A. Connection and anchorage hardware, including interlocking channels, anchor plates, Z-sections, angle clips and threaded inserts.

2.04 Related Materials

A. Sealants: Sealant materials specified in section 07 92 00 shall be tested for compatibility with the natural stone honeycomb reinforced wall cladding specified.

2.05 Fabrication

A. General:
   1. Fabricate components on the structure intended to receive panels per manufacturer’s installation instructions and with minimum clearances and shim spacing.
2.06 Stone Type and Finishes

A. Material and color will be selected to match final masonry selection for BR02.
B. Finish: Honed

2.07 Source Quality Control

A. Source Quality: Provide Natural Stone Honeycomb Reinforced Wall Cladding System specified herein from a single source.

PART 3 – EXECUTION

3.01 Examination

C. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer’s instructions. Verify modules are sized to receive natural stone honeycomb reinforced wall cladding system in accordance with manufacturer’s acceptable tolerances.

1. Field Measurements: Verify actual measurements/openings by field measurements before fabrication. Confirm recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

3.02 Installation

A. General: Install lightweight honeycomb reinforced natural stone panel systems plumb, level and true to line, with manufacturer’s prescribed tolerances and installation instructions. Provide supports and anchor in place.

1. Dissimilar Materials: Provide separation of aluminum materials from sources of corrosion or electrolytic action contact points.
2. Weather Tight Construction: Refer to installation instructions & consult sealant manufacture for project specific application. Coordinate installation with wall flashings and other components of construction.

D. Related Products Installation Requirements:

1. Sealants (Perimeter): Refer to Section 7 Joint Treatment (Sealants).

3.03 Protection and Cleaning

A. Protection: Protect installed product’s finish surfaces from damage during construction. Protect stone facing from damage from harmful contaminants.
B. Cleaning: Repair or replace damaged installed products. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance. Remove construction debris from project site and legally dispose of debris.
DISCLAIMER STATEMENT

This guide specification is intended for use by a qualified construction Specifier. The guide specification is not intended to be verbatim as a project specification without appropriate modifications for the specific use intended. The guide specification must be used and coordinated with the procedures of each design firm, and the particular requirements of a specific construction project.

END OF SECTION 04 42 00
SECTION 04 72 00 – CAST STONE MASONARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Cast stone trim including the following:
   a. Coping.
   b. Wall trim.
   c. Wall units.

B. Related Sections include the following:

1. Division 04 Section "Unit Masonry" for installing cast stone units in unit masonry.

1.3 DEFINITIONS

A. Cast Stone: Architectural precast concrete building units intended to simulate natural cut stone.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for cast stone units.

B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1. Include building elevations showing layout of units and locations of joints and anchors.

C. Samples for Initial Selection: For colored mortar.

D. Samples for Verification:

1. For each color and texture of cast stone required, 10 inches square in size.

E. Mockup Samples: Furnish sample units for each color and texture of cast stone required, 10 inches square in size for installation in mockups.

F. Full-Size Samples: For each type of cast stone unit required.
1. Make available for Architect's review at Project site.
2. Make Samples from materials to be used for units used on Project.
3. Approved Samples may be installed in the Work.

G. Qualification Data: For manufacturer and testing agency.
   1. Include copies of material test reports for completed projects, indicating compliance of cast stone with ASTM C 1364.

H. Quality-Control Plan: Manufacturer's written quality-control plan that includes all elements of the Cast Stone Institute's "Quality Control Procedures Required for Plant Inspection."
   1. Provide copies of documentation showing compliance with quality-control plan as requested by Architect.

I. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364, including test for resistance to freezing and thawing.
   1. Provide test reports based on testing within previous two years.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, with sufficient production capacity to manufacture required units.
   1. Manufacturer is a producing member of the Cast Stone Institute.

B. Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.

C. Source Limitations for Cast Stone: Obtain cast stone units through one source from a single manufacturer.

D. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup of typical wall area as shown on Drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of cast stone with unit masonry work to minimize the need for on-site storage and to avoid delaying the Work.

B. Pack, handle, and ship cast stone units in suitable packs or pallets.
1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units, if required, using dollies with wood supports.
2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

C. Store installation materials on elevated platforms, under cover, and in a dry location.

D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.7 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until cast stone has dried, but not less than 7 days after completing cleaning.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 CAST STONE MATERIALS

A. General: Comply with ASTM C 1364 and the following:

B. Portland Cement: ASTM C 150, Type I, containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33; gradation as needed to produce required textures and colors as needed to produce required cast stone colors.

D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33, gradation as needed to produce required textures and colors as needed to produce required cast stone colors.

E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

F. Admixtures: Do not use admixtures unless specified or approved in writing by Architect.

1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
4. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
5. Water-Reducing, Retarding Admixture: ASTM C 494/C 494M, Type D.

G. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast stone material.

1. Epoxy Coating: ASTM A 775/A 775M.
2. Galvanized Coating: ASTM A 767/A 767M.

H. Embedded Anchors and Other Inserts: Fabricated from steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M.

2.2 CAST STONE UNITS

A. Manufacturers:

1. Advanced Cast Stone, Inc.
2. AHI Supply, Inc.
3. American Artstone Co., Inc.
5. Architectural Art Stone, Inc.
6. Architectural Cast Stone Corp.
7. Architectural Cast Stone, Inc.
8. Architectural Concrete Company, Inc.
10. Architectural Ornamental Castings, Inc.
11. Architectural Ornaments, Inc.
15. ConArt, Inc.
18. Custom Cast Stone, Inc.
20. Dallas Cast Stone Co., Inc.
22. DuraStone.
27. Miller Precast, Inc.
29. Olympian Precast, Inc.
31. Plasticrete Architectural Concrete Products.
32. Precision Development.
33. Siteworks, Inc.
34. Southern Cast Stone Manufacturing, Inc.
35. Steps Plus, Inc.
36. Stonco.
37. Stone Castle Industries, Inc.
39. Sun Precast Co., Inc.
40. Techcrete Architectural Precast.
41. Thunderstone.
42. Towne House Restorations, Inc.

B. Provide cast stone units complying with ASTM C 1364 using the vibrant dry tamp or wet-cast method.

1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666, Procedure A, as modified by ASTM C 1364, or are made from cast stone that has a history of successful resistance to freezing and thawing.

C. Fabricate units with sharp arris and details accurately reproduced with indicated texture on all exposed surfaces, unless otherwise indicated.

1. Slope exposed horizontal surfaces 1:12, unless otherwise indicated.
2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
3. Provide drips on projecting elements, unless otherwise indicated.

D. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.

E. Cure units by one of the following methods:

1. Cure units with steam in enclosed curing room at temperature of 105 deg F or above and 95 to 100 percent relative humidity for 6 hours.
2. Cure units with dense fog and water spray in enclosed warm curing room at 95 to 100 percent relative humidity for 24 hours.
3. Cure units to comply with one of the following:
   a. Not less than 5 days at mean daily temperature of 70 deg F or above.
   b. Not less than 6 days at mean daily temperature of 60 deg F or above.
   c. Not less than 7 days at mean daily temperature of 50 deg F or above.
   d. Not less than 8 days at mean daily temperature of 45 deg F or above.

F. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
G. Colors and Textures: As selected by Architect from manufacturer's full range.

2.3 MORTAR MATERIALS
A. Provide mortar materials that comply with Division 04 Section "Unit Masonry."

2.4 ACCESSORIES
A. Anchors: Type and size indicated, fabricated from steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M.
B. Dowels: Round steel bars complying with ASTM A 36/A 36M or ASTM A 615/A 615M, 1/2-inch diameter, and hot-dip galvanized to comply with ASTM A 123/A 123M.
C. Proprietary Acidic Cleaner: Manufacturer's standard-strength, general-purpose cleaner designed for removing mortar/grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by cast stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.
   1. Manufacturers:
      a. Diedrich Technologies, Inc.
      b. EaCo Chem, Inc.
      c. ProSoCo, Inc.

2.5 MORTAR MIXES
A. Comply with requirements in Division 04 Section "Unit Masonry" for mortar mixes.

2.6 SOURCE QUALITY CONTROL
A. Employ an independent testing agency to sample and test cast stone units according to ASTM C 1364.
   1. Include one test for resistance to freezing and thawing.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of cast stone.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 SETTING CAST STONE IN MORTAR

A. Install cast stone units to comply with requirements in Division 04 Section "Unit Masonry."

B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
   1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.

C. Wet joint surfaces thoroughly before applying mortar or setting in mortar.

D. Set units in full bed of mortar with full head joints, unless otherwise indicated.
   1. If not indicated, set units with joints 1/4 to 3/8 inch wide.
   2. Build anchors and ties into mortar joints as units are set.
   3. Fill dowel holes and anchor slots with mortar.
   4. Fill collar joints solid as units are set.
   5. Build concealed flashing into mortar joints as units are set.
   6. Keep head joints in coping and other units with exposed horizontal surfaces open to receive sealant.
   7. Keep joints at shelf angles open to receive sealant.

E. Rake out joints for pointing with mortar to depths of not less than 3/4 inch. Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.

F. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.

G. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

H. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated. Keep joints free of mortar and other rigid materials.
   1. Form open joint of width indicated, but not less than 3/8 inch.

I. Prepare joints indicated to receive sealant and apply sealant of type and at locations indicated to comply with applicable requirements in Division 07 Section "Joint Sealants."
   1. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant, unless otherwise indicated.

3.3 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

A. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.

2. Shim and adjust anchors, supports, and accessories to set cast stone in locations indicated with uniform joints.

B. Keep cavities open where unfilled space is indicated between back of cast stone units and backup wall; do not fill cavities with mortar or grout.

C. Fill anchor holes with sealant.

1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.

D. Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of cast stone a distance at least equal to width of joint.

E. Keep joints free of mortar and other rigid materials. Remove temporary shims and spacers from joints after anchors and supports are secured in place and cast stone units are anchored. Do not begin sealant installation until temporary shims and spacers are removed.

1. Form open joint of width indicated, but not less than 3/8 inch.

F. Prepare joints and apply sealant of type and at locations indicated to comply with applicable requirements in Division 07 Section "Joint Sealants."

1. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant, unless otherwise indicated.

3.4 INSTALLATION TOLERANCES

A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

B. Variation from Level: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.

D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except due to warpage of units within tolerances specified.

3.5 ADJUSTING AND CLEANING

A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean cast stone as work progresses.
   1. Remove mortar fins and smears before tooling joints.
   2. Remove excess sealant immediately, including spills, smears, and spatter.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample; leave one sample uncleared for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
   3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
   6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 04 72 00
SECTION 051200 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 SUMMARY

A. Section includes labor, materials, services, equipment, and appliances required in conjunction with or related to the furnishing, fabrication, delivery, and erection of all structural steel, as defined below. Include all supplementary parts, members, and connections necessary to complete the structural steel work, regardless of whether all such items specifically are shown or specified on the drawings. Miscellaneous metal fabrications, architecturally exposed structural steel, metal stairs and ladders, steel joists and joist girders, cold-formed metal framing, and steel deck are specified in other Division 05 sections.

B. Related Requirements:

1. Specification 014000 “Quality Requirements” for requirements of material testing and inspection.

2. Specification 014529 “Structural Testing and Inspections” for testing and inspection requirements associated with structural steel.

3. Section 051220 “Straight Beam Ultrasonic Examination” for requirements for testing of certain steel elements.

4. Specification 099100 “Painting” for surface preparation and priming requirements.

1.3 PRICE AND PAYMENT PROCEDURES

A. Alternates: Substitutions for the member sizes, type(s) of steel connection details, or any other modifications proposed will be considered by the Architect/Engineer only under the following conditions:

1. The request has been made and accepted prior to the submission of shop drawings. All substitutions shall be marked clearly and indicated on the shop drawings as a substitute.

2. There is a substantial cost advantage or time advantage to the Owner or that the proposed revision is necessary to obtain the required materials or methods at the proper times to accomplish the work in the time scheduled.

3. Sufficient sketches, engineering calculations, and other data have been submitted to facilitate checking by the Architect/Engineer, including cost reductions or savings in time to complete the work.

4. In no case shall such substitutions result in additional cost to the Owner.
1.4 REFERENCES

A. Definitions:

1. Erection Drawings: Field installation or member-placement drawings that are prepared by the Fabricator to show the location and attachment of the individual shipping pieces.

2. Erection-Bracing Drawings: Drawings that are prepared by the Erector to illustrate the sequence of erection, any requirements for temporary supports, and the requirements for raising, bolting, and or/welding. These drawings are in addition to and separate from the Erection Drawings.

3. Professional Engineer: A professional engineer who is licensed to practice engineering in the state where the project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material.

4. Shop Drawings: Drawings of the individual structural steel shipping pieces that are to be produced in the fabrication shop.

5. Structural Steel: Structural steel shall be defined as that work prescribed in Section 2.1 of AISC 303 and all steel support for elevator guide rails and catwalks (including support members and attached structural steel shapes and plates such as hangers, toe plates, and the grating or checkered plate walking surface).

B. Reference Standards:

1. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified.

   a. All federal (OSHA), state, and local laws that govern safety requirements for steel erection and other requirements if more stringent than the codes and standards enumerated below. OSHA requirements include regulation 29 CFR 1926, Part R, “Safety Standard for Steel Erection”.


   c. AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," except as noted herein.

      1) Certain sections in this specification contain requirements that are more restrictive and/or different than contained in this standard. In such cases, the requirements of this specification shall control.


   e. ANSI/AWS D1.1, "Structural Welding Code – Steel.”


1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Quality Control:
   a. The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.
   b. The Contractor shall coordinate the fabrication and erection of all structural steel work with the work of other trades.
   c. The Fabricator alone shall be responsible for all errors of detailing, fabrication, and for the correct fitting of the structural members.
   d. The Fabricator shall coordinate connection details, joint fit-up procedures, and field adjustment requirements with Erector. The Contractor shall coordinate provision of all erection bolts, lifting lugs, or other devices required for erection with the Fabricator and the Erector and for interference with architectural finishes and constraints.

2. Document Conflict and Precedence:
   a. In case of conflict among documents, including architectural and structural drawings and specifications, notify Architect/Engineer prior to submitting proposal. In case of conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing by the Architect/Engineer.
   b. Questions about Contract Documents: The Contractor shall notify promptly the Architect/Engineer whenever design of members and connections for any portion of the structure are not indicated clearly or when other questions exist about the Contract Documents. Such questions shall be resolved prior to the submission of shop drawings.

3. Materials and installed work may require testing and retesting, as directed by the governing building code or the Architect/Engineer, at any time during progress of work.
   a. The Contractor shall provide adequate notification to the Owner’s Testing Agency of construction operation including the project schedule to allow the Testing Agency to schedule inspections. Failure to notify sufficiently may result in additional costs incurred by the Testing Laboratory that may be back-charge to the Contractor by the Owner.
   b. The Contractor shall cooperate with laboratory personnel, provide access to the work, and provide access to manufacturer’s operations.
   c. The Contractor shall cooperate with the Owner’s Testing Laboratory when Arbitration Testing and Inspection is called for due to a disagreement regarding the tension in installed bolts that have been inspected according to the Structural Testing and Inspections specification.
   d. The Contractor shall make adequate arrangement with the Owner’s Testing Agency for inspection of material stockpiles and facilities.
   e. The Contractor shall provide to the laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.
f. The Contractor shall furnish labor, equipment, and facilities as required for sampling and testing by the laboratory and other facilitates the required inspections and test.

B. Preinstallation Meetings:

1. At least 14 days prior to beginning structural steel erection, the Contractor shall hold a meeting to review the detailed quality control and construction requirements and to determine the procedures for producing proper structural steel construction. Also, review requirements for submittals, status of coordinated work, and availability of materials. Establish work progress schedule and procedures for materials inspection, testing, and certification.

2. The Contractor shall require responsible representatives of every party who is concerned with the structural steel work to attend the conference, including, but not limited to, the following:

   a. Contractor’s Superintendent.
   b. Laboratory responsible for field quality control.
   c. Special Inspector or Laboratory responsible for shop inspection or testing.
   d. Structural steel detailer.
   e. Structural steel fabricator.
   f. Structural steel erector.
   g. Owner’s Representative.
   h. Engineer.

3. Minutes of the meeting shall be record, typed, and printed by the contractor and distributed to all parties concerned within five days of the meeting. One copy of the minutes shall be transmitted to the following for information purposes:

   a. Owner’s Representative.
   b. Architect.
   c. Engineer.

4. The Engineer shall be present at the conference. The Contractor shall notify the Engineer at least seven days prior to the scheduled date of the conference.

1.6 SUBMITTALS

A. Product Data: Submit producer’s or manufacturer’s specifications and installation instructions for following products to show compliance with specifications, including the specified standards):

   1. Shrinkage-Resistant Grout.
   2. Welding Electrodes.
   3. Structural Steel Primer Paint.
   4. Inorganic or Other Protective Paint.
   5. Shear Studs.

B. Shop Drawings:
1. Preliminary Connection Review: Submit preliminary details of proposed connections not less than 14 days in advance of the start of preparation of detailed shop drawings. Proposed variations from the details shown on the drawings will be considered and such variations must have preliminary approval from the Engineer prior to the preparation of detailed shop drawings. Failure to adhere to the requirements of this paragraph obligates the Contractor to take responsibility for any and all resulting delays in the detailing and fabrication of structural steel.

2. Detailed Shop Drawings: Submit drawings showing complete details and schedules for fabrication and assembly of structural steel members. Drawings shall include the following minimum information:

   a. Details of cuts, connections, camber, holes, and other pertinent data.
   b. Indication of welds by standard AWS symbols, and show size, length, and type of each weld.
   c. Indication of type, size, and length of bolts, distinguishing between shop and field bolts. Identify the type of high-strength bolted connection (slip-critical, direct-tension, or bearing connections). Indicate locations of pretensioned bolts.
   d. Connection material specification and sizes.
   e. Joints or groups of joints in which a specific assembly order, welding sequence, welding technique, or other special precautions are required.
   f. Holes, flange cuts, slots, and openings shall be made as required by the structural drawings, all of which shall be properly located by means of templates.
   g. Setting drawings, templates, and directions for installation of anchor rods and other anchorages to be installed by others.
   h. Non-Destructive Testing (NDT) to be performed by the Fabricator, if any.
   i. A letter sealed by the Fabricator’s Professional Engineer responsible for the design of any of the connections shown on the shop drawings attesting that the engineer has reviewed the shop drawings and that the connections detailed and shown on the shop drawings conform to the engineer’s design.

3. Erection Drawings: Submit complete erection drawings showing field installation and member-placing instructions for locating and attaching the individual shipping pieces.

4. Shear Connector Placement Drawings: Provide drawings showing proper placement (longitudinal and transverse spacing) of shear connectors on each composite beam requiring such connectors. The drawings shall show the proper relationship of the shear connectors to the flutes in the steel deck and the arrangement of shear connectors along the span of the composite beam. Show the method of attachment of shear connectors and the proposed brand and model of equipment to be used.

5. All drawings submitted for review shall have blank space for a 2” high and 3.5” wide shop drawing stamp of the Engineer as part of the title block

C. Certificates:

   1. Structural Steel: Submit for each type.
   2. High-Strength Bolts: Submit for each type, including nuts and washers.

D. Delegated Design Submittals:

   1. Preliminary Connection Design Review: In conjunction with the Preliminary Connection Review submittal, the Fabricator’s licensed professional engineer shall submit example
design calculations for each connection type not less than 14 days in advance of the start of preparation of detailed shop drawings.

2. Connection Design Submittals: The Fabricator’s licensed professional engineer shall submit complete design calculations show all information as specified in the “Connections” section under Part 2. The Engineer reserves the right to reject all shop drawings submitted without complete design calculations.

3. Connection Design Validation Letter: The Fabricator’s licensed professional engineer responsible for the design of any of the connections shown on the shop drawings shall submit a letter that is sealed attesting that the connection design engineer has reviewed the shop drawings and that the connections detailed and shown on the shop drawings conform to the engineer’s design.

E. Test and Evaluations Reports: Submit certified reports of tests required by this Specification. Include data on type(s) of tests conducted and test results.

F. Field Quality Control Submittals:

1. Surveys: Submit for each survey required.

G. Qualification Statements:

1. Submit qualification data, including required certifications, for firms and persons specified in the “Qualifications” section under Part 1, to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

2. Submit a resume from the structural steel detailer showing a minimum of two years of experience selecting or completing structural steel connection details using information found in tables in the AISC “Steel Construction Manual”.

3. Submit Welding Procedure Specifications (WPS) in accordance with ANSI/AWS D1.1 for all welded joints. Submit test reports showing successful passage of qualification tests for all non-prequalified WPSs.

4. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests as specified in the “Qualifications” section under Part 1. If recertification of welders is required, retesting will be at Contractor's responsibility.

5. A fabricator that is registered with the local building official and is approved to perform fabrication without special inspection shall submit a certificate of compliance stating that the work was performed in accordance with the approved construction documents.

H. Record Documentation:

I. Minutes of Preinstallation Meeting: Submit for review.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. Fabricator:
a. The structural steel fabricator shall have not less than **five** years of experience in the successful fabrication of structural steel similar to this project.

b. The structural steel fabricator must participate in the AISC Quality Certification Program and be designated an AISC Certified Plant in Category STD, Standard for Steel Building Structures.

c. The structural steel fabricator must be registered and approved by the local building official to perform fabrication work without special inspection. Should the fabricator not be so approved, the fabricator shall reimburse the Owner for the cost of the special inspections required by the local building official.

2. Detailer:

   a. The structural steel detailer shall have not less than **two** years of experience in the successful detailing of structural steel similar to this project including experience in selecting or completing structural steel connection details using information found in tables in the AISC “Steel Construction Manual.

   b. The structural steel detailer firm shall be certified under the Quality Procedures Program of the National Institute of Steel Detailing. The project shall be detailed by qualified structural steel detailers who are either personally certified under the National Institute of Steel Detailing as a Class I or Class II Detailer in the Structural/Miscellaneous discipline or are supervised by a detailer certified as a Class I Senior Detailer in the Structural/Miscellaneous discipline.

3. Erector:

   a. The structural steel erector shall have not less than **two** years of successful experience in the erection of structural steel of a similar nature to this project.

   b. The structural steel erector must participate in the AISC Erector Certification Program and be designated an AISC **Certified Steel Erector**.

4. Welding Qualifications: Qualify welding processes and welding operators in accordance with AWS “Structural Welding Code – Steel”.

5. Professional Engineer:

   a. The Professional Engineer employed by the Fabricator for connection design shall be experienced in the specific area of structural steel connection design with demonstrated experience of not less than three projects of similar scope and complexity.

6. Specialty Welding Consultant: The welding consultant employed by the Fabricator shall be a licensed Professional Engineer registered in the state where the project is located and shall have a minimum of five years of experience in weld engineering.

7. Independent Testing Laboratory:

   a. Any testing laboratory retained to perform tests that are required by this specification shall meet the basic requirements of ASTM E 329 and shall submit to the Owner, Architect, and Engineer evidence of current accreditation from the American...
1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.

B. Deliver anchor rods and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time so as not to delay work.

C. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration. Do not store materials on structure in a manner that might exceed allowable loads on or cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed by Architect/Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel:

1. All hot rolled steel plates, shapes, sheet piling, and bars shall be new steel conforming to ASTM A 6.

2. Comply with the provisions of the following ASTM Specifications as appropriate for the grades and types, and at the locations as specified on the drawings:

   a. Structural Steel Wide Flange and WT Shapes: High Strength Steel, ASTM A 992.
   c. M-Shapes, S-Shapes, and Channels: High Strength Steel, ASTM A 572, Grade 50.
d. Angle Shapes: Carbon Steel, ASTM A 36.
e. Angle Shapes: High Strength Steel, ASTM A 529, Grade 50.
f. Angle Shapes: High Strength Steel, ASTM A 572, Grade 50.
g. Structural Steel Plates and Bars: Carbon Steel, ASTM A 36.
h. Structural Steel Plates and Bars: High Strength Steel, ASTM A 572, Grade 50.
i. Round HSS: ASTM A 500, Grade C (Fy = 46 ksi).
   Square and Rectangular HSS: ASTM A 500, Grade C (Fy = 50 ksi).

3. Connection Material: Unless noted otherwise on the drawings, column stiffener plates and
doubler plates at moment connections shall be the same grade of steel as the beam
connecting the column (highest grade if more than one grade is used). All other connection
material except as noted otherwise on the drawings including bearing plates, gusset plates,
stiffener plates, filler plates, angles, etc. shall be A36 steel unless a higher or matching
grade of steel with the members connected is required by strength or stiffness calculations
and provided the resulting sizes are compatible with the members connected.

B. Structural Bolts and Threaded Fasteners: Structural bolts and threaded fasteners shall comply
with the following ASTM Specifications as appropriate for the types and at the locations as
specified on the drawings:

1. ASTM F 3125 Grade A325 Type 1.
2. Twist-Off-Type Tension-Control Bolt Assemblies:
   a. Bolts that are manufactured to conform to ASTM F 3125 Grade F1852.
   b. Bolts that are manufactured to conform to ASTM F 3125 Grade F2280.
   c. Subject to conformance with specified requirements, acceptable manufacturers
      include but are not limited to:
      1) Nucor Fastener, A Division of Nucor Corporation.
      2) Lake Erie Screw Corp.
      3) Vermont Fasteners Manufacturing.
      4) Lohr Structural Fasteners.

3. Threaded Round Stock:
   a. ASTM A 36.
   b. ASTM A 572 Grade 50 (to 2 inches in diameter).

4. Bolts and Nuts, High Strength Bolts: Bolts and nuts for all high strength bolts shall be
   heavy hex head conforming to ANSI Standards B18.2.1 and B18.2.2 respectively. Nuts
   shall conform to ASTM A 563.
5. Washers: All washers shall be circular, flat and smooth and shall conform to the
   requirements of Type A washers in ANSI Standard B23.1. Washers for high strength bolts
   shall be hardened and conform to ASTM F 436. Beveled washers for American Standard
   Beams and channels shall be square or rectangular, shall taper in thickness (16 2/3% slope)
   with an average thickness of 5/16”. When an outer face of a bolted part has a slope greater
   than 1:20 with respect to a plane normal to the bolt axis, a beveled washer shall be used.
   Washers to be used with A490 bolts larger than 1 inch in diameter and installed over
   oversized or short-slotted holes and other similar situations shall conform to ASTM F 436
   except with 5/16 inch minimum thickness.
6. **Zinc-Coated Bolts:** ASTM F 3125 Grade A325 bolts, with their nuts and washers, that are used to connect steel called for on the drawings or in the specifications as hot-dip galvanized after fabrication shall be zinc-coated either by the hot-dip process in accordance with ASTM A 153, Class C or by the mechanical deposition process in accordance with ASTM B 695, Class 50, Type 1. The bolts, nuts, and washers shall all be zinc-coated using the same process and they shall be considered together as an assembly and shall be tested and shipped together as such. Comply with all the requirements of ASTM F 3125 Grade A325 and ASTM A 563 as they relate to zinc-coated materials. ASTM F 1852 bolts with their nuts, and washers shall be zinc-coated only by the mechanical deposition process in accordance with ASTM B 695, Class 50, Type 1. Do not zinc-coat ASTM F 3125 Grade A490 bolts.

7. **Bolt Lubrication:** All bolts shall be well lubricated at time of installation. Dry, rusty bolts will not be allowed.

8. **New Bolts:** All bolts shall be new and shall not be reused.

C. **Electrodes for Welding:**

1. Provide electrodes that comply with AWS D1.1, "Structural Welding Code - Steel" and that can produce welds that have a minimum Charpy V-notch toughness of 20 ft-lbs at 40°F, unless noted otherwise in these specifications or on the drawings.

2. Electrodes for various welding processes shall be as specified below:
   a. **SMAW:**
      1) E70XX low hydrogen.
   b. **SAW:**
      1) F7X-EXXX.
   c. **GMAW:**
      1) ER70S-X.
   d. **FCAW:**
      1) E7XT-X.

3. Electrodes shall be compatible with parent metal joined.

D. **Headed Studs used as Anchors for Structural Steel Plates and Members connecting to Concrete:** AWS Type A studs manufactured in conformance with ASTM A 29 with a minimum tensile strength of 61,000 psi of sizes as specified on the drawings.

E. **Headed Studs used as Composite Member Shear Connectors:** AWS type B studs manufactured in conformance with ASTM A 29 with a minimum tensile strength of 65,000 psi of sizes as specified on the drawings.

F. **Deformed Bar Anchors:** 3/8” to 5/8” diameter AWS Type C studs manufactured in conformance with ASTM A 1064 with a minimum yield strength of 70,000 psi and a tensile strength of 80,000 PSI. 3/4” or larger diameter, ASTM A 706 bars of equal size with welds to steel substrate that
develop the full strength of the anchor. ASTM A 615 reinforcing bars may not be substituted for deformed bar anchors. Reinforcement shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted for Engineer review. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of intended use on the project:

b. Tru-Weld Division, TFP Corporation; Deformed Bar Anchors (ESR-2823).

G. Anchor Rods:

1. All anchor rods shall conform to ASTM F 1554. unless noted otherwise on the drawings and shall be of the yield strength as specified below as appropriate for the types and at the locations as specified on the drawings:

   a. Grade 55 (1/4 inch to 4 inches in diameter), complying with Supplementary Requirement S1 of ASTM F 1554.

2. Anchor rods used with galvanized baseplates shall be galvanized.
3. Nuts: All nuts with anchor rods shall be heavy hex head conforming to ASTM A 563.
4. Washers: Unless indicated otherwise, washers for all base plates shall be in accordance with the AISC “Steel Construction Manual”, Table 14-2 with holes 1/16” larger than the anchor rod diameter. Washers shall conform to ASTM A 36 steel.

H. Structural Steel Primer Paint:

1. Primer paint shall produce a Class A coating on all painted faying surfaces that are a part of a slip-critical connection as noted on the drawings; surface prepared according to SSPC-SP-6 (Commercial Blast Cleaning) and shall be of the following types.

   a. Polyamide Epoxy with a minimum volume solids ratio of 65 percent. The primer shall comply with the AISC Class A slip critical requirement. (SSPC-SP6 Commercial Blast Cleaning).

2. Unless noted otherwise, primer paint shall be one of the following types with the indicated surface preparation:

   a. Zinc oxide, raw linseed oil and alkyd primer, surface prepared according to SSPC-SP-2 (Hand Tool Cleaning) unless noted otherwise in this specification.
b. Fast-curing, lead- and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements of FS TT-P-664, surface prepared according to SSPC-SP-2 (Hand Tool Cleaning) unless noted otherwise in this specification. The contractor is responsible for supplying a paint that complies with the VOC requirements of all local governing agencies.

3. Refer to Architect's drawings and specifications for final paint finish requirements of structural steel. Primer paint shall be compatible with final paint requirements.

I. Non-Shrink Grout: Provide grout type(s) as specified on the drawings:
1. Non-Metallic Non-Shrink Grout: Premixed, non-corrosive, non-staining product containing Portland cement, silica sands, shrinkage compensating agents, and fluidity improving compounds. Conform to ASTM C 1107. Provide the minimum strength as shown below as determined by grout cube test at 28 days:

   a. 8,000 PSI for supporting concrete greater than 3,000 PSI and less than or equal to 4,000 psi.

Subject to conformance with specified requirements, acceptable non-shrink grouts include:

   a. L&M Construction Chemicals, Inc.; Crystex and Duragrout.
   b. Dayton-Superior Corporation; Sure Grip High Performance Grout and 1107 Advantage Grout.
   c. BASF Construction Chemicals; Masterflow 555 and Set Grout.
   e. The Euclid Chemical Company; NS Grout.
   f. Hilti, Inc.; CG 200 PC.

2. High Flow, Non-Metallic Grout: Use high-flow grout where high fluidity and/or increased placing time is required and for base plates that are larger than 10 square feet. The factory pre-mixed grout shall conform to ASTM C 1107, "Standard Specification for Packages Dry, Hydraulic-Cement Grout (Non-Shrink).” In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95% bearing under a 18” x 36” base plate. Provide one of the following:

   a. The Euclid Chemical Co.; Hi-Flow Grout.
   b. BASF Construction Chemicals; Masterflow 928.

J. Grating: Welded steel bar grating of the type, depth, and finish noted on the drawings capable of carrying not less than the stated live load and deflecting not more than span/360 under that load.

K. Hot-Dip Galvanizing:

1. Scope: All structural steel items and their connections permanently exposed to exterior conditions or that are within areas of unconditioned airspace, whether specified on the drawings or not, shall be hot-dip galvanized after fabrication unless indicated on the drawings or in Specification 099100 to receive a primer and/or finish coat. Such items include, but are not limited to:

   a. Base plates and anchor rods supporting galvanized members.
   b. Shelf angles.
   c. Mansard roof supporting members
   d. Parapet wall supporting members.
   e. Screen wall supporting members.
   f. Window washing support members.
   g. Exterior covered walkways.
   h. Embedded plates in concrete exposed to unconditioned airspace.
   i. Building skin support steel exposed to moisture outside the exterior waterproofing surface.
j. Examine the architectural and structural drawings for other items required to be hot-dip galvanized.

2. Zinc-coat all ASTM F 3125 Grade A325 bolts nuts, and washers used in the connection of such steel. Field welded connections shall have welds protected and the exposed portions of ASTM F3125 Grade A490 bolts, nuts, and washers shall be protected with galvanizing repair paint.

3. Surface Preparation: All steel to be hot-dip galvanized shall undergo the following surface preparation as specified by the Society for Protective Coatings (SSPC), Volume 2.
   a. Remove all grease, oil, grime and foreign contaminants by thorough cleaning with an alkaline or organic solvent followed by thorough rinsing in cold water.
   b. Remove scale by pickling in diluted sulfuric or hydrochloric acid. Pickling shall be followed by a rinse in warm water and a second rinse in cold water. As an alternative to pickling, the steel may be white metal blast cleaned according to SSPC-SP-5.
   c. Dip in a flux solution of zinc ammonia chloride followed by drying at room temperature.

4. Zinc Coating: The zinc coating for steel shapes and plates shall conform to ASTM A 123. Weight of zinc coating per square foot of surface for 1/8 inch and 3/16 inch thick steels shall average not less than 3.0 mils with no individual thickness less than 2.6 mils. The coating weight shall average not less than 3.9 mils for 1/4" thick and heavier steel with no individual thickness less than 3.3 mils.

L. Galvanizing Repair Paint: Galvanizing repair paint shall be "ZRC Cold Galvanizing Compound" as manufactured by ZRC Chemical Products or a paint complying with SSPC-Paint 20, Level 1.

2.2 FABRICATION

A. Structural steel members for which shop drawings have not been reviewed shall not be fabricated. Any steel detailed or fabricated prior to the Initial Survey from Part 3 below is at contractor’s risk.

B. All fabricated material and connections shall fit within architectural constraints.

C. The omission from the shop drawings of any materials required by the Contract Documents shall not relieve the Contractor of the responsibility of furnishing and installing such materials, even though the shop drawings may have been reviewed.

D. Shop Fabrication and Assembly:
   1. Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specification and as indicated on approved final shop drawings. Provide camber in structural members where indicated.
   2. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
   3. Clearly mark the grade of steel on each piece, distinguishable in the field from floor surfaces, for purpose of field inspection and confirmation of grade of steel.
   4. Milled surfaces of built-up sections shall be completely assembled or welded before milling.
5. Fitted stiffeners shall be fabricated neatly between flanges, and the ends of stiffeners shall be milled or ground to secure an even bearing against abutting surfaces. All milled or ground joints shall bear throughout their contact length.

E. Dimensional Tolerances: Dimensional tolerances of fabricated structural steel shall conform to Section 6.4 of the AISC Code of Standard Practice.

F. Camber:

1. Camber of structural steel members is indicated on the drawings. Camber shall be measured in the Fabricator’s shop in the unstressed condition, prior to erection. The Fabricator shall provide camber measurements of all beams and a report to the Testing Laboratory confirming this has been done.
2. Where possible, camber of beams shall be applied by a cold bend process.
3. The local application of heat may be used to introduce or correct camber, curvature, or straightness provided the temperature of the heated area, as measured by temperature crayons or other approved means, does not exceed 1,200°F.
4. Where indicated on the drawings in a camber diagram, cantilever or double cantilever beams shall be cambered for the main span and cantilever end separately, either by a staged cold bending process or by the application of heat.
5. Beams detailed without specified camber shall be fabricated so that after erection any natural camber due to rolling or shop fabrication is upward.

G. Splices in Structural Steel: Splicing of structural steel members in the shop or the field is prohibited without prior approval of the Engineer. Any member having a splice not shown and detailed on approved shop drawings will be rejected.

H. Compression Joints: Ends of columns, except as otherwise noted, and other compression joints at splices and other connections as noted on the drawings which depend on contact bearing as part of the splice strength shall be finished to bear in accordance with AISC Specification M2.6 so as to provide complete true bearing in accordance with AISC Specification M4.4.

I. Cutting: Manual oxygen cutting shall be done only with a mechanically guided torch. An unguided torch may be used provided the cut is not within 1/8 inch of the finished dimension and final removal is completed by means such as chipping or grinding to produce a smooth surface quality free of notches or jagged edges. All corners shall be smooth and rounded to a minimum 1/2" radius.

J. Anchor Rods: Furnish anchor rods and other connectors required for securing structural steel to foundations and other in-place work. Furnish 1/8" minimum steel templates for presetting bolts and other anchors to accurate locations.

K. Large Plates to be Embedded in Concrete: For steel plates that are larger than 24”x24” and are to be embedded horizontally in and at the top surface of concrete, provide one-inch diameter holes to prevent trapped air underneath plates and to achieve full consolidation. The location of holes shall be shown on the shop drawings and shall not impair the strength of the plate.

L. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members as shown on the contract documents, and/or the final shop drawings.
1. Provide specialty items as indicated to receive other work.
2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

M. Lifting and Erection Devices: The Fabricator shall be responsible for designing, detailing, and furnishing all lifting devices and erection aids required for erection. Such devices shall be removed after erection if they interfere with architectural finish requirements.

N. Drainage Holes: Provide 1 inch diameter drainage (weep) holes in all members (girders, beams, etc.) exposed to weather where rain water could collect (at low points and/or behind dams caused by connections, stiffener plates, etc.). Show all holes on shop drawings for review by the Engineer.

O. Requirements for Heavy Shapes and Heavy Plates: Heavy Shapes and Heavy Plates shall meet the following requirements:

1. Cutting: Preheating is required. Preheat temperature shall be sufficient to prevent cracking. The minimum preheat temperature is 150 degrees F through the entire thickness; higher preheat shall be provided if necessary to prevent cracking.
2. All cut edges shall be free of gouges and notches.
3. Edge preparations: Copes, cuts, weld access holes, and other flame-cut edges within 12” of a groove weld, hole, or discontinuity in that section shall be ground to bright metal with a surface roughness not exceeding 1000 micro-inches and tested for cracks using the dye penetrant method.

2.3 WELDING

A. Code: All shop and field welding shall conform to all requirements in the "Structural Welding Code – Steel", ANSI/AWS D1.1, as published by the American Welding Society (AWS).

B. Welder Certification: All shop and field welders shall be certified according to all the applicable AWS procedures for the welding process and welding position used. Each welder shall be assigned an identifying symbol or mark and all shop and field welded connections containing complete or partial joint penetration welds, multi-pass fillet welds, and fillet welds greater than 5/16” shall be identified by the symbol or mark of the welder responsible for the connection.

C. Minimum Size and Strength:

1. Fillet Welds: Minimum size of fillet welds shall be as specified in Table J2.4 in AISC Specification, Chapter J.
2. Partial-Penetration Groove Welds: The minimum effective throat thickness of partial-penetration groove welds shall be as specified in Table J2.1 in AISC Specification, Chapter J.
3. Minimum Strength of Welded Connections: Except as specified below in "Connections" or noted otherwise on the drawings, all shop and field welds shall develop the full tensile strength of the member or element joined. All members with moment connections as indicated on the drawings shall be welded to develop the full flexural capacity of the member, unless noted otherwise on the drawings.
D. Filler Metal Requirements: Weld metal shall be as specified in Table J2.5 in AISC Specification, Chapter J and other requirements of this specification.

E. Welding Procedure Specification:

1. All welding shall be performed in accordance with a Welding Procedure Specification (WPS) as required in AWS D1.1 and reviewed by the Owner’s Testing Laboratory and by the Architect/Engineer. The WPS variables shall be within the parameters established by the filler-metal manufacturer. Engage the services of an independent Testing Laboratory to provide the qualification testing required by AWS D 1.1, Chapter 4, part B to qualify any non-prequalified WPS needed for the project. The independent Testing Laboratory shall prepare Welding Procedure Qualification Records (WPQR) documenting the successful qualification of each Welding Procedure Specification.

F. Welding Procedures:

1. All welding processes shall comply with the requirements of ANSI/AWS D1.1 unless noted otherwise.
2. Built-up sections assembled by welding shall be free of warpage and all axes shall have true alignment.
3. Welds not specified shall, if possible, be continuous fillet welds developing the minimum strength, as specified above, using not less than the minimum fillet welds as specified by AISC.
4. The toughness and notch sensitivity of the steel shall be considered in the formation of all welding procedures to prevent brittle and premature fracture during fabrication and erection.
5. The Welding Procedure Specification shall be followed without deviation unless specific approval for change is obtained from the Owner's Testing Laboratory and the Architect/Engineer.
6. Before welding, particular attention shall be paid to surface preparation, fit up, and cleanliness of surfaces to be welded.
7. Minimum preheat and interpass temperatures for structural steel welding shall be as specified in ANSI/AWS D1.1, except that no welding shall be performed when the ambient temperature is lower than 0 degrees F. The temperature shall be measured from the side opposite that upon which the preheat is applied.
8. The heat, input, length of weld, and sequence of weld shall be controlled to prevent distortions. The surfaces to be welded and the filler metals to be used shall be subject to inspection before any welding is performed.
9. Welds shall be sound throughout. There shall be no crack in any weld or weld pass. Welds shall be considered sound if they conform to AWS requirements, as confirmed by non-destructive testing.
10. Welds shall be free from overlap.
11. Craters shall be filled to the full cross section of the welds.
12. For high-strength low-alloy steels, follow welding procedures as recommended by steel producer for exposed and concealed connections.
13. Fabricator and Erector shall coordinate welding responsibility at all welded joints.
2.4 BOLTING

A. Bolt Diameter: Minimum bolt diameter shall be 3/4 inch. The difference in diameter between bolts of differing sizes used on the project shall be not less than ¼”.

B. Connection Type: Unless noted otherwise on the drawings, all bolted connections shall be snug-tightened using high-strength bolts in standard holes (hole diameter nominally 1/16 inch greater than the nominal bolt diameter) with threads included in the shear planes. Notwithstanding, the contractor shall be responsible to adhere to provisions of ANSI/AISC 360 Section J1.10, which lists circumstances under which certain connections require pretensioned high strength bolts.

C. Oversize, Short-Slotted and Long-Slotted Holes: The dimensions and washer requirements of oversize, short-slotted, and long-slotted holes shall conform to ANSI/AISC 360 Table J3.3.

D. Fastener Tension:

1. High strength bolts in snug-tightened joints shall be tightened to a snug tight condition only. Do not pretension bolts in snug-tightened joints the same as if they were in slip-critical joints. The snug-tightened condition is defined as the tightness that exists when all plies are in firm contact. This may usually be attained by a few impacts of an impact wrench or the full effort of an ironworker using an ordinary spud wrench. If Twist-Off-Type Tension-Control Bolt Assemblies are used in snug-tightened joints, do not fully tension bolts and leave the splines intact.

2. High-strength Bolts in Slip-critical and Pretensioned Joints:

   a. High-strength bolts in slip-critical and pretensioned joints shall be tightened to achieve the minimum bolt tension as specified in the RCSC’s "Specification for Structural Joints using High-Strength Bolts" when all the fasteners of a joint are tight.

   b. Any of the four methods to tighten bolts specified in the RCSC Specification may be used to achieve the minimum bolt tension. The tightening procedure that uses direct tension indicator washers shall conform to the requirements of ASTM F 959. Conform to the requirements of ASTM F 1852 for a Twist-Off-Type Tension-Control bolt pretensioning.

E. Washers: Washers under the bolt head and/or nut shall be used as required by the RCSC Specification.

F. Bolt Lubrication: All bolts shall be well lubricated at time of installation. Dry, rusty bolts are not be allowed.

G. Impact Wrenches: Properly sized and lubricated air impact wrenches with adequate air pressure shall be utilized for all bolt installation.

H. New Bolts: All bolts shall be new and shall not be reused.
2.5 CONNECTIONS

A. Conceptual connection details with the required member design forces are shown on the drawings for bidding purposes and are applicable to all connections not designed and completely detailed on the drawings. The conceptual details are provided only to indicate the connection type required and may not fully represent the complexity of the connection as required by the final connection design for the forces they must resist. Except as noted below, the Fabricator is responsible for engaging the services of a professional engineer to prepare a final connection design for submission that meets the requirements of the conceptual connection details and resists the indicated design forces. Refer to the drawings and specifications for complete requirements.

By bidding this project, the fabricator acknowledges that additional connection elements may not be specifically shown in the conceptual details but may be required by the final connection design, such as stiffener plates, doubler plates, supplement/reinforcing plates or other connection material. The fabricator is responsible to include within his bid all material and labor required to conform to the intent of the conceptual details and to carry the design forces indicated, regardless of whether or not all connection elements (such as stiffener plates, doubler plates, supplement/reinforcing plates or any other connection material) required by final connection design are shown in the conceptual detail.

B. Typical connection details are indicated on the drawings.

C. Design and Detailing Procedure:

1. Unless noted otherwise or specifically detailed on the drawings, end connections of beams, girders, and trusses shall be designed as flexible and the connection shall accommodate end rotations of the unrestrained beams. Restrained end connections, as indicated on the drawings, shall be designed for the combined effect of bending moment and shears induced by the rigidity of the connection. Forces to be used in the design are described below.

2. The Fabricator's licensed professional engineer shall design and submit sealed calculations documenting the design and showing details of the assembled joint with the bolts and welds required for the conditions noted below:
   a. For each connection not otherwise completely detailed on the drawings.
   b. Where connections are encountered on the project that do not match those assumed in the AISC Manual.

3. Where connections are of the type that can be selected or completed using information found in tables in the AISC “Steel Construction Manual”, sealed calculations need not be submitted provided the project design conditions precisely match those assumed in the referenced publications. For conditions encountered on the project that do not conform to the AISC Manual, a complete design shall be prepared and submitted for Engineer’s review.

4. The Fabricator’s licensed professional engineer shall seal all design calculations.

5. The Engineer reserves the right to reject all shop drawings submitted without complete design calculations if required. Failure to adhere to the requirements of this section obligates the Contractor to take responsibility for any and all resulting delays in the detailing and fabrication of structural steel.

6. The Fabricator’s detailer shall complete connection detailing using predesigned connections taken directly from the AISC “Steel Construction Manual”. The Fabricator’s
Professional Engineer shall submit a sealed letter attesting that the engineer has reviewed the shop drawings and the connections detailed and shown on the shop drawings conform to the requirements of AISC and meet the required capacities.

7. Where connections are of the type that would normally be selected or completed using information found in tables in the AISC “Steel Construction Manual” but where conditions are encountered on the project that do not match those assumed in the AISC Manual publication, the Fabricator shall retain a Professional Engineer to design and submit sealed calculations documenting the design and showing details of the assembled joint with the bolts and welds required.

8. The Fabricator, his detailer, and professional engineer shall coordinate all connection requirements with the Erector. The Fabricator is responsible to detail connections that contain the adjustability and all other requirements that allow the Erector to erect the structural steel in conformance to all specified tolerances. The Fabricator shall be responsible for providing adjustability in all connections between exterior-cladding systems, skylights, and other architectural features and the supporting structural steel as required in achieving the specified tolerances for the architectural feature as specified in the contract documents or per the manufacturer’s requirements.

D. Design Intent: It is the intention of the plans and specifications that shop connections be welded or bolted and that field connections be bolted, unless detailed otherwise on the drawings.

E. Preliminary Connection Review: The fabricator shall submit preliminary details of proposed typical connections for Engineer review not less than 14 days prior to the start of preparation of detailed shop drawings. Proposed variations from the details shown on the drawings will be considered and such variations must obtain preliminary approval from the Engineer prior to preparation of detailed shop drawings.

F. Flexible (Simple) Beam Connections:

1. All typical beam simple connections shall conform to requirements of the AISC specifications. Refer to the drawings for typical connection types.
2. Seated beam connections and stiffened seated beam connections shall not be used unless indicated on the drawings or unless Engineer approval is obtained to verify capacity of supporting member for the resulting eccentricity. The Fabricator must verify and bear responsibility that the use of such connections does not interfere with architectural or MEP requirements.
3. Simple Beam Connection Capacity: Support a factored load reaction $R$ equal to the reaction shown on the plans. Contact the Engineer if no reaction for a beam is shown on the plan. Each connection shall contain not less than the minimum number of bolts shown in the AISC connection tables for each beam size.

G. Restrained (Moment) Connections:

1. Refer to the drawings for moment connection details.
2. Design Reactions for Moment Connected Beams: Shear connections for moment-connected beams shall be designed for the factored reactions shown on the drawings.
3. Design and Furnishing of Reinforcement in Moment Connected Joints: As part of the design responsibility outlined above, the fabricator shall design and furnish all additional reinforcement in moment connected joints to resist the specified design forces unless otherwise specifically detailed on the drawings. Column sections shall be investigated for
web shear, web yielding, web buckling, and tension. Stiffeners and/or doubler plates shall be furnished as required by the AISC Specification Section J10.

H. Tightening of Bolts in Welded Moment Connections: At moment connections where beams are complete-joint penetration welded directly to columns or girders in the field, welds shall be made after installation of erection bolts to draw the pieces together and before the final shear connection bolts are tightened. Where loose moment plates are used, such plates shall be groove welded to columns prior to connecting these plates to the beams.

I. Base Plates and Bearing Plates:
1. Finish: All baseplates and bearing plates shall be finished in accordance with AISC Specification M2.8.

J. Hangers and Braces:
1. Connections for all hangers and braces shall have connections designed to develop the factored axial force shown on the drawings. Contact the Engineer if no force for a member is shown on the drawings.
2. Compression members composed of two or more rolled shapes separated from one another by intermittent fillers shall be connected to one another at such fillers at intervals (not to exceed 48”) so that the slenderness ratio l/r of either shape, between the fasteners, does not exceed 75% of the governing slenderness ratio of the built-up member. The least radius of gyration, r, shall be used in computing the slenderness ratio of each component part.

K. Stiffeners: Provide stiffeners finished to bear under load concentrations where shown on the drawings.

L. Steel Shelf Angles: Shelf angles supporting veneer shown on the drawings to be continuous shall be furnished to a maximum length of 20’-0”. Provide a 1/4” gap at each joint. The gap shall not be welded. The distance from the joint to the first supporting bolt shall not exceed 40% of the bolt spacing (12” maximum). Shelf angles shall be continuous around corners with corner joint complete-joint penetration welded. The distance to the first supporting bolt from the corner shall not exceed 12”.

M. Limitations on Use of A307 Bolts: ASTM A 307 bolts shall not be used in any permanent steel-to-steel or concrete-to-steel connection.

N. Bolts in Combination with Welds: Bolts shall not be considered as sharing the load in combination with welds, except as allowed in AISC Specification Section J1.8.

2.6 SURFACE PREPARATION AND SHOP PRIME PAINTING


B. Scope: All steel shall remain unpainted, except the following:
1. Shop paint surfaces that are to remain exposed to view in the final construction.
2. Shop paint any steel other than weathering steel that, in the final construction, will not be in a controlled environment and is therefore subject to moisture or high humidity infiltration and that has not been specified to be galvanized.

3. Shop paint any steel that is shown on the drawings to receive a finished paint system as defined in Specification <099100>.

4. Coordinate all shop painting of structural steel with Architect's painting requirements as specified on the architectural drawings and in the specifications. The Fabricator shall be responsible for determining all painting requirements (which surfaces are to be painted or left unpainted) on the project prior to fabrication.

C. Additional Painting Requirements:

1. Extend shop paint to 2" from location of welds on surfaces that are to be field welded.

2. All unpainted mating surfaces of all elements that are welded together into an assembly that is permanently exposed to the exterior shall be seal welded in addition to structural welding requirements.

3. If individual elements (including the mating surfaces) of an assembly that is required to be painted are painted prior to welding into an assembly, then all painted surfaces affected by welding shall be touched-up and repaired (according to manufacturer’s instructions, if any) to prevent corrosion bleeding.

4. The fabricator shall be responsible to ensure that all elements of all assemblies that are to be painted are fabricated so that no exposed surface shall be subject to stains due to corrosion bleeding during the warranty period of the paint.

5. Structural steel elements that are bolted with slip-critical joints and are required on the drawings to be painted shall have all faying surfaces (including all surfaces of filler plates, member end supplement plates, and welds) painted to comply with the specified slip-critical coating requirement.

D. Surface Preparation – Unpainted Steel: All structural steel that is not specified to receive a shop coat of primer paint shall be prepared in accordance with Society for Protective Coatings specifications as follows:

1. SSPC-SP 2, “Hand Tool Cleaning” or SSPC-SP 3, “Power Tool Cleaning” unless otherwise specified.

2. SSPC-SP 6, “Commercial Blast Cleaning” shall be applied to the faying surfaces of connections that are noted on the drawings as slip-critical connections requiring a Class B surface. Apply this surface preparation to the area surrounding all bolt holes including the area up to 2” outside the outer-most holes.

E. Surface Preparation and Primer Paint – Shop Painted Steel:

1. Surface Preparation: Prepare the surface of all structural steel specified to be shop painted as required by the paint manufacturer or the Society for Protective Coatings specifications, but not less than the following:

   a. SSPC-SP 2, “Hand Tool Cleaning” or SSPC-SP 3, “Power Tool Cleaning” unless otherwise specified.
b. SSPC-SP 6, “Commercial Blast Cleaning” shall be applied to the faying surfaces (including filler and member-end supplement plates, if any) of connections that are noted on the drawings as requiring a slip-critical coating. At a minimum, apply this surface preparation to the area between and surrounding all bolt holes including the area up to 2” outside the outer-most holes.

2. Priming: Immediately after surface preparation, apply primer to all structural steel specified to be shop primed in strict accordance with manufacturer’s instructions and the Society for Protective Coatings specifications. Apply paint at a rate to conform to the manufacturer’s written instructions and to provide a dry film thickness of not less the 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, welds, and all exposed surfaces. Apply two coats to surfaces that are inaccessible after assembly or erection. Change the color of the second coat to distinguish it from the first coat.

3. Finish Coat: Coordinate shop primer paint requirements with architectural drawings and specifications. The primer selected must be compatible with any specified finish coat.

F. Shop Touch-Up Painting: The Fabricator shall provide for cleaning and touch-up painting of welds, bolted connections (including nuts, bolts, washers, filler plates, member end supplement plates and welds, if any), and abraded areas. Prior to shipment, apply paint to exposed areas using same materials and surface preparation as used for shop painting. Paint shall be applied by brush or spray with minimum dry film thickness of 1.5 mils.

2.7 SOURCE QUALITY CONTROL

A. Source Testing and Inspection: Refer to Specification 014529 “Structural Testing and Inspections” for testing and inspection requirements associated with structural steel.

B. The Testing Laboratory shall provide the following tests at the designated fabrication shops:

1. Test welds completed in the shop according to “Weld Testing” Paragraph below.
2. Test bolted connections completed in the shop according to “High-Strength Bolt Testing” Paragraph below.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspection Prior to Erection: Erector shall examine areas and conditions under which structural steel work is to be installed and notify the Contractor and the Architect/Engineer in writing of conditions detrimental to proper and timely completion of the work.

3.2 PREPARATION

A. Temporary Shoring and Bracing:

1. The lateral-load resisting or stability-providing system and connecting diaphragms are identified on the drawings. Comply with the provisions of the Code of Standard Practice
regarding stability of the structure during the erection process, except where stricter requirements are noted herein.

2. The Erector shall design and provide all required temporary shoring and bracing to hold structural framing securely in position and to safely withstand all loads as specified in the Code of Standard Practice and ASCE 37 unless larger loads are required by the local building code or specified herein. Provide all bracing, any additional structural members, and increase member sizes and/or connections shown on the drawings as required to accommodate the erection loads, methods, sequence of erection, and equipment until the lateral-load resisting or stability-providing system is completely installed. Clearly show all temporary supports and modifications to designed members on the Shop Drawings and the Erection-bracing Drawings. A qualified licensed professional engineer, hired by the Erector, shall design the temporary shoring and bracing and shall seal the erection-bracing drawings.

3. Where architectural or MEP requirements do not allow for any temporary supports, members, erection devices, or connections to be left in place permanently or where such items affect the final structural behavior, they shall be removed by the Erector. All costs associated therewith shall be included in the bid price.

3.3 ERECTION

A. The erection work shall comply with the requirements of AISC Specification Section M4.

B. Surveys: The following surveys shall be performed by a qualified land surveyor:

1. Initial Survey: Check elevations of concrete and masonry bearing surfaces, anchor bolt locations, embedded connection plates, and all dimensions of existing structures to which new connections are to be made prior to erection and submit any discrepancies to the Engineer prior to the start of erection. Corrections or compensating adjustments to the structural steel shall be made and approved prior to the start of erection.

2. Final Survey: Upon completion of erection of the steel frame, and before the start of work by other trades that may be supported, attached, or applied to the frame, a final survey shall be made and a report submitted certifying compliance with specified tolerances.

C. Erection Tolerances: Erection tolerances of anchor rods, embedded items, and all structural steel shall conform to the AISC Code of Standard Practice, Section 7, unless stricter tolerances are specified elsewhere in the contract documents.

D. Wherever the erection equipment is supported by the structure, the contractor shall be responsible for the retention of a licensed professional engineer to determine the adequacy of the member supporting the erection equipment in relation to the loads imposed thereon. The Contractor shall submit to the Architect/Engineer, for review, the loads that will be imposed by the erection equipment on the building structure. Where the imposed load exceeds the allowable strength, the Contractor shall be responsible for any additional materials, supports, bracing, connections and similar measures required to support the imposed load of the equipment while in use, subject to review by the Architect/Engineer.

E. Anchor Rods: Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout. Use only steel wedges or shims.
F. Splices: Splices will be permitted only where indicated on the contract drawings and approved shop drawings. Fastenings of splices of compression members shall be done after the abutting surfaces have been brought completely into contact within AISC tolerances. Bearing surfaces and surfaces that will be in permanent contact are to be cleaned before the members are assembled.

G. Field Assembly of Structural Steel:

1. As erection of the steel progresses, the work shall be fastened securely to safely carry all dead load, wind, and erection forces. Particular care shall be exercised to ensure straightness and tautness of bracing immediately upon raising a steel column.
2. Provide temporary planking and working platforms as necessary to effectively complete work.
3. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment. Level and plumb individual members of structure within specified AISC tolerances. The Contractor shall coordinate with Erector and Fabricator regarding possible discrepancies in member lengths between temperature at time of fabrication and temperatures during erection, and shall make necessary adjustments to ensure plumbness within AISC tolerances at 70°F. Compensate for cumulative welding draw, construction loadings, sequential applications of dead loads, or any other predictable conditions that could cause distortions to exceed tolerance limitations.
4. On welded construction exposed to view or weather, remove erection bolts, fill holes with plug welds or filler and grind smooth at exposed surfaces.
5. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces receiving field welds.
6. Comply with all bolting and welding requirements of Part 2 of this specification.

H. Field Modifications to Structural Steel: Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and structural fitting of parts shall be reported immediately to the Architect/Engineer, and approval of the method of correction shall be obtained. Approved corrections shall be made at no additional cost to the Owner. Do not use cutting torches, reamers, or other devices in the field for unauthorized correction of fabrication errors.

I. Miscellaneous Framing: Provide supplemental structural steel support framing for steel deck where columns, or other framing members or floor openings interrupt normal deck bearing whether shown or not on the architectural, mechanical, or structural drawings.

J. Removal of Erection Aids and Devices: The Erector shall remove all erection aids and devices that interfere with architectural finish or MEP requirements.

K. Field Touch-Up Painting:

1. Clean field welds, unpainted areas of bolted connections (including all exposed areas of nuts, bolts, washers, filler plates, member end supplement plates, and welds), and any shop painted areas that are abraded. Apply paint to all exposed areas using same material and surface preparation as used for shop painting. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.
2. Clean field welds, ungalvanized areas of bolted connections (including all exposed areas of nuts, bolts, washers, filler plates, member end supplement plates, and welds), and any galvanized areas that are abraded. Prepare surfaces and apply two coats of the specified galvanizing repair paint in accordance with ASTM A 780.

3. The Contractor shall ensure that, at the substantial completion of the project, all structural steel, bolted and/or welded, required to be painted shall have all necessary steel surfaces painted (including touch-up painting as required) to prevent corrosion bleeding.

L. Shear Connector Installation:

1. Composite Beams:
   a. Studs shall be welded in the field (not the shop) using automatically timed stud welding equipment.
   b. The top flange of the beams must be unpainted and free of heavy rust, mill scale, dirt, sand or other foreign material which will interfere with the welding operation.
   c. The steel deck must be free of dirt, sand, oil, or other foreign material and must be dry and free of moisture. Steel deck must rest tightly on the beam flange. Welding must take place through only one thickness of deck.
   d. Stud Spacing: Studs shall be spaced on beams and girders as shown on the drawings.

M. Headed Stud Anchor Installation:

1. Steel Plates Embedded in Concrete:
   a. Studs shall be welded using automatically timed stud welding equipment.
   b. Plates must be unpainted and free of heavy rust, mill scale, dirt, sand or other foreign material that will interfere with the welding operation.

N. Clean Up: Clean up all debris caused by the Work of this Section, keeping the premises neat and clean at all times.

3.4 FIELD QUALITY CONTROL

A. Field Testing and Inspection: Refer to Specification 014529 “Structural Testing and Inspections”.

END OF SECTION 051200
SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 SCOPE OF WORK

A. Extent of steel joists is shown on drawings, including basic layout and type of joists required.

B. Quantity of joists required shall be determined from the contract drawings.

1.3 QUALITY ASSURANCE

A. The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

B. Qualifications:

1. The steel joist manufacturer shall be a firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance for a minimum of 2 years.

2. The steel joist manufacturer must show evidence of compliance with the submittal, testing, and inspection requirements of the Steel Joist Institute (SJI) Standard Specifications for verification of design and manufacturing.

C. Design and Manufacturing: Provide joists designed and manufactured in compliance with the following, and as herein specified.


2. Design top and bottom chords for additional bending stresses resulting from a vertical concentrated load of 100 pounds (service) located anywhere between panel points. This load is used only for a bending check of the chord members.


4. SJI Technical Digest #8 "Welding of Open Web Steel Joists"

5. Comply with all OSHA requirements.

D. Load Test of Joists: Full scale load tests of joists are required for the project as specified herein.

1. Frequency of Testing: Load tests shall be performed on one joist out of every 200 or fraction thereof up to a maximum of 5 tests for the project. The joists series to be tested shall be indicated by the Engineer-of-Record on the approved shop drawings. Actual joists
to be tested shall be selected on a random basis by the Owner's Testing Laboratory from joists fabricated for this project.

2. Test Load Procedure:

   a. First, the joist shall be loaded to design load in 25% increments and deflection measurements at midspan shall be taken.
   b. Secondly, the joist shall be loaded to 1.2 times the dead load (including self weight) plus 1.60 times the design live load and the midspan deflection measurement taken while the load is still in place.
   c. All test loads shall then be removed and the final deflection measured.
   d. All test loads shall be applied to the joists either uniformly or at panel points. In no case shall the test load be applied in a manner that would cause overload in any of the members.
   e. The weight of the steel joist and any weight applied by the test apparatus itself shall be included in the total test load.
   f. The top and bottom chords of the joist shall be laterally supported in accordance with the SJI specifications or as shown otherwise on the contract drawings.

3. Acceptance Criteria: The load test shall be considered successful if the following criteria are satisfied:

   a. No evidence of failure has occurred in any member, connection, splice, or bearing seat.
   b. The permanent deflection immediately upon removal of all test load shall not exceed 20% of the deflection under full test loading.

4. Failure of Load Test:

   a. Final decision as to passage or failure of any load test shall rest solely with the Engineer-of-Record.
   b. The Owner reserves the right, at no cost penalty, to reject usage of the joist manufacturer's product if any load test has failed.
   c. The Owner reserves the right to perform further inspections of any or all joists proposed to be used on the project at his own cost.
   d. All repair costs required by the Engineer-of-Record to be implemented on joists proposed for use on the project in order to bring them in compliance with this specification shall be borne by the joist manufacturer.
   e. One additional successful load test shall be performed if requested by the Owner for each test that fails, at no additional cost to the Owner.

5. Joists Used in Load Test: Joist used in any load test shall not be utilized in the project.

E. Qualification of Field Welding: Qualify field welding processes and welding operators in accordance with American Welding Society (AWS) qualification procedure.

1.4 SUBMITTALS

A. Qualification Data: Submit evidence of compliance with the requirements listed in section 1.3 A and B.
B. Shop Drawings:
   1. Submit detailed drawings showing layout of joist units, connections, jointing and accessories. Include length, camber, mark, number, type, location and spacing of joists and bridging. Submit details for member splices.
   2. Provide templates or location drawings for installation of anchorage devices and bearing plates in other construction materials.

C. Design Calculations: Submit design calculations for all joists showing complete geometry and member sizes, including web and chord member splices to verify compliance with these specifications, contract drawings, and SJI specifications. Calculations shall be signed and sealed by a licensed engineer in the state where the project is located.

D. Mill Certificates: Submit mill reports for the structural steel used in the joists and for the bolts certifying compliance with specified requirements.

E. Certificate of Compliance: Submit certificate of compliance to Architect and Building Official certifying that manufacturing work was done in accordance with approved construction documents and with SJI Standard Specifications.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle steel joists as recommended in SJI specifications. Handle and store these in a manner to avoid deforming members and to avoid excessive stresses.

1.6 SHOP INSPECTION

A. The manufacturer's quality assurance inspector shall inspect joists before shipment to insure compliance of materials and workmanship with the documents specified in this specification. Repair any defects found prior to shipment of the joists.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel: Comply with SJI specifications for chord and web members

B. Steel Bearing Plates: ASTM A 36


D. High-Strength Threaded Fasteners: ASTM A 325 heavy hexagon structural bolts with nuts and hardened washers.

E. Steel Prime Paint: Comply with SJI specifications.

F. Welding Electrodes: Comply with AWS standards.
2.2 FABRICATION

A. General: Fabricate steel joists in accordance with all documents listed in "Quality Assurance," except as noted below.

B. Splices in Chord Members: All splices shall be designed and provided in accordance with SJI Specifications. The splices in each of the two angles or bars of all members shall not be at the same location, but shall be staggered a minimum of 6 inches.

C. Holes in Chord Members: Provide holes in chord members where shown in contract drawings for securing other work to steel joists; however, deduct area of holes from the area of chord when calculating strength of member.

D. Joists shall be cambered for dead loads: Provide all joists with SJI standard camber unless specified otherwise on the drawings. Review the Structural Drawings and Specifications for information concerning dead loads for joists requiring other than standard camber. Joist camber must be shown on shop drawings submitted for review. Not showing camber information on shop drawings shall be cause for rejection of shop drawings.

E. Joist Bearing: Provide minimum end bearing of joists as required by SJI specifications but subject to requirements below: Provide sloped shoes if joist slope exceeds ¼ inch per 12 inches (1:48).

1. Joists Less than 60-Foot Span:
   a. If two joists do not abut each other at a support, provide required joist bearing centered on the supporting member unless detailed otherwise on the drawings.
   b. If two joists abut each other at a support and sufficient minimum bearing for each joist exists, provide 1/4" space between joist ends centered over the support unless detailed otherwise on the drawings.
   c. If two joists abut each other at a support and sufficient minimum bearing for each joist does not exist at the support, offset the ends of each joist and center joist bearing on the center of the support.

2. Joists Greater than or Equal to 60-Foot Span: All joists having a span greater than or equal to sixty feet must have required minimum bearing centered over the support. Joists abutting each other at a support must be offset at the bearing end to satisfy this requirement.

F. Top Chord Extensions and Extended Ends: Provide top chord extensions and extended ends on joists where shown in contract drawings complying with the requirements of SJI specification and load tables.

G. Ceiling Extensions: Provide ceiling extensions in areas having ceilings attached directly to joist bottom chord. Provide either an extended bottom chord element or a separate unit, to suit manufacturer's standards, of sufficient strength to support ceiling construction. Extend ends to within 1/2" of finished wall surface unless otherwise indicated.

H. Bridging: Provide horizontal and/or diagonal type bridging for all joists, complying with SJI specifications at a minimum.
   1. Examine the drawings carefully for special bridging requirements such as may be required to resist net uplift forces as shown on the drawings or to provide special bracing.
   2. Provide bridging anchors for ends of bridging lines terminating at walls or beams.
I. End Anchorage: Provide end anchorages to secure joists to adjacent construction, complying with SJI specifications, unless otherwise indicated.

J. Header Units: Any situation requiring heading of joists not shown on the structural drawings shall be referred to engineer for framing.

K. Shop Painting: Remove loose scale, heavy rust, grease, oil and other foreign materials from fabricated joists and accessories by rotary wire brushes and/or solvents before application of shop paint. Apply one shop coat of primer paint to steel joists and accessories, by spray, dipping, or other method to provide a continuous dry paint film thickness of not less than 0.50 mil.

PART 3 - EXECUTION

3.1 ERECTION

A. Place and secure steel joists strictly in accordance with SJI code of standard practice, SJI specifications, final shop drawings, and as herein specified.

B. Bearing Plates: Furnish steel bearing plates to be built into concrete and masonry construction.
   1. Refer to Division 03 sections for installation of plates set in concrete.
   2. Refer to Division 04 sections for installation of plates set in masonry.

C. Placing Joists: Do not start placement of steel joists until supporting work is in place and secured. Place joists on supporting work, adjust and align in accurate locations and spacing before permanently fastening.
   1. Comply with SJI specifications regarding required bridging, connections, and anchors to ensure lateral stability during construction. Remove as required for architectural, structural, and mechanical clearances after erection.
   2. Where members support joists from both sides and the supporting width does not meet the SJI recommendations for bearing lengths of both joists, the joists shall be offset to provide recommended bearing lengths. Such offsets shall be subject to approval by the Architect/Engineer.

D. Bridging: Install bridging simultaneously with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams.

3.2 ANCHORING JOISTS

A. Anchor steel joists to supporting steel framework with welds, bolts, or a combination of the two in accordance with SJI specifications for type of joists used. Joists on column lines shall be field bolted with high-strength threaded fasteners installed snug tight.

B. Joists where shown with bottom chord extensions shall not have the bottom chords connected to the supporting members until the full dead load is applied.
C. Anchor joists resting on [masonry or] concrete to steel bearing plates embedded therein with welds, bolts, or a combination of the two in accordance with SJI specifications for type of joists used.

D. Anchor joists resting on masonry to steel bearing plates embedded therein with welds, bolts, or a combination of the two in accordance with SJI specifications for type of joists used.

E. Touch-Up Painting: After joist installation, paint field bolt heads and nuts, welded areas, and abraded or rusty surfaces on joists and steel supporting members. Wire brush surfaces and clean with solvent before painting. Use same type of paint as used for shop painting.

3.3 ATTACHMENTS TO JOISTS

A. The Contractor shall ensure that no cuts or holes are made in the members of the erected joists for attachment of ceiling, ducts, pipes, or any other items not specifically shown in the contract drawings. Use of power driven fasteners in the diagonal and bottom chord members of the joists is prohibited.

B. The Contractor shall not hang any elements from the top or bottom chords of joists except ceiling, ducts, pipes or other items specifically shown on the Contract Documents, without the written authorization of the Engineer.

1. All pipes, ducts, and other mechanical, electrical, and plumbing equipment suspended from the joists' top or bottom chord and producing hanger loads exceeding 100 pounds shall have the hanger attached at a joist panel point only except if the chord member is stiffened according to the typical detail shown on the drawings.

2. All ceilings hung from the joists and producing a concentrated load of 100 pounds or less may have the grid hung anywhere along the bottom chord. Hung ceilings producing more than a 100 pound concentrated load shall have the grid hung only at joist panel points except if the chord member is stiffened according to the typical detail shown on the drawings.

3. Heavy pipes, ducts, or other equipment hung from joists may require additional reinforcement and shall be referred to the Engineer for framing.

3.4 QUALITY ASSURANCE TESTING AND INSPECTION DURING FABRICATION AND ERECTION

A. See Testing Laboratory Services section of the Specifications for open web steel joist inspection and testing requirements.

END OF SECTION 052100
SECTION 053100 – STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 SUMMARY

A. Section includes all labor, materials, services, equipment, and hardware required in conjunction with or related to all steel deck work, including but not necessarily limited to deck units, cover plates, pour stops, hanger slots or clips, steel deck edge closures, cell closures, and all related accessories.

B. Related Requirements:

1. Specification 014000 “Quality Requirements” for requirements of material testing and inspection.
4. Specification 032000 “Concrete Reinforcing” for reinforcement in steel deck slabs.
5. Specification 033000 “Cast-in-Place Concrete” for normal-weight and lightweight structural concrete fill over steel deck.

1.3 REFERENCES

A. Definitions:

1. Professional Engineer: A professional engineer who is licensed to practice engineering in the state where the project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with steel decking that are similar to that indicated for this Project in material.

B. Reference Standards:

1. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified.

   a. AISI, “Specification for the Design of Cold Formed Steel Structural Members.”
   c. SDI, “Design Manual for Composite Decks, Form Decks, and Roof Decks.”
1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Quality Control: The Contractor is responsible for quality control, including workmanship and materials furnished by subcontractors and suppliers.

2. Document Conflict and Precedence: In case of conflict among documents, including architectural and structural drawings and specifications, notify the Architect/Engineer prior to submitting proposal. In case of conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing by the Architect/Engineer.

3. Materials and installed work may require testing and retesting, as directed by the governing building code or the Architect/Engineer, at any time during progress of work.

   a. The Contractor shall provide adequate notification to the Owner’s Testing Agency of construction operations including the project schedule to allow the Testing Agency to schedule inspections. Failure to notify sufficiently may result in additional costs incurred by the Testing Laboratory that may be back-charged to the Contractor by the Owner.

   b. The Contractor shall cooperate with laboratory personnel, provide access to the work, and provide access to manufacturer’s operations.

   c. The Contractor shall make adequate arrangement with the Owner’s Testing Agency for inspection of material stockpiles and facilities.

   d. The Contractor shall provide to the laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.

   e. The Contractor shall furnish casual labor, equipment, and facilities as required for sampling and testing by the laboratory and otherwise facilitate the required inspections and tests.

   f. Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents. Tests not specifically indicated to be done at the Owner’s expense, including retesting of rejected materials and installed work, shall be done at the Contractor’s expense. See 014529 Structural Testing and Inspections section of the Specifications.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer’s specifications and installation instructions for each type of deck specified.

B. Shop Drawings: Submit detailed shop drawings showing type of deck, complete layout, attachment details, closures, edge strips, pans, deck openings, special jointing, supplementary framing, and all other accessories.

C. Certificates: Submit a certificate of product compliance with SDI standards as specified.

D. Delegated Design Submittals: If the submitted deck does not comply with the minimum properties shown on the drawings, the steel deck manufacturer shall submit design calculations
sealed by a Professional Engineer verifying compliance with the specifications for all load and span conditions shown on the drawings.

E. Qualification Statements:

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests as specified in the “Qualifications” section under Part 1. If recertification of welders is required, retesting will be at Contractor's responsibility.

F. Insurance Certification: Assist Architect and Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire, windstorm, and extended coverage insurance.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Supplier: The steel deck supplier shall be a manufacturer with a minimum of two years of successful experience and with a minimum of two successful projects of a comparable size and scope to this project.

2. Erector: The steel deck erector shall have a minimum of two years of successful experience and with a minimum of two successful projects of a comparable size and scope to this project.

3. Welding Qualifications: Qualify welding processes and welding operators in accordance with AWS D1.3 procedures.

B. Underwriters Laboratories Classifications:

1. Provide steel deck units which are listed and conform to Underwriters Laboratories "Fire Resistance Directory", with each deck unit bearing the UL label and marking for specific fire-resistant system detailed.

2. Provide units and construction meeting the requirements of Construction No. [58] [76] [157] [192] [234] [241] [266] [110] [143] [155] [250] [434] as listed in the 2006 UL “Roofing Materials & Systems Directory” under Roof Deck Constructions (TGKX) and rated as a Class [30] [60] [90] assembly, and with each deck unit bearing the UL label and marking for specific wind-rated system detailed.

C. Factory Mutual Listing: Provide steel roof deck units which have been evaluated by Factory Mutual Research Corporation and are listed in "Factory Mutual Research Approval Guide" for "Class 1" or "Non-Combustible" fire rated construction and [60] [75] [90] [120] [150] [190] windstorm ratings.
PART 2 - PRODUCTS

2.1 COMPOSITE FLOOR DECK

A. General Requirements

1. See the drawings for location of steel deck types and for depth of deck, design deck properties, design deck yield strength, concrete type, total slab thickness, slab reinforcing, and design superimposed loads. The average rib width to depth of deck ratio shall be greater than or equal to 2.0. The deck properties specified are the values used for the design of the deck shown on the drawings. Provide deck with the depth as noted and other properties equal to or greater than the values stated on the drawings except that a deck with properties less than those stated, other than depth, may be used provided that the deck manufacturer take responsibility for the design of the deck. The design shall include the ability to carry the construction dead loads and design superimposed loads indicated for all the spans shown on the drawings and to meet all performance criteria as specified by the SDI. Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with “SDI Specifications and Commentary for Composite Steel Floor Deck”.

2. Acceptable manufacturers include the following:

a. ASC Steel Deck.
b. Canam Steel Corp.
c. New Millennium Building Systems, Inc
d. Cordeck.
e. DACS, Inc.
f. Marlyn Steel Decks, Inc.
g. New Millennium Building Systems, Inc.
h. Roof Deck, Inc.
i. United Steel Deck, Inc.
j. Valley Joist, Inc.
k. Verco Manufacturing Co.
m. Other manufacturers may be used only with Architect/Engineer approval.

B. Grade of Steel:

1. Composite steel deck shall be cold formed from steel sheets conforming to ASTM A1008 or ASTM A653, Structural Steel Grade, with a minimum yield strength as stated on the drawings. The delivered thickness of the uncoated steel shall not be less than 95% of design thickness. Sheet metal accessories shall conform to the same material specification as the deck product.

C. Finish:


D. Fabrication:

1. Steel Deck Spans: The deck properties shown on the drawings are selected so that the spans do not exceed the maximum clear spans with unshored construction as required by SDI criteria unless indicated otherwise on the drawings. The deck manufacturer shall be responsible for supplying a deck that meets that criterion. Where possible, all steel deck shall extend over three or more spans. Simple span deck will not be permitted unless it is shored at midspan or approved by EOR. Any additional concrete topping specified over the composite slab shall be placed after the slab has reached 75% of its design strength.

2.2 ROOF DECK

A. General Requirements:

1. See General Notes on the drawings for the location, depth of deck, design thickness, and type of deck required.

2. Acceptable manufacturers include:

   a. ASC Steel Deck.
   b. Canam Group.
   c. New Millennium Building Systems, Inc
   d. Cordeck.
   e. Epic Metals Corp.
   f. Loadmasters Systems, Inc.
   g. Marlyn Steel Decks, Inc.
   h. New Millennium Building Systems, Inc.
   i. United Steel Deck, Inc.
   j. Valley Joist, Inc.
   k. Verco Manufacturing Co.
   m. Other manufacturers may be used only with Architect/Engineer approval.

B. Grades of Steel:

1. Steel deck shall be manufactured from steel conforming to ASTM A1008 Grades C, D, or E for painted deck or A653, Structural Steel Grade for galvanized deck or Engineer approved equal, having a minimum yield strength as stated on the drawings.

C. Finish:

1. Galvanizing: Steel deck shall be galvanized with a protective zinc coating conforming to ASTM A653 G90.

D. Fabrication:

1. General: Fabricate deck panels, without top-flange stiffening grooves, to comply with “SDI Specifications and Commentary for Steel Roof Deck”, in SDI Publication No. 29, and the following.
2. Steel Deck Spans: Where possible, all steel deck shall extend over three or more supports. Single span deck is prohibited.

2.3 NONCOMPOSITE VENTED FORM DECK

A. General Requirements:

1. See General Notes on the drawings for location of steel deck types and for depth of deck, minimum deck thickness, section properties of deck, concrete type, total slab thickness, slab reinforcement, and suggested manufacturer.
2. Acceptable deck manufacturers include the following:
   a. Canam Steel Corp.
   b. New Millennium Building Systems, Inc.
   c. Epic Metals Corp.
   d. United Steel Deck, Inc.
   e. Valley Joist, Inc.
   g. Other manufacturers may be used only with Architect/Engineer approval.
3. Factory Mutual Windstorm Classification Requirements: Provide steel deck panels that comply with the requirements of the Factory Mutual Research Approval Guide 2000 – Building Materials for Windstorm Classification 1-90 for the following manufacturers of lightweight insulating concrete:
   a. Airlite Processing Corp. of Florida
   b. Celcore, Inc.
   c. Cellular Concrete, LLC, Mearlcrete Div.
   d. Concrecel International, Inc.
   e. Elastizell Corp. of America
   f. Siplast, Inc.
4. Underwriters Laboratories Wind Uplift Classification: Provide steel deck panels meeting the requirements of Construction No. 110/143/155/250/434 as listed in the 2000 UL Roofing Materials & Systems Directory under Roof Deck Constructions (TGKX) and rated as a Class 1-30/1-60/1-90 assembly.

B. Grades of Steel:

1. Steel Form Deck shall be manufactured from steel conforming to ASTM A1008 or ASTM A 653, Structural Steel Grade having a minimum yield strength as stated on the drawings. The delivered thickness of uncoated steel shall not be less than 95% of the design thickness. Sheet steel accessories shall conform to the same material specification as the deck product.
C. Finish:

1. Roof Deck: Roof deck shall be galvanized with a protective zinc coating conforming to ASTM A 653 G90 class.

2. Floor Deck:

   a. Galvanized: Floor deck shall be galvanized with a protective zinc coating conforming to ASTM A 653 G90 class.
   
   b. Painted: Floor deck shall be phosphatized painted with the steel chemically cleaned of all oil, grease, dirt and then phosphate coated. The deck shall then receive a two-coat baked-on lead- and chromate- free rust inhibitive primer on the bottom side complying with the performance requirements of FS TT-P-664.


D. Venting:

1. All steel form deck supporting lightweight insulating concrete shall have built in slot vents at the bottom or sides of each rib having a minimum uniformly distributed open area of 1.5%.

E. Fabrication:

1. General: Fabricate deck panels to comply with “SDI Specifications and Commentary for Non-composite Steel Floor Deck”, in SDI Publication No. 29, and the following.

2. Steel Deck Spans: Where possible, all steel deck shall extend over three or more supports. Single span deck is prohibited.

2.4 ACCESSORIES

A. Mechanical Fasteners:

1. Powder-Actuated or Pneumatically Driven Pins: Provide corrosion-resistant, powder-actuated or pneumatically driven fasteners manufactured from steel conforming to AISI 1060 or 1061 steel, austempered to a core hardness of 52 to 58 Rockwell C. Fasteners shall have a knurled shank and shall be zinc-plated in accordance with ASTM B633, Sc. I, Type III.

   a. Subject to compliance with requirements, provide products of one of the following manufacturers:

      1) Hilti, Inc.
      2) ITWBuildex.
      3) Pneutek, Inc.
2. **Self-Drilling Screw Fasteners:** Provide corrosion-resistant, hexagonal head, steel self drilling screws, austempered to a core hardness of Rockwell C 50.

   a. Subject to compliance with requirements, provide products of one of the following manufacturers:

   1) Hilti, Inc.
   2) ITWBuildex.
   3) Grabber Construction Products.
   4) SFS Intec Fastening Systems, Inc.
   5) Textron Fastening Systems.

B. **Side-Lap Fasteners:**

   1. Provide corrosion-resistant, hexagonal washer head undercut with reverse serrations, self-drilling, carbon-steel screws, No. 10 minimum diameter.

   a. Subject to compliance with requirements, provide products of one of the following manufacturers:

   1) Hilti, Inc.
   2) Other approved alternative.

C. **Roof Deck Accessories:**

   1. Provide minimum 20 gauge ridge and valley plates, minimum 20 gauge cant strips, minimum 14 gauge sump pans, minimum 20 gauge inside or outside closure channels angles or plates, minimum 20 gauge butt strips at change of deck directions, and minimum 20 gauge filler sheets.

   2. Provide a 20 gage galvanized flat plate to reinforce openings in roof deck that are greater than 6” and less than 10” in any one direction.

D. **Composite/Form Deck Accessories:**

   1. Flexible Closure Strips: Provide manufacturers standard vulcanized closed cell, synthetic rubber.


   3. Metal Cover Plates – Cellular Deck: Fabricate metal cover plates for end abutting floor deck units of not less than same thickness as decking, formed to match contour of deck units.

   4. Cell Closure at Ends of Steel deck Flutes: Fabricate metal closure strips of not less than 0.0358” minimum (20 gage) cold formed sheet steel. Form to provide tight fitting cell closures at open ends of cells or flutes to prevent wet concrete from leaking through open cells.

   5. Pour Stop Closures at Slab Edges: Provide sheet metal pour stop closures at all slab edges, columns, walls, and openings unless steel angles or bent plates are specified in details on the drawings. The closures shall be fabricated from light gage steel not less than the thickness shown below when the slab edge is parallel to the deck span. Provide a return
lip on the vertical leg in accordance with the SDI Design Manual. The overhang dimension is measured from the edge of the flange to the edge of the slab.

a. Slab Thickness = 2.5” to 4”:
   1) Overhang between 0” and 2”: 20 gage.
   2) Overhang between 2” and 4”: 18 gage.
   3) Overhang between 4” and 6”: 16 gage.
   4) Overhang between 6” and 8”: 12 gage.
   5) Overhang between 8” and 10”: 12 gage.
   6) Overhang between 10” and 12”: 10 gage.
   7) Overhang greater than 10”: Not acceptable as light gage.

b. Slab Thickness = 5.25”:
   1) Overhang between 0” and 2”: 18 gage.
   2) Overhang between 2” and 4”: 16 gage.
   3) Overhang between 4” and 6”: 14 gage.
   4) Overhang between 6” and 8”: 12 gage.
   5) Overhang between 8” and 10”: 10 gage.
   6) Overhang greater than 10”: Not acceptable as light gage.

c. Slab Thickness = 6.25”:
   1) Overhang between 0” and 2”: 16 gage.
   2) Overhang between 2” and 4”: 14 gage.
   3) Overhang between 4” and 8”: 12 gage.
   4) Overhang between 8” and 10”: 10 gage.
   5) Overhang greater than 10”: Not acceptable as light gage.

d. Slab Thickness = 6.5”:
   1) Overhang between 0” and 2”: 16 gage.
   2) Overhang between 2” and 4”: 14 gage.
   3) Overhang between 4” and 8”: 12 gage.
   4) Overhang greater than 8”: Not acceptable as light gage.

e. Slab Thickness = 8.0”:
   1) Overhang between 0” and 4”: 12 gage.
   2) Overhang between 4” and 8”: 10 gage.
   3) Overhang greater than 8”: Not acceptable as light gage.

E. Openings on Concrete Floor:

1. For unframed openings, provide blockout in slab for opening with deck uncut. Cut deck at opening after concrete has been poured and obtained 75% of its design strength. See Section 033000, “Cast-In-Place Concrete”, 032000, “Concrete Reinforcing”, for reinforcing in the slab around all unframed openings in steel deck that are greater than 10” width in either direction.
F. Extra Concrete Required for Deck Deflection
   1. The General Contractor shall include in his bid additional concrete required for steel deck slabs to account for deck deflection.

2.5 CONCRETE SLAB REINFORCEMENT
   A. See drawings for reinforcement in composite and non-composite concrete slabs. See Section 033000, “Cast-in-Place Concrete”, for minimum reinforcement requirements.

2.6 CHLORIDE ADMIXTURES
   A. The use of admixtures in concrete containing chloride salts shall not be permitted for steel deck concrete.

2.7 ROOF OPENINGS
   A. Provide a 20 gage galvanized flat plate to reinforce openings in roof deck that are greater than 6” and less than 10” in any one direction.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. General: Install deck units as accessories in accordance with manufacturers recommendations and approved shop drawings, and as specified herein:
      1. Place deck units on supporting framework and adjust to final position with ends accurately aligned and minimum bearing on supporting members indicated below before being permanently fastened. Do not stretch or contract side lap interlocks. Place the end joint over a chord angle for deck bearing on steel joists.
      2. Place deck units in straight alignment for entire length of run of cells and with close alignment between cells at ends of abutting units.
      3. Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.
      4. Do not place deck units on concrete supporting structure until concrete has cured and is dry.
      5. Do not use floor or roof deck units for storage or working platforms until permanently secured.
      6. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.
      7. The Contractor is responsible for temporary deck fastening to meet OSHA requirements to use the floor deck unit as a storage or working platform before final attachment is installed.
B. Deck Attachments: The deck shall be fastened to the structural support members using one of the following methods:

1. Powder-Actuated Driven Pins:
   a. An operator licensed by the manufacturer shall install all pins.
   b. Comply with the manufacturer’s requirements to install the pins through all layers of the deck material and the manufacturer’s required embedment into the supporting member.

2. Welding: Welds shall be puddle welds with diameters as indicated below. Where two deck units abut each other, each unit shall be so welded. Puddle welds may be replaced with welded shear connectors when applicable.
   a. All welding shall be performed by AWS qualified welders unless otherwise approved by the building official.
   b. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.
   c. Weld metal shall penetrate all layers of deck material at end laps and side joints and shall have good fusion to the supporting member.
   d. Welding washers shall be used only when welding steel deck less than 0.028" thickness. Welding washers shall be a minimum thickness of 0.0568 inches and have a nominal 3/8" diameter hole.

3. Self-Drilling Fasteners: Comply with the manufacturer's requirements to install the screws through all layers of the deck material and the manufacturer’s required embedment into the supporting member.

4. Attachment of Composite Deck:
   a. Powder-Actuated Driven Pins: Refer to the drawings for type of pin used and number and spacing of attachments.
   b. Welding: Steel deck units shall be welded to the structural support members with 5/8" diameter puddle welds at each end of sheet and each intermediate support at each low flute, unless more frequent attachment is specified on the drawings.
      1) Welding Washers: Welding washers shall be used when welding steel deck units less than 0.028" thickness.
   c. Self-Drilling Fasteners may not be used for attachment of composite deck.
   d. Attachment to Girders: Steel deck units shall be attached to girders (steel framing that is parallel to span of deck) using one of the specified fastening methods at a spacing of 12" center to center.
   e. Side Laps: Unless noted otherwise on the drawings, side laps of adjacent units shall be fastened by welding (1-1/2 inch long), sheet metal screws (No. 10 or larger) or button punching at maximum intervals not exceeding the lesser of half of the span or 36".
   f. Welding of Composite Deck used on Roof: In addition to the minimum attachment specified above, typical areas of the roof deck shall be welded to resist the net uplift pressures as specified in the General Notes on the drawings.
g. Minimum Bearing: Provide a minimum deck bearing of 1 1/2” over all supports with butted end joints.

h. Cellular Decks: Keep the interiors of cells that will be used as raceways free of welds or screw edges having sharp points or edges.

5. Attachment of Floor Form Deck:

a. Unless noted otherwise on the drawings, floor deck units shall be fastened to each end support at each side lap and half way in between. At each interior support floor deck units shall be fastened at each side lap.

b. Powder-Actuated Driven Pins: Refer to the drawings for type of pin used and number and spacing of attachments, if different than above.

c. Welding: Provide 5/8” puddle welds, unless noted otherwise on the drawings.

d. Self-Drilling Fasteners: Refer to the drawings for type of fasteners and number and spacing of attachments, if different than above.

e. Attachment to Girders: At locations where the deck flutes are parallel to the span of the steel framing and the top of the framing is at the bottom of the deck elevation, the deck shall be attached to the girder using one of the specified fastening methods at 18 inches on center.

6. Attachment of Roof Deck and Roof Form Deck:

a. The method of attachment, attachment pattern, and side lap fastener type and spacing, shall be as shown on the drawings and comply with the requirements noted below.

b. Powder-Actuated or Pneumatically Driven Pins.

c. Welding: Use 5/8” diameter puddle welds.

d. Self-Drilling Fasteners.

e. Side Lap Fastening: Unless required otherwise by provisions of Factory Mutual, Underwriters Laboratories, or this specification, side laps of adjacent units shall be fastened by welding (on 20 gauge or heavier deck only) or #10 (minimum) TEK screws so that spacing between supports and fasteners does not exceed the value prescribed on the drawings. Nest side laps one-half corrugation for form deck. Button punching is not allowable as a side-lap fastener.

f. End Bearing: Provide a minimum end bearing of 2” over supports.

g. End Joints: End joints of sheets shall be lapped 2” minimum over supports unless a more stringent requirement is specified by Factory Mutual or Underwriters Laboratory. Decks that slope 1/4 inch or more in 12 inches in the long direction shall be erected beginning at the low side to insure that end laps are shingle fashion.

h. Underwriters Laboratories Wind Uplift Classification Requirements: Unless a more stringent attachment requirement is specified elsewhere in this specification or on the drawings, roof deck units shall be attached to the supporting structure as required by the Construction Number specified elsewhere in this section.

i. Attachment to Girders: At locations noted in the drawings, attach the deck to steel members that are parallel to the deck flutes in accordance with the requirements noted in the drawings.

j. Definition of Perimeter and Corner

1) Definition of Roof Height: Roof height shall be defined as eave height for roofs that slope less than 10% and mean roof height for roofs with a greater slope.
2) Buildings with roof heights of 60 feet or less
   a) Perimeter: The width of the perimeter strip shall be the smaller of one-tenth the least building dimension and four-tenths the roof height but not less than 4 feet. The strip either side of a ridgeline shall be considered as a perimeter strip for the purposes of deck fastening for roofs that slope between 10° and 45°.
   b) Corner: On an exterior (not re-entrant) corner, a strip the width of a perimeter strip defined above and extending for a length equal to the dimension of one perimeter strip each direction from the exterior corner.

3) Buildings with roof heights greater than 60 feet
   a) Perimeter: The width of the perimeter strip shall be one-tenth the least dimension of the building but not less than four feet.
   b) Corner: On an exterior (not re-entrant) corner, a strip the width of a perimeter strip defined above and extending for a length equal to the dimension of two perimeter strips each direction from the exterior corner.

k. Underwriters Laboratories Wind Uplift Classification Requirements: Unless a more stringent attachment requirement is specified elsewhere in this specification or on the drawings, roof deck units shall be attached to the supporting structure as required by Construction Number specified elsewhere in this section.

l. Attachment to Girders: At locations where the deck flutes are parallel to the span of the steel framing and the top of the framing is at the bottom of the deck elevation, the deck shall be attached to the girder using one of the specified fastening methods at 18 inches on center.

C. Welding Requirements: Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.

D. Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking.

E. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking, and support of other work.

1. Roof Openings: Roof openings less than 6” square or diameter require no reinforcement. Opening 6” to 10” inclusive shall be reinforced with a 20 gauge galvanized plate welded to the deck at each corner and 6” maximum centers with a 5/8” diameter puddle weld or sheet metal screws. For openings greater than 10” in diameter or width, refer to the drawings and structural steel specifications for additional framing to support the deck around the opening.
F. Hanger Slab or Clips: Provide UL approved punched hanger slots between cells or flutes of lower element where floor deck units are to receive hangers for support of ceiling construction, air ducts, diffusers or lighting fixtures.

1. Hanger clips designed to clip over male side lap joints of floor deck units may be used instead of hanger slots.
2. Locate slots or clips at not more than 14" o.c. in both directions, not over 9" from walls at ends, and not more than 12" from walls at sides, unless otherwise shown.
3. Provide manufacturer's standard hanger attachment devices.
4. Loads hanging from steel deck slabs shall not exceed 100 pounds unless specifically detailed otherwise on the drawings.

G. Joint Covers and Cell Closures: Weld steel sheet joint covers at abutting ends and at changes in direction of deck units, except where taped joints are specified. Weld steel sheet column closures, cell closures and Z-closures to deck with 1" long weld at 12" maximum centers to provide tight-fitting closures at open ends of ribs, unless shown otherwise on the drawings.

H. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated. Provide minimum 2" bearing over steel support.

I. Roof Sump Pans and Sump Plates: Install over openings provided in roof decking and weld flanges to top of deck. Space welds not more than 12 inches apart with at least 1 weld in each corner.

J. Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, and reinforcing channels according to deck manufacturer’s written instructions. Weld to substrate to provide a complete deck installation.

3.2 TOUCH-UP PAINTING

A. After deck installation, wire brush, clean and paint scarred areas, welds and rust spots on top and bottom surfaces of decking units and supporting steel members.

B. Touch-up galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instructions.

C. Touch-up painted surfaces with same type of shop paint used on adjacent surfaces.

D. In areas where shop-painted surfaces are to be exposed, apply touch-up paint to blend into adjacent surfaces.

3.3 FIELD QUALITY CONTROL

A. Field Testing and Inspection: Refer to Specification 014529 “Structural Testing and Inspections” for testing and inspection requirements associated with steel decking.

END OF SECTION 053100
SECTION 054000 – COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of cold-formed metal framing used as structural support for exterior cladding and/or used as loadbearing support for any floor or roof areas is shown on the drawings.

B. Design of cold-formed metal framing components, connections and fasteners is the responsibility of the contractor’s or subcontractor’s Professional Engineer.

C. Types of cold-formed metal framing units include the following:
   1. Exterior non-load bearing stud framing supporting cladding.
   2. Ceiling or soffits framing.

1.3 QUALITY ASSURANCE

A. AISI, “North American Specification for the Design of Cold-Formed Steel Structural Members.”

B. AISI, “Standard for Cold-Formed Steel Framing – General Provisions.”


E. Professional Engineer Qualification: 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 cold-formed metal framing that are similar to those indicated for this project in material, design and extent.

F. Product Certification: Manufacturer’s material certification or data from a independent testing agency that is qualified according to ASTM E 329 indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

G. Fire-Rated Assemblies: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product information, certification, and installation instructions for each type of cold-formed metal framing and accessory indicated. Include test reports and published allowable loads for all fasteners used.

B. Shop Drawings: Submit shop drawings for all cold-formed metal framing used to support exterior cladding, floor or roof framing, ceiling or soffit framing and load-bearing support framing for any floor or roof areas. Shop drawings shall indicate placing of all framing members showing type, size, member thickness, number, location and spacing. They shall also indicate supplemental strapping, bracing, splices, bridging, accessories and details required for proper installation. Shop drawings must indicate type of fastening system used along with size and number of fasteners.
   1. Welded connections shall show size and length of welds for all connections.
   2. Screwed connections shall show type, size, and number of screws for all connections.
      Submit manufacturer’s data giving strength values for screws used.
   3. Connections using anchors shall show product name, embedment, edge distance and spacing.
   4. Shop drawings submitted must be prepared under the supervision of and sealed by a professional engineer licensed in the state where the project is located.

C. Calculations: Submit calculations for all cold-formed metal that are prepared and sealed by a professional engineer licensed in the state where the project is located. Calculations shall indicate sizing of members supporting the loads as indicated on the drawings and the design of connections indicating method of connection and
   1. Size and length of all welds for welded connections.
   2. Type, size, number and capacity of all screwed connections.

D. Deflection Limits: Design framing to withstand loads without deflections greater than the following:
   1. Brick back-up: L/600
   2. Stucco back-up: L/600
   3. EIFS back-up: L/360
   4. Back-up for glass – L/175 for length less than 13’-6”
      L/240 + ¼” for lengths greater than 13’-6” and less than 40’-0”
   5. Back-up for metal panel – L/175 – Use 16 gage minimum or as required by the metal panel supplier.

E. Welding certificates.

F. Qualification data for professional engineer.

1.5 DELIVERY AND STORAGE

A. Protect metal framing units from corrosion, deformation, and other damage during delivery storage and handling.

B. Deliver to project site in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade.
C. Store off ground in a dry ventilated space or protect with suitable waterproof coverings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing shall be members of the Steel Stud Manufacturer’s Association unless otherwise agreed to by the Engineer.

2.2 SYSTEM COMPONENTS

A. With each type of metal framing indicated on the Architectural or Structural Drawings, provide manufacturer's standard steel studs, joists, rafters, runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners and accessories as recommended by the manufacturer for applications indicated, as needed to provide a complete cold-formed metal framing system.

2.3 GRADES OF STEEL

A. Steel Sheet: ASTM A 1003, Structural Grade, Type H, metallic coated, of grade ST33H or ST50H as required by performance or as indicated and coated with G60 galvanized coating.

B. Steel Sheet for Vertical Deflection Clips: ASTM A 653, structural steel, zinc coated with G60 galvanized coating and grade as required by structural performance or as indicated.

C. Minimum Base Metal Thickness: 43 mil for brick back-up, 33 mil for other applications.

2.4 TYPES

A. Structural Stud/Joist (S-Section): Steel studs of size and thickness as required by structural performance or as indicated, with minimum 1.625” flange and flange return lip.

B. Track (T-Section): Standard tracks of size, shape, and thickness as required by structural performance or as indicated, with a minimum flange width of 1.25 inches with no return flange lip.

C. Channel (U-Section): Standard U-section of size, shape, and thickness as required by structural performance or as indicated, with a flange width of 0.500 inches with no return flange lip.

D. Furring Channel (F-Section): Standard F-section (hat-shaped) of size, shape, and thickness as required by structural performance or as indicated.

2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003, Structural Grade, Type H, metallic coated of same grade and coating weight used for framing members
B. Provide accessories of manufacturer’s standard thickness and configuration, unless otherwise indicated or as required for structural performance, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. Anchor clips.
   5. End clips.
   6. Foundation clips.
   7. Gusset plates.
   8. Stud kickers, knee braces, and girts.
   9. Joist hangers and end closures.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Hot-rolled Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.

B. Anchor Rods: ASTM F 1554, Grade 36, threaded carbon-steel, hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153, Class C.

C. Anchoring to Concrete: See Cast-In-Place Concrete Section for acceptable anchoring processes and products.

D. Powder-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.


F. Welding Electrodes: E 60 XX, Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: Galvanizing repair paint shall be "ZRC Cold Galvanizing Compound" as manufactured by ZRC Chemical Products or a paint complying with SSPC-Paint 20.

B. Shims: Load bearing, high-density multi-monomer plastic, non-leaching.

C. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.
2.8 FABRICATION

A. General: Framing components may be prefabricated into panels prior to erection. Fabricate panels plumb, square, true to line and braced, reinforced, and stiffened to resist handling, delivery, and erection stresses. Perform lifting of prefabricated panels in a manner to prevent damage or permanent distortion. All load-bearing stud framing must be fabricated into panels and must be compressed to eliminate gaps at ends of studs.

B. Connections:
   1. Type: Fasten cold-formed metal components by any of the following methods or as indicated on the drawings.
      a. Welded
      b. Screwed
      c. Wire tying of framing components shall not be permitted
   2. Design Forces: Connections of members shall develop the full allowable tensile force of the members connected unless calculations are submitted substantiating lower forces.
   3. Welded Connections: Connection of cold-formed metal components may be made using arc welding methods. All welding shall be performed in accordance with the American Welding Society, AWS D1.3. Welding process along with weld sizes and lengths necessary to develop the member forces specified shall be shown on the shop drawings. Protection of the weld area after welding shall be accomplished using a zinc-rich galvanizing repair paint.
   4. Screwed Connections: Connection of cold-formed metal components may be made using self-drilling self-tapping screws. Screw type and size along with the number of screws required to resist the member forces specified shall be shown on the shop drawings. Screw penetration into joined members shall be a minimum of three exposed screw threads.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

A. Pre-Installation Conference: Prior to start of installation of metal framing systems, meet at project site with installers of other work including door and window frames and mechanical and electrical work. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.

B. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
C. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.2 INSTALLATION

A. Install cold-formed metal framing systems according to AISI’s “Standard for Cold-formed Steel Framing – General Provisions” and to manufacturer's printed or written instructions and recommendations.

B. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved, except do not exceed 24" o.c. spacing for nail or powder-driven fasteners, or 16" o.c. for other types of attachment. Abutting pieces of track shall be securely spliced together. Provide fasteners at corners and ends of tracks.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements. Splices in axially loaded stud systems shall not be permitted. Splices in other work shall not be permitted unless the splice has been engineered and detailed on the shop drawings.

D. Provide four (4) studs at each intersecting wall and three (3) studs at each corner minimum.

E. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.

F. Install supplementary framing, blocking and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.

G. Installation of Wall Stud System: Load-bearing studs shall be seated firmly against the track webs with a gap not exceeding 1/8 inch. Connect load-bearing studs to top and bottom runner tracks by either welding or screw fastening as specified at both inside and outside flanges. Install studs at spacing to align directly under joist spacing above but do not exceed 16 inches for load-bearing walls or as shown on the drawings. Install studs at spacing as shown on the drawings or as required to resist structural loads for non-load-bearing walls.

H. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support using drift clips, vertical deflection clips, or deflection tracks. Frame wall openings larger than 2'-0" square with double stud at each jamb of frame except where more than 2 are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall. Secure stud system wall opening frame in manner indicated.
I. Frame both sides of expansion and control joints, with separate studs; do not bridge the joint with components of stud system.

J. Horizontal Bridging:
1. Horizontal bridging shall consist of a channel (U-section) attached to each stud using a manufacturer’s clip angle. At stud walls 8 inches or deeper, horizontal shall consist of flat strapping screwed to both flanges of stud wall, and to blocking at 8’-0’’ on center.
2. Install horizontal bridging in all non-loadbearing exterior cladding stud systems, spaced (vertical distance) at not more than 4’-0’’ o.c.
3. Provide stud bracing during construction as required for studs to carry construction loads.

K. Sheathing Attachment: Provide attachment of interior and exterior sheathing and wall material to each stud in accordance with structural drawings.

L. Field Painting: Touch-up shop-applied protective coatings damaged during handling and installation. Use compatible primer for prime coated surfaces; use galvanizing repair paint for galvanized surfaces.

END OF SECTION 054000
SECTION 05 50 00 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Steel framing and supports for overhead doors.
2. Steel framing and supports for folding doors.
3. Steel framing and supports for countertops.
4. Steel framing and supports for toilet partitions.
5. Elevator pit sump cover.
6. Steel framing and supports for mechanical and electrical equipment.
7. Steel framing and supports for applications where framing and supports are not specified in other Sections.
8. Shelf angles.
9. Metal bollards.
10. Metal U-shaped bollards.
11. Elevator pit ladders.
12. Roof access ladders.
13. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section:
1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Sections:
1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Division 04 Section "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Division 05 Section "Structural Steel Framing."
1.3 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Paint products.
   2. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.
   1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Qualification Data: For qualified professional engineer.

E. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.

F. Welding certificates.

G. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
   3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
1.7 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500, cold-formed steel tubing.

C. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

D. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 coating; 0.079-inch nominal thickness.

E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.

D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

   1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Eyebolts: ASTM A 489.

F. Machine Screws: ASME B18.6.3.

G. Lag Screws: ASME B18.2.1.


J. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

K. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

L. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

M. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

   1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

E. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

G. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

   1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

   1. Fabricate units from slotted channel framing where indicated.
   2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

   1. Provide mitered and welded units at corners.
   2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize shelf angles located in exterior walls.

D. Prime shelf angles located in exterior walls with zinc-rich primer.

E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.
2.8  METAL BOLLARDS
   A. Fabricate metal bollards from Schedule 40 steel pipe.
   B. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch- thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
   C. Prime bollards with zinc-rich primer.

2.9  METAL LADDERS
   A. General:
      2. For elevator pit ladders, comply with ASME A17.1/CSA B44.
   B. Steel Ladders:
      1. Space siderails 18 inches apart unless otherwise indicated.
      2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
      4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
      5. Prime ladders, including brackets and fasteners, with zinc-rich primer.

2.10 METAL U-SHAPED BOLLARDS
   A. Fabricate U-shaped metal bollards from Schedule 40 steel pipe.
   B. Fabricate bollards with 3/8-inch- thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
      1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
   C. Prime bollards with zinc-rich primer.

2.11 ELEVATOR PIT SUMP COVERS
   A. Fabricate from 1/8-inch rolled-steel floor plate with four 1-inch- diameter holes for water drainage and for lifting.

2.12 LOOSE BEARING AND LEVELING PLATES
   A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
   B. Galvanize plates.
2.13 LOOSE STEEL LINTELS
A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches unless otherwise indicated.
C. Galvanize loose steel lintels located in exterior walls.

2.14 STEEL WELD PLATES AND ANGLES
A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.15 FINISHES, GENERAL
A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
B. Finish metal fabrications after assembly.
C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.16 STEEL AND IRON FINISHES
A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
   1. Shop prime with zinc-rich primer.
C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
3.3 INSTALLING METAL BOLLARDS

A. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

3.4 INSTALLING METAL U-SHAPED BOLLARDS

A. Anchor U-shaped bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

3.5 INSTALLING BEARING AND LEVELING PLATES


B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00
SECTION 05 51 00 – METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Preassembled steel stairs with concrete-filled treads.

B. Related Sections:
   1. Division 03 Section "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
   2. Division 05 Section "Pipe and Tube Railings" for pipe and tube railings.
   3. Division 06 Section "Rough Carpentry" for wood blocking for anchoring railings.
   4. Division 09 Section "Non-Structural Metal Framing" for metal backing for anchoring railings.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch, whichever is less.

1.4 SUBMITTALS

A. Product Data: For metal stairs and the following:
   1. Nonslip aggregates and nonslip-aggregate finishes.
   2. Paint products.
B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Qualification Data: For qualified professional engineer.

E. Welding certificates.

F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for stairs.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

   1. Preassembled Stairs: Commercial class.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

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

1.6 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

F. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.

G. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for stairs indicated to be shop primed with zinc-rich primer.

D. Machine Screws: ASME B18.6.3.

E. Lag Screws: ASME B18.2.1.


H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.


F. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

G. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.

H. Welded Wire Fabric: ASTM A 185/A 185M, 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.

2. Use connections that maintain structural value of joined pieces.
3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Weld exposed corners and seams continuously unless otherwise indicated.
   5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Alfab, Inc.
   2. American Stair, Inc.
   3. Sharon Companies Ltd. (The).
   4. Custom stair.

B. Stair Framing:
   1. Fabricate stringers of steel channels.
      a. Provide closures for exposed ends of channel stringers.
   2. Construct platforms of steel channel headers and miscellaneous framing members as needed to comply with performance requirements and indicated.
3. Weld stringers to headers; weld framing members to stringers and headers.
4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.067 inch.
   1. Steel Sheet: Uncoated cold-rolled steel sheet unless otherwise indicated.
   2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
   3. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
   4. Shape metal pans to include nosing integral with riser.

2.7 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
   2. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   1. Interior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."

E. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

G. Place and finish concrete fill for treads and platforms to comply with Division 03 Section "Cast-in-Place Concrete."

3.2 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION 05 51 00
SECTION 05 51 33.23 - ALTERNATING TREAD STEEL STAIRS

PART 1 - GENERAL

1.1 SCOPE OF WORK

Fabricate and install carbon steel or stainless steel alternating tread stair assemblies in accordance with the requirements set forth in this section.

Note: Terminology used for the component covered by this specification varies among the codes or standards that address the component. This specification uses the term alternating tread stair. MasterFormat uses the term alternating tread ladder. The International Building Code and NFPA-101, Life Safety Code use the term alternating tread device.

1.2 ADDITIONAL WORK INCLUDED IN THIS SECTION

A. Field measurements of alternating tread stair installation sites and verification of vertical distance between floors.

1.3 WORK SPECIFICALLY EXCLUDED IN THIS SECTION

The items in this section are not to be included in the metal stair contractor's work:

A. Temporary shoring or bracing.
B. Demolition and removal of existing work.
C. Clean up of site prior to installation.
D. Concrete supports or other concrete work
E. Cutting; preparation of pockets; setting of plates, inserts, adapters, or other hardware of built in items.
F. Placement of wire mesh or re-bar for concrete fill
G. Temporary lights or electricity.
H. Temporary safety rails.
I. Protection after erection.
J. Wood trim or moldings, for treads or stringers.
K. Rubber treads or carpets.
L. Slip resistant concrete treatments.
M. Field painting other than touch up of damaged surfaces.
N. Final surface cleaning, passivation, or application of surface protectant after installation.

1.4 RELATED DOCUMENTS:

Project drawings and specifications and general provisions of Contract; including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
Crossover and Landing platforms used with alternating tread stairs are addressed in Section 05 51 36.

1.5 SUMMARY:

A. Provide all material, labor, equipment and services and perform all operations required for the work of this section in accordance with the Drawings and Specifications; including fabrication and installation of alternating tread steel stairs.

B. Related work specified elsewhere includes but is not limited to:

   1. Metal Stairs per other Division 5 sections
   2. Metal Fabrications per other Division 5 sections
   3. Crossover and Landing platforms used with alternating tread stairs are addressed in Section 05 51 36.
   4. Painting in Division 9

1.6 REFERENCES

*American Institute of Steel Construction (AISC)*

A. Manual of Steel Construction (AISC-360)
B. Code of Standard Practice (AISC-303)

*American Iron and Steel Institute*

A. Type 304 Stainless Steel (UNS S30400)
B. Type 1010 Stainless Steel (UNS G10100)

*American Society for Testing and Materials (ASTM)*

A. ASTM A108 Standard Specification for Steel Bars, Carbon, Cold-Finished
C. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications
D. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
E. ASTM A269 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
F. ASTM A276 Standard Specification for Stainless Steel Bars and Shapes
H. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

J. ASTM A554 – Standard Specification for Welded Stainless Steel Mechanical Tubing


L. ASTM A568/A568M – Specification for Steel Sheet, Carbon, Structural, and High Strength, Low Alloy, Hot Rolled and Cold Rolled General Requirements for

M. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

N. ASTM A786/A786M Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates

O. ASTM A1011/A1011M Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability and Ultra High Strength

P. ASTM F844 Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use

Note: Editions specified in the applicable building code apply. If the editions is not specified in the applicable building code, then the latest edition of the References shall apply.

National Association of Architectural Metal Manufacturers (NAAMM)

A. NAAMM STANDARD AMP 510-92 Metal Stairs Manual 5th Edition

Society of Automotive Engineers

A. SAE J403 Chemical Compositions of SAE Carbon Steels

B. SAE J429 Mechanical and Material Requirements for Externally Threaded Fasteners

1.7 PERFORMANCE REQUIREMENTS:

A. Alternating Tread Stair Treads: shall be capable of withstanding a single concentrated 1000 pound load without permanent deformation; or 100 pounds per square foot or 300 pounds on an area of 4 square inches without exceeding the allowable working stress of the material.

B. Alternating Tread Stair Guard/Handrail: shall be capable of withstanding a single concentrated load of 200 pounds or a uniform load of 50 pounds per linear foot applied in any direction at any point on the rail without exceeding the allowable working stress of the material.

C. Alternating Tread Stair Stringers: shall be capable of withstanding a single concentrated load of 1000 pounds at any point on the stair without permanent deformation; or a uniform live loading of 100 pounds per square foot applied in a downward direction to all
tread surfaces or a 300 pound load on an area of 4 square inches without exceeding the allowable working stress of the material.

1.8 CONSTRUCTION REQUIREMENTS:

A. Landings, Treads, and Mounting Base: shall be stamped and formed from single piece material. Stock shapes, hand forming, or welded remnants shall not be permitted. All stamped parts shall have integrally formed rigidizing bends and shall be spot welded to stringers of like material.

B. Welds: shall be a minimum of 6 welds per tread, and 12 welds each on the landing and mounting base. Each weld shall be quality controlled and be capable of withstanding a minimum of 2800 lbs. in shear.

C. Landing and Tread Surfaces: shall be punched through with upset non-skid openings.

D. Riser Spacing: shall be equally spaced to within 3/16" for adjacent risers and to within 3/8" for any two non-adjacent risers on a stair.

E. Guards and Handrails: shall be contoured for body guidance and underarm support and shall be attached to the outside stringers and landings by bolting.

F. Landing Reinforcement: shall be with 1/4" steel angle notched and punched and factory welded to the landing at the points of a guard or handrail attachment.

G. Rubber Bumper: shall be affixed to the central portion of the landing. A rubber bumper strip shall be attached or will be provided for field attaching to the central stringer.

1.9 DIMENSIONS:

A. Alternating Tread Stair Angle: 56 or 68 degrees from horizontal as specified in the drawings.

B. Vertical Drop: the change in elevation, as shown on the drawings, between the upper finished floor surface where the top landing will be attached and the lower finished floor surface where the base of the alternating tread stair will be secured.

1.10 SUBMITTALS:

Dimensional Prints: shall be submitted for approval prior to fabrication.

1.11 DELIVERY STORAGE AND HANDLING

Reference: AISC Code of Standard Practice, sections 6 & 7

A. Deliver materials to the job-site in good condition and properly protected against damage to finished surfaces.
B. Store material in a location and manner to avoid damage. Do not stack components. Lay out components on firm foundation material such that bending cannot occur.
C. Store metal components in a clean dry location, away from uncured concrete, cement, or masonry products, acids, oxidizers, rain water, or any other chemical or substance that might damage the material or finish.
D. Plan work and storage locations to keep on-site handling to a minimum.
E. Exercise particular care to avoid damage to material finishes or unprotected surfaces when handling.

PART 2- PRODUCTS

2.1 BASIS OF DESIGN MANUFACTURER:

A. Lapeyre Stair, Inc. 5117 Toler St.
Harahan, LA. 70123
1-(800)-535-7631 or 1-(504)-733-6009

B. Substitutions allowable that meet this specification.

2.2 MATERIALS:

A. Carbon Steel:

1. Treads: 13 Gauge; Minimum 36 ksi yield stress; AISI 1010/15 HRPO or ASTM A1011 structural steel (SS) type grade 36 (or higher).

2. Landing & Foot Stampings: 11 Gauge; Minimum 36 ksi yield stress; AISI 1010/15 or ASTM A1011 structural steel (SS) type grade 36 (or higher).

3. Top Landing Support Clips: Formed L2 x 2 x ¼” x 4” lg. with 5/8” Φ round holes and 5/8” x 1” slot holes, ASTM A1011 structural steel (SS) Type, grade 36 (or higher)

4. Stringers:

   a. 2” x 1 3/4” x 11 Gauge U section; minimum 36 ksi yield stress; AISI 1010/15 or ASTM A1011 structural steel (SS) Type, grade 36 (or higher) for 56 degree stairs 10 vertical feet or less and for 68 degree stairs 12 vertical feet or less.

   b. 3” x 1 3/4” x 11 Gauge U section; minimum 36 ksi yield stress AISI 1010/15 or ASTM A1011 structural steel (SS) Type, grade 36 or higher for 56 degree stairs over 10 vertical feet and for 68 degree stairs over 12 vertical feet.

5. Handrails: 1 1/2” OD x 0.095”; Minimum 42 ksi yield stress; AISI 1010/15 CS or ASTM A1011 cold drawn, fully annealed tube per ASTM A513 grade 1026 or higher As-welded tubing or ASTM A500 Grade B. B. Stainless Steel:
1. Treads: 13 Gauge AISI 304 SS

2. Landing & Foot Stampings: 11 Gauge AISI 304 SS

3. Stringers:
   a. 2" x 1 3/4" x 11 Gauge U section; Minimum 36 ksi yield stress, AISI 304 SS for 56 degree stairs 10 vertical feet or less and for 68 degree stairs 12 vertical feet or less.
   b. 3" x 1 3/4" x 11 Gauge U section; Minimum 36 ksi yield stress, AISI 304 SS 56 degree for stairs over 10 vertical feet and for 68 degree stairs over 12 vertical feet.

4. Handrails: 1 1/2" OD x 0.065" 304 SS cold drawn, Minimum 42 ksi yield stress, fully annealed tube per ASTM A269 seamless or ASTM A554 welded.

C. Fasteners
   a. Bolts: handrail to stringer; Hex Head A307 or SAE J429 Grade 5, ½” Φ x 13 TPI Landing to structure; Carriage Head A307 or Hex Head SAE J429 Grade 5, ½” Φ x 13 TPI; dimensions per ANSI/ASME B18.2.1
   b. Nuts: ASTM A563 Grade A, B, C, D or O; dimensions per ANSI/ASME B18.2.2.
   c. Washers ASTM F436 or F844, dimensions per ANSI/ASME B18.22.1

D. Miscellaneous Material:
   a. Rubber Spine: Hollow neoprene
   b. Rubber Foot Divider: Solid Santoprene

2.3 FINISHES:

A. Carbon Steel:
   1. Gray Primer: Epoxy Powder Coat or
   2. Safety Yellow Paint: Polyester TGIC* Powder Coat or
   3. Iron Gray: TGIC*
   4. Typical RAL selections: Polyester Powder Coat
   5. Hot-Dip Galvanized: per ASTM A123

* Triglycidyl Isocyanate

B. Stainless Steel: Natural finish

2.4 FABRICATION:
General: Fabricate alternating tread steel stairs to conform to performance and construction requirements, in accordance with approved shop drawings or dimensional prints. Fabricate and shop-assemble to greatest extent possible.

A. Carbon Steel: gas metal arc welded (GMAW/MIG) with E70 electrodes (or other approved welding wire) with treads spot welded to stringers and bolt-on handrails (with bolts included).

B. Stainless Steel: gas tungsten arc welded (GTAW/TIG) and/or gas metal arc welded (GMAW/MIG) with approved welding wire and with treads spot welded to stringers and bolt-on handrails (with bolts included).

PART 3- EXECUTION:

3.1 PREPARATIONS:

A. Coordination: Coordinate start and installation of steel alternating tread stair with all other related and adjacent work. Installation shall not start until the construction has progressed to the point that weather conditions and remaining construction operations will not damage alternating tread stair installation.

B. Verification: Verify that dimensions and angle are correct and that substrate is in proper condition for alternating tread stair installation. Do not proceed with installation until all necessary corrections have been made.

3.2 INSTALLATION:

A. If bumper has not been installed at the factory, install the bumper in accordance with the manufacturer's instructions (peel and stick). B. Prepare mounting holes.

C. Position alternating tread stair with top tread at same elevation as upper finished floor or roof surface.

D. Secure alternating tread stair with not less than 2 bolts or studs at top and with not less than 2 at bottom of stair.

E. Touch up with matching paint any chipped or abraded damage to factory finish or

F. Touch up any damage to galvanized surfaces using galvanized repair paint in accordance with ASTM A780.

3.3 CLEAN-UP:

Leave work area clean and free of debris.

END OF SECTION
SECTION 05 52 13 – PIPE AND TUBE RAILINGS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Steel pipe railings.
B. Related Sections:
   1. Division 06 Section "Rough Carpentry for wood blocking for anchoring railings.

1.3 PERFORMANCE REQUIREMENTS
A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
   1. Steel: 72 percent of minimum yield strength.
C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ft. applied in any direction.
      b. Concentrated load of 200 lbf applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   2. Infill of Guards:
      a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
      b. Infill load and other loads need not be assumed to act concurrently.
D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Manufacturer's product lines of mechanically connected railings.
   2. Railing brackets.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For each type of exposed finish required.
   1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
   2. Fittings and brackets.
   3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
      a. Show method of connecting members at intersections.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Qualification Data: For qualified professional engineer.

F. Welding certificates.

G. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.7 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Steel Pipe and Tube Railings:
   a. Pisor Industries, Inc.
   b. Wagner, R & B, Inc.; a division of the Wagner Companies.
   c. Custom.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.3 STEEL AND IRON

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
2.4 FASTENERS

A. General: Provide the following:
   1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
   2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:
   1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

   1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

   1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

G. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form changes in direction as follows:
   1. By radius bends.
J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

N. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

O. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Other Railings: SSPC-SP 3, "Power Tool Cleaning."

D. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with universal shop primer.
2. Do not apply primer to galvanized surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

B. Attach railings to wall with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
3.6 ADJUSTING AND CLEANING

A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 13
SECTION 06 10 00 – ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood blocking and nailers.
   2. Plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:
   1. Wood-preservative-treated wood.
   2. Fire-retardant-treated wood.
   5. Metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.

3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat the following:

1. Wood nailers, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood blocking and similar concealed members in contact with masonry or concrete.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.

2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings, and the following:
   1. Concealed blocking.
   2. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.

C. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:
   1. Mixed southern pine; No. 2 grade; SPIB.
   2. Eastern softwoods; No. 2 Common grade; NeLMA.
   3. Northern species; No. 2 Common grade; NLGA.
   4. Western woods; No. 2 Common grade; WCLIB or WWPA.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, AC in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

   1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.


C. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

D. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC’s International Building Code.
3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC’s International Residential Code for One- and Two-Family Dwellings.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00
SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Composite nail base insulated roof sheathing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For following products, from ICC-ES:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

2.2 WOOD PANEL PRODUCTS

A. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Certified Wood: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":
   1. Plywood.
   2. Oriented strand board.

C. Plywood: DOC PS 1.

D. Oriented Strand Board: DOC PS 2.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction, Use Category UC3b for exterior construction.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat all plywood unless otherwise indicated and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

   1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
   2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
   3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings
specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F shall be not less than span ratings specified.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat all plywood unless otherwise indicated.

2.5 WALL SHEATHING

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Type and Thickness: Type X, 1/2 inch thick.

2.6 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING

A. Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: Rigid, cellular, polyisocyanurate thermal insulation with oriented strand board laminated to one face complying with ASTM C 1289, Type V.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   b. Cornell Corporation.
   c. Dow Chemical Company (The).
   d. Johns Manville; Berkshire Hathaway Inc.
   e. Rmax, Inc.

2. Polyisocyanurate-Foam Thickness: 4 inches.
3. Oriented-Strand-Board Nominal Thickness: 7/16 inch.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

2.8 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and
sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

2.9 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."

D. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
3.2  GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
   1. Fasten gypsum sheathing to cold-formed metal framing with screws.
   2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
   3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Seal sheathing joints according to sheathing manufacturer's written instructions.
   1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
   2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.3  WOOD STRUCTURAL PANEL INSTALLATION


B. Fastening Methods: Fasten panels as indicated below:
   1. Wall and Roof Sheathing:
      a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
      b. Space panels 1/8 inch apart at edges and ends.

END OF SECTION 06 16 00
SECTION 064023 - INTERIOR ARCHITECTURAL MILLWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manufactured fluted wood panels
   2. Wood furring, blocking, shims, and hanging strips for installing interior architectural millwork items that are not concealed within other construction.

B. Related Requirements:
   1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.
   2. Section 062023 "Interior Finish Carpentry" for interior carpentry exposed to view that is not specified in this Section.

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Anchors.
   2. Adhesives.
   4. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings:
   1. Include the following:
a. Dimensioned plans, elevations, and sections.
b. Attachment details.

2. Show full-size details.
3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.

C. Samples: For each exposed product and for each shop-applied color and finish specified.
   1. Size:
      a. Panel Products: 12 inches by 12 inches.
      b. Lumber Products: Not less than 5 inches wide by 12 inches long for each species and cut, finished on one side and one edge.

1.5 INFORMATIONAL SUBMITTALS
A. Qualification Data: For architectural woodwork manufacturer and Installer.
B. Product Certificates: For the following:
   1. Composite wood products.
   2. Adhesives.
C. Field quality-control reports.

1.6 QUALITY ASSURANCE
A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Build mockups of typical interior architectural woodwork as shown on Drawings Include top trim at Lobby second level.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Comply with the Architectural Woodwork Standards, Section 2.
B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.

C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
   1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

1.8 FIELD CONDITIONS

A. Environmental Limitations with Humidity Control: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
   1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where interior architectural woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Frames: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
   1. Smoke- and Draft-Control Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.

2.2 ARCHITECTURAL MILLWORK MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following

1. Akupanel: 1 x 0.25 Black PET Polyester Fiber, Black thru core colored MDF and real wood walnut veneer. Nominal panel sizes are 24 x 96 x 13/16”. Each strip is 11mm thick and 1.06 inch wide planks with .25 inch spacing. Strips are attached to 9mm thick black-dyed PET polyester Fiber material by staples from the backside.
   a. Flame spread rating of 65 and a smoke Index of 522, Class B

2. Akupanel planks to be used for wainscot trim,

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install interior architectural woodwork level, plumb, true in line, and without distortion.
   1. Shim as required with concealed shims.
   2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Akupanel 1x025 to be installed on walls. For direct application, furring strips installed directly to the wall or ceiling on 600mm centers perpendicular to the Akupanel 1x025 are recommended. Akupanel 1x025 can then be attached to the furring strips by using screws between the strips through the PET fiber backing into the studs. A minimum of 15 screws per panel is recommended. Using a black-anodized screw will achieve the best appearance. In
addition to the screws a small bead of construction adhesive applied to the furring strips may
also be used if desired. Along with using furring strips, ceiling installations may also be
achieved by cutting the Akupanel 1x025 to fit into a suspended ceiling grid system similar to
what is used for typical drop ceilings. Akupanel 1x025 may also be suspended from the ceiling
in full panel lengths as well. This is best achieved by using threaded eyebolts for attachment and
aircraft cable for suspension at preferred height.

3.3 REPAIR

A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate
functional and visual defects.

B. Where not possible to repair, replace defective woodwork.

C. Shop Finish: Touch up finishing work specified in this Section after installation of interior
architectural woodwork.

1. Fill nail holes with matching filler where exposed.
2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces
where only sealer/prime coats are shop applied.

3.4 CLEANING

A. Clean interior architectural woodwork on exposed and semiexposed surfaces.

END OF SECTION 064000
SECTION 06 41 16 – PLASTIC-LAMINATED-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Plastic-laminate-faced architectural cabinets.
   2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:
   1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.

1.3 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product, including high-pressure decorative laminate, adhesive for bonding plastic laminate, fire-retardant-treated materials and cabinet hardware and accessories.

   1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

   1. Show details full size.
   2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   3. Show locations and sizes of cutouts and holes for installed in architectural plastic-laminate cabinets.
   4. Apply AWI Quality Certification Program label to Shop Drawings.
C. Samples for Initial Selection:
   1. Plastic laminates.
   2. Thermoset decorative panels.

D. Samples for Verification:
   1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with one sample applied to core material.
   2. Thermoset decorative panels, 8 by 10 inches, for each color, pattern, and surface finish.
   3. Corner pieces as follows:
      a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
      b. Miter joints for standing trim.
   4. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.
B. Product Certificates: For each type of product.
C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockups of typical plastic-laminate cabinets as shown on Drawings.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide certificates from AWI certification program indicating that woodwork, including installation complies with requirements of grades specified.

2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade: Premium.
C. Type of Construction: Face frame.

D. Cabinet, Door, and Drawer Front Interface Style: As shown.

E. Reveal Dimension: As indicated.

F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
   1. **Manufacturers:** Subject to compliance with requirements, provide products by the following:
      a. Abet Laminati, Inc.
      b. Formica Corporation.
      c. Lamin-Art, Inc.
      d. Panolam Industries International, Inc.
      e. Wilsonart International; Div. of Premark International, Inc.

G. Laminate Cladding for Exposed Surfaces:
   1. Horizontal Surfaces: Grade HGS.
   2. Postformed Surfaces: Grade HGP.
   3. Vertical Surfaces: Grade HGS.
   4. Edges: Grade HGS.

H. Materials for Semiexposed Surfaces:
   1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
      a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
      b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
   2. Drawer Sides and Backs: Solid-hardwood lumber.
   3. Drawer Bottoms: Hardwood plywood.

I. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

J. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

K. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
   1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

L. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. As scheduled.
2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.

2. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.

2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.

3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.

2. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.

3. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.

C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to
achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.

1. For panels 3/4 inch thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi; modulus of elasticity, 300,000 psi; internal bond, 80 psi; and screw-holding capacity on face and edge, 250 and 225 lbf, respectively.
2. For panels 13/16 to 1-1/4 inches thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi; modulus of elasticity, 250,000 psi; linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf, respectively.
3. **Products:** Subject to compliance with requirements, provide the following:
   a. Flakeboard Company Limited; Duraflake FR.
   b. SierraPine; Encore FR.

### 2.4 CABINET HARDWARE AND ACCESSORIES

**A. General:** Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."

**B. Butt Hinges:** 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch-thick metal, and as follows:
   1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
   2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

**C. Wire Pulls:** Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

**D. Adjustable Shelf Standards and Supports:** BHMA A156.9, B04071; with shelf rests, B04081.

**E. Shelf Rests:** BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

**F. Drawer Slides:** BHMA A156.9.
   1. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.

**G. Door Locks:** BHMA A156.11, E07121.

**H. Door and Drawer Silencers:** BHMA A156.16, L03011.

**I. Exposed Hardware Finishes:** For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
   1. Satin Stainless Steel: BHMA 630.

**J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.**
2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesives: Do not use adhesives that contain urea formaldehyde.

D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

2.6 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate cabinets to dimensions, profiles, and details indicated.

C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.

2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

D. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.
3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 06 41 16
SECTION 06 64 00 – PLASTIC PANELING

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes glass-fiber reinforced plastic (FRP) wall paneling and trim accessories.
   B. Related Sections:
      1. Division 06 Section "Rough Carpentry" for wood furring for installing plastic paneling.

1.3 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Samples for Initial Selection: For plastic paneling and trim accessories.

1.4 QUALITY ASSURANCE
   A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.
   B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      1. Flame-Spread Index: 25 or less.
      2. Smoke-Developed Index: 450 or less.

1.5 PROJECT CONDITIONS
   A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
PART 2 - PRODUCTS

2.1 PLASTIC SHEET PANELING

A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kemlite Company Inc.
   b. Marlite.
   c. Nudo Products, Inc.

2. Nominal Thickness: Not less than 0.075 inch.


2.2 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, [outside corners,] and caps as needed to conceal edges.


B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.

C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

D. Adhesive: As recommended by plastic paneling manufacturer.

1. VOC Content: 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Sealant: Single-component, mildew-resistant, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Division 07 Section "Joint Sealants."

1. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.

B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

C. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.

D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.
   1. Mark plumb lines on substrate at trim accessory locations for accurate installation.
   2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive.

D. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

F. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.

G. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 06 64 00
SECTION 07 17 00 – BENTONITE WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bentonite waterproofing at elevator pit.

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for forms, waterstops, and concrete placement.
2. Division 31 Section "Earth Moving" for excavating and backfilling.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include product specifications and manufacturer's written installation instructions.

B. Shop Drawings: Show installation details for interface with other work.

C. Samples: For each of the following products, in sizes indicated:

1. Waterproofing: 6 inches square.
2. Drainage Panels: 6 inches square.

D. Material Certificates: For each type of bentonite waterproofing, from manufacturer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for bentonite waterproofing.

F. Field quality-control reports.

G. Warranty: Sample of special warranty.
1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain bentonite waterproofing system from single source from single manufacturer. Obtain accessory products used with bentonite waterproofing from sources acceptable to bentonite waterproofing manufacturer.

B. Mockups: Build mockups to verify selections made under sample submittals and to set quality standards for fabrication and installation.
   1. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

C. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original unopened and undamaged containers.

B. Store materials in a dry, well-ventilated space.

C. Remove and replace bentonite materials that have been prematurely exposed to moisture.

1.6 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit bentonite waterproofing to be installed according to manufacturers' written instructions and warranty requirements.
   1. Do not apply waterproofing materials to surfaces where ice or frost is visible. Do not apply bentonite waterproofing materials in areas with standing water.
   2. Placing bentonite clay products in panel or composite form on damp surfaces is allowed if approved in writing by manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree(s) to repair or replace components of bentonite waterproofing system that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 COMPOSITE HDPE/BENTONITE MEMBRANE

A. Composite HDPE/Bentonite Membrane: Minimum 170-mil-thick membrane consisting of a HDPE geomembrane liner bonded to a layer of bentonite clay granules.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CETCO; Swelltite.
   b. Tremco Commercial Sealants & Waterproofing, an RPM company; Paraseal LG.

3. Vapor Permeance: 0.03 perms according to ASTM E 96.

2.2 INSTALLATION ACCESSORIES

A. Bentonite Mastic: Trowelable consistency, bentonite compound, specifically formulated for application at joints and penetrations.

B. Granular Bentonite Tubes: Manufacturer's standard 2-inch- diameter, water-soluble tube containing approximately 1.5 lb/ft. of bentonite; hermetically sealed; designed specifically for placing on wall footings at line of joint with exterior base of wall.

C. Termination Bar: Extruded-aluminum or formed-stainless-steel bars with upper flange to receive sealant.

D. Masonry Fasteners: Case-hardened nails or hardened-steel, powder-actuated fasteners. Depending on manufacturer's written requirements, provide 1/2- or 1-inch- diameter washers under fastener heads.

E. Sealants: As recommended in writing by waterproofing manufacturer. Comply with requirements specified in Division 07 Section "Joint Sealants."

F. Tapes: Waterproofing manufacturer's recommended tape for joints between sheets, membranes, or panels.

G. Adhesive: Water-based adhesive used to secure waterproofing to both vertical and horizontal surfaces.

H. Geotextile Protection Course: As recommended by waterproofing manufacturer.

I. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side with a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm per foot.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate preparations affecting performance of bentonite waterproofing.

B. Verify that substrate is complete and that work that will penetrate waterproofing is complete and rigidly installed.

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

3.2 PREPARATION

A. Coordinate work in the vicinity of waterproofing to ensure proper conditions for installing the waterproofing system and to prevent damage to waterproofing after installation.

B. Formed Concrete Surfaces: Remove fins and projections. Fill voids, rock pockets, form-tie holes, and other defects with bentonite mastic or cement grout patching material according to manufacturer's written instructions.

C. Excavation Support and Protection System: If water is seeping, use plastic protection sheets or other suitable means to prevent wetting the bentonite waterproofing. Fill minor gaps and spaces 1/8 inch wide or wider with wood, metal, concrete, or other appropriate filling material. Cover or fill large voids and crevices with cement mortar according to manufacturer's written instructions.

3.3 INSTALLATION, GENERAL

A. Install waterproofing and accessories according to manufacturer's written instructions.

   1. Apply granular bentonite tubes, bentonite mastic, or both at changes of plane, construction joints in substrate, projections, and penetrations.

B. Apply granular bentonite tubes continuously on footing against base of wall to be waterproofed according to manufacturer's written instructions.

C. Protect waterproofing from damage and wetting before and during subsequent construction operations. Repair punctures, tears, and cuts according to manufacturer's written instructions.

D. Install protection course before backfilling or placing overburden when recommended by waterproofing manufacturer.

3.4 COMPOSITE HDPE/BENTONITE MEMBRANE INSTALLATION

A. General: Install a continuous layer of waterproofing membrane with ends and edges lapped a minimum of 3 inches. Stagger end joints between membranes. Seal joints with permanent seam tape.
B. Vertical Concrete Walls: Apply mastic around penetrations and form continuous 2-inch cant at intersection of footings and walls with mastic.

   1. Starting at lowest point, install a layer of waterproofing membrane horizontally, extending a minimum of 6 inches onto the footing. Lap membrane ends and edges a minimum of 2 inches.
   2. Secure membrane to wall with adhesive or washer-headed fasteners, and tape terminations of membrane at grade.

3.5 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate. Use adhesives or mechanical fasteners that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.6 FIELD QUALITY CONTROL

A. Inspection: Arrange for manufacturer's representative to inspect completed waterproofing installation before covering with other construction and provide written report that installation complies with manufacturer's written instructions.

   1. Remove and replace applications of bentonite waterproofing where inspection indicates that it does not comply with specified requirements.

B. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 07 17 00
SECTION 07 19 00 – WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes penetrating water-repellent coatings for the following vertical surfaces:
   1. Cast stone masonry.
   2. Stucco.

B. Related Sections include the following:
   1. Division 07 Section "Joint Sealants."

1.3 PERFORMANCE REQUIREMENTS

A. Performance Testing: Provide water repellents that comply with test-performance requirements indicated, as evidenced by reports of tests performed by manufacturer by a qualified independent testing agency on manufacturer's standard products applied to substrates simulating those on Project using same application methods to be used for Project.

   1. Owner will engage testing agency to perform preconstruction tests on laboratory mockups.
   2. Select sizes and configurations of assemblies to adequately demonstrate capability of water repellents to comply with performance requirements.
   3. Notify Architect seven days in advance of the dates and times when assemblies will be constructed.

B. Absorption: Minimum 80 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens.


C. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E 96.

D. Permeability: Minimum 80 percent water-vapor transmission in comparison of treated and untreated specimens, per ASTM D 1653.

E. Water Penetration and Leakage through Masonry: Maximum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM E 514.
F. Durability: Maximum 5 percent loss of water repellency after 2500 hours of weathering in comparison to specimens before weathering, per ASTM G 154.

G. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.
   1. Reduction of Water Absorption: 80 percent.
   2. Reduction in Chloride Content: 80 percent.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Include manufacturer's printed statement of VOC content.
   2. Include manufacturer's standard colors.

B. Samples: For each type of water repellent and substrate indicated, 12 by 12 inches in size, with specified water-repellent treatment applied to half of each Sample.

C. Manufacturer Certificates: Signed by manufacturers certifying that water repellents comply with requirements.

D. Qualification Data: For Installer.

E. Preconstruction Testing Reports: For water-repellent-treated substrates.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for assemblies.

G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 548 for testing indicated.

C. Test Application: Apply a finish sample for each type of water repellent and substrate required. Duplicate finish of approved sample.
   1. Locate each test application as directed by Architect.
   2. Size: 25 sq. ft.
   3. Final approval by Architect of water-repellent application will be from test applications.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
1.6 PROJECT CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:

1. Ambient temperature is above 40 deg F.
2. Concrete surfaces and mortar have cured for more than 28 days.
3. Concrete or brick masonry walls are not treated prior to 30 days after building close-in.
4. Rain or snow is not predicted within 24 hours.
5. Application proceeds more than 24 hours after surfaces have been wet.
6. Substrate is not frozen, or surface temperature is above 40 deg F.
7. Windy conditions do not exist that may cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in Part 1 "Performance Requirements" Article within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PENETRATING WATER REPELLENTS

A. Silane, Penetrating Water Repellent: Clear, monomeric compound containing 20 percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 3.3 lb/gal. or less of VOCs.

1. Products:

   a. Advanced Chemical Technologies, Inc.
   b. Anti-Hydro International, Inc.; Aridox 40M.
   c. ChemMasters; Aquanil Plus 40.
   d. Euclid
   e. Gemite Products, Inc.; Gem Guard SL.
   f. Hydrozo, a division of ChemRex; Enviroseal 20.
   g. Nox-Crete Products Group.
   h. Pecora Corporation; Klear-Seal 9100 S.
   j. Sonneborn Building Products, a division of ChemRex; White Rox 10 VOC.
   k. Tamms Industries, Inc.; Baracade Silane 100.
   l. Wacker Chemical Corp.; 1316.
PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to water-repellent manufacturer's written instructions, to ensure that surface is dry enough.

B. Test for pH level, according to water-repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.

C. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live plants and grass.

D. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
   1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

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

3.2 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.

C. Apply a second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.3 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

END OF SECTION 07 19 00
SECTION 07 21 00 – THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Concealed building insulation.
   2. Sound attenuation insulation.
   3. Cavity wall insulation.

B. Related Sections include the following:
   1. Division 06 Section Sheathing for insulation specified as part of roofing construction.
   2. Division 07 Section "Fire-Resistive Joint Systems" for insulation installed as part of a perimeter fire-resistive joint system.
   3. Division 09 Section "Gypsum Board" and "Gypsum Board Shaft-Wall Assemblies" for installation in metal-framed assemblies of insulation specified by referencing this Section.
   4. Division 22 Section "Plumbing Insulation."
   5. Division 23 Section "HVAC Insulation."

1.3 DEFINITIONS

A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.4 PERFORMANCE REQUIREMENTS

A. Plenum Rating: Provide glass-fiber insulation where indicated in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.

   1. Erosion Test Results: Insulation shows no visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at 2500-fpm air velocity.
   2. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with Chaetomium globosium on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.
1.5 SUBMITTALS

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

B. Samples for Verification: Full-size units for each type of exposed insulation indicated.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

D. Research/Evaluation Reports: For foam-plastic insulation.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.


C. Recycled Content: Provide glass-fiber insulation with recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 10 percent.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.
PART 2 - PRODUCTS

2.1 GLASS-FIBER BOARD INSULATION

A. Manufacturers:
   1. CertainTeed Corporation.
   2. Johns Manville.
   4. Owens Corning.

B. Location:
   1. Spandrel glass insulation.

C. Unfaced, Glass-Fiber Board Insulation: ASTM C 612, Type IA or Types IA and IB; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics; and of the following nominal density and thermal resistivity:
   1. Nominal density of 2.25 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F.

2.2 GLASS-FIBER BLANKET INSULATION

A. Manufacturers:
   1. CertainTeed Corporation.
   2. Guardian Fiberglass, Inc.
   4. Knauf Fiber Glass.
   5. Owens Corning.

B. Location:
   1. Interior and exterior walls and roof where shown.

C. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

D. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:
   1. 3-5/8 inches thick with a thermal resistance of 11 deg F x h x sq. ft./Btu at 75 deg F.
   2. 5-1/2 inches thick with a thermal resistance of 19 deg F x h x sq. ft./Btu at 75 deg F.
2.3 CAVITY-WALL INSULATION

A. Polyisocyanurate Board Insulation: ASTM C 1289, Type I (aluminum-foil-faced), Class 2 (glass-fiber-reinforced).

B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.4 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2.5 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:

1. Products:
   a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
   b. Eckel Industries of Canada; Stic-Klip Type N Fasteners.
   c. Gemco; Spindle Type.

2. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

3. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.

B. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch between face of insulation and substrate to which anchor is attached.

1. Products:
   a. Gemco; Clutch Clip.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION
A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL
A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION
A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
C. Install board insulation in curtain-wall construction where indicated on Drawings according to curtain-wall manufacturer's written instructions.
   1. Retain insulation in place by metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated between insulation and glass.
   2. Install insulation where it contacts perimeter fire-containment system to prevent insulation from bowing under pressure from perimeter fire-containment system.
D. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
E. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

   1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.5 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

A. Install specified, unfaced glass-fiber blanket insulation over suspended ceilings at partitions in a width that extends insulation 48 inches on either side of partition.

3.6 PROTECTION

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

END OF SECTION 07 21 00
SECTION 072119 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Closed-cell spray polyurethane foam.
   B. Related Requirements:
      1. Section 072100 "Thermal Insulation" for foam-plastic board insulation.
      2. Section 079200 “Joint Sealants” for spray polyurethane foam insulation installed as part of a barrier system.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For Installer.
   B. Product Test Reports: For each product, for tests performed by a qualified testing agency IAS International Accreditation Service.
   C. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES

1.5 QUALITY ASSURANCE
   A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer. Any repairs by an Icynene licensed contractor.
   B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
C. Fire Resistance Characteristics: As determined by testing identical products (based on a 4 inch minimum thickness) according to ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

D. Fire Resistance Characteristics: As determined by testing identical products according to NFPA 285 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect spray polyurethane foam components as follows:

1. Component A and B: store between 60 degrees F and 90 degrees F
2. Component B can be frozen but must be protected from overheating over 120 degree F and prolonged storage over 100 degree F
3. Component B: mix thoroughly prior to use.
4. Components should be a matched set (system) as supplied by the manufacturer.
5. Use components within their labeled shelf-life.
6. Use components as supplied with no site alterations or additions.

1.7 WARRANTY

A. Refer to manufacturer’s standard warranty terms (as applicable).

PART 2 - PRODUCTS

2.1 PERFORMANCE CHARACTERISTICS

A. Air Material Air Leakage Rate: Maximum material air leakage rate of less than 0.004 cfm/ft² under a pressure differential of 0.3 in w.g.1.6 psf per ASTM E 2178 or E 282.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Development Index: 450 or less.

C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

D. Compressive strength: Minimum 40 psi (276 kPa) (ASTM C1029 Type II).

E. Sustainability Requirements: Provide spray polyurethane foam insulation as follows:

1. Low Emitting: Insulation tested according to CA/DPH/EHLB/v1.1-2010.
2. Resistant to fungal growth as per ASTM C1338.
3. Containing no PBDE.
2.2 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 2.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 7.0 deg F x h x sq. ft./Btu at 75 deg F.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Icynene Inc.; Icynene ProSeal or comparable product by one of the following:
   a. BASF Corporation.
   b. Dow Chemical Company (The).

2.3 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.

B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Spray insulation to envelop entire area to be insulated and fill voids.

C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

D. Do not apply insulation within 3-inches of heat emitting devices or where the temperature is in excess of 200 degrees F, as per ASTM C411 or in accordance with applicable codes.

E. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.

F. Miscellaneous Voids: Apply according to manufacturer's written instructions.
3.3 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Thermal Protection: Protect installed spray polyurethane foam insulation with qualified thermal or ignition barrier per applicable building codes.

3.4 INSTALLATION OF AIR BARRIER COMPONENTS

A. Install air barrier components – membranes and sealants – as indicated on drawings for spray polyurethane foam as part of an air barrier system.

END OF SECTION 072119
PART 1  GENERAL

1.01  SUMMARY

A. Cement Board Stucco System specification is based on a Sto system. This can be provided by another manufacturer’s as an “or equal” submittal.

B. StoQuik™ Silver II System is a composite wall finish system consisting of base coat, reinforcing mesh and finish coat applied to a cement board. The cement board is attached to framing over a code approved sheathing and water-resistive barrier.

C. Limitations:

1. This system is intended for use in residential and light commercial or institutional construction (low-rise, 3 stories or less).
2. Minor surface cracking may occur due to stress induced by framing or thermal movement.
3. Telegraphing of studs through finished wall surface may occur in some climates because of thermal bridging effects of studs.
4. Planar irregularities/waviness may be visible in the finished wall surface because of out of plane studs or other framing irregularities. Heavy texture finishes (>1.5 mm aggregate) and/or two coats of base coat may be required in some cases to minimize the effects of planar irregularities or to improve appearance of fine texture finishes.
5. Requires joints at areas of stress and at intervals to accommodate thermal movement as with conventional stucco wall assemblies.

C. Related Sections

1. Section 06 16 00: Sheathing
2. Section 07 27 26: Fluid Applied Membrane Air Barriers
3. Section 07 62 00: Sheet Metal Flashing and Trim
4. Section 07 92 00: Joint Sealants

1.02  SUBMITTALS

A. Manufacturer's specifications, details, installation instructions and product data.

B. Manufacturer's standard warranty.

C. Applicator’s certificate of instruction and lists of project references

D. Samples for approval as directed by architect or owner.
1.03 REFERENCES

A. ASTM Standards:

1. C 150 Specification for Portland Cement
2. C 1177 Specification for Glass Mat Gypsum for Use as Sheathing
5. D 968 Test for Abrasion Resistance of Organic Coatings by Falling Abrasive
7. E 84 Test Method for Surface Burning Characteristics of Building Material
12. G 154 Practice for Operating Light and Water Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Non-metallic materials

B. National Fire Protection Association:


C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

1. Handbook of Fundamentals

D. United States Defense Standard:


E. International Code Council

1. International Building Code, Chapter 26
1.04 DESIGN REQUIREMENTS

A. L/360 maximum allowable stud deflection. Space studs 16 inches (406 mm) on center maximum. Provide horizontal blocking where needed for continuous support and attachment of cement board perimeter. Provide only kiln dried wood studs.

B. Verify conformance of wall assembly wind load resistance with project design pressure requirements.

C. Determine whether a vapor barrier is appropriate in the wall assembly. Refer to 2005 ASHRAE Handbook Fundamentals, Chapter 25. Do not use vapor barrier on the inside of wall assemblies in hot, humid climates or on the exterior in cold climates.

D. Prevent water infiltration into or behind the cement board stucco system (refer to Sto Tech Hotline Nos. 0403-BSc, Critical Detail Checklist for Wall Assemblies, and 0603-BSc, Moisture Control Principles for Design and Construction of Wall Assemblies).

E. Provide expansion joints at floor lines, dissimilar materials, where framing material changes, changes in building height, shape or structural system, and at expansion joints in the framing or building. Provide control joints at intervals of 25 ft (7.6m) maximum in each direction with length/width ratio not to exceed 2-1/2:1. Maximum allowable area without a control joint is 625 ft² (58 m²). When using dark color finishes (lightness value less than 50) the allowable control joint interval/area is reduced to 16 ft/256 ft² (4.68 m/23.5 m²)

F. Select colors with a lightness value of 30 or more. Refer to Sto Color Chart.

G. When adding foam trim features use foam plastic in compliance with the applicable code. Refer to IBC Chapter 26 and Sto ICC ES Evaluation Report No 1720. Reinforce all foam trim with base coat and reinforcing mesh. Comply with thickness and slope limitations for foam trim. Refer to Sto Details.

H. Where fire rated wall construction is required, start with an existing hourly rated assembly. The addition of the StoQuik Silver II System to an existing hourly fire-resistive wall assembly will not detract from the rating. Also see ICC ES Legacy Report Nos. 578 and 5371 for proprietary assemblies.

I. Not intended for use below grade. Maintain minimum 4 inches (102mm) above earth grade and 2 inches (51mm) above pavement. Increase distance above grade for snow regions.

J. Do not use as a parapet coping or for other non-vertical weather exposed surfaces.

1.05 PERFORMANCE REQUIREMENTS

A. DEFS System Performance: Sto Quik™ Silver System with Sto Essence DPR Finish
1.06 QUALITY ASSURANCE

A. Manufacturer requirements

1. System manufacturer for a minimum of twenty five (25) years.

B. Contractor requirements

1. Licensed, insured and engaged in application of portland cement stucco, EIFS or DEFS for a minimum of three (3) years.
2. Knowledgeable in the proper use and handling of Sto materials and possessing a certificate of completion for the on-line Sto applicator test.
3. Employ skilled mechanics who are experienced and knowledgeable in EIFS, DEFS or portland cement stucco application and familiar with the requirements of the specified work.
4. Successful completion of minimum of three (3) projects of similar size and complexity to the specified project.
5. Provide the proper equipment, manpower and supervision on the job site to install the system in compliance with Sto's published specifications and details and the project plans and specifications.

C. Cement board manufacturer requirements

1. Recognized by Sto as capable of producing ASTM C 1325 compliant cement board to meet system requirements.
2. Cement board shall be listed in an ICC evaluation report.

D. Inspections

1. Provide independent third party inspection where required by code or contract documents.
2. Conduct inspections in accordance with code requirements and contract documents.

2 1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in their original sealed containers bearing manufacturer's name and identification of product.

B. Protect coatings (pail products) from freezing and temperatures in excess of 90°F (32°C). Store away from direct sunlight.

C. Protect portland cement based materials (bag products) from moisture and humidity. Store under cover and off the ground in a dry location.

D. Store cement board materials inside and protected from damage by the elements. Protect ends, edges, and faces of cement boards from damage.
1.08 PROJECT/SITE CONDITIONS

A. Maintain ambient and surface temperatures above 40°F (4°C) during application and for 24 hours after set of base coat and finish materials.

B. Provide supplementary heat for installation in temperatures less than 40°F (4°C) such that temperatures are maintained as in 1.08A. Prevent concentration of heat on the uncured waterproofing/air barrier, base coat and finish coat and vent fumes and other products of combustion to the outside to prevent contact with the waterproofing/air barrier, base coat and finish coat.

C. Provide protection of surrounding areas and adjacent surfaces from application of materials.

2.09 COORDINATION/SCHEDULING

A. For load bearing stud wall assemblies, commence the cement board system installation after completion of all floor, roof construction and other construction that imposes dead loads on the walls to prevent excessive deflection (and potential cracking) of the cement board system.

B. Sequence interior work such as drywall installation prior to cement board system installation to prevent stud distortion (and potential cracking) of the cement board system.

C. Provide site grading such that the cement board stucco terminates above earth grade minimum 4 inches (102 mm) and above finished grade (pavers/sidewalk) minimum 2 inches (51 mm). Provide increased clearance above grade for snow regions.

D. Provide protection of rough openings before installing windows, doors, and other penetrations through the wall and provide sill flashing. Coordinate installation of water-resistant barrier with window and door installation to provide weather proofing of the structure and to prevent moisture infiltration and excess air infiltration.

E. Install window and door head flashing immediately after windows and doors are installed.

F. Install diverter flashings wherever water can enter the wall assembly to direct water to the exterior.

G. Install copings and sealant immediately after installation of the cement board stucco system and when finish coatings are dry.

H. Attach penetrations through the cement board stucco system to structural support and provide watertight seal at penetrations.
2.10 WARRANTY

A. Provide manufacturer's 10 year limited materials and moisture protection warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sto Corp.—StoQuik™ Silver II System: primer (if used), meshes, base coat and finish coat as furnished by Sto Corp, or equal


2.02 SHEATHINGS

A. Glass Mat Faced Gypsum Sheathing (ASTM C1177)

2.03 WATER-RESISTIVE BARRIER (supplied by others)

A. Liquid applied air and vapor barrier.

2.04 CEMENT BOARD

A. Minimum ½ inch (13 mm) thick complying with ASTM C 1325, or equal

2.05 MECHANICAL FASTENERS

A. Appropriate non-corroding fasteners, depending on the type framing or substrate:

1. Steel Framing—minimum # 8 Type S-12 wafer head fully threaded corrosion resistant screws with minimum 3/8 inch (10 mm) penetration into studs.

2.06 BASE COAT

A. Cementitious Base Coat

1. Sto Primer/Adhesive-B—one-component polymer modified cement based factory blend base coat with less than 33% portland cement content by weight.
2.07 REINFORCING MESHES

A. Standard Mesh

1. Sto Mesh—nominal 4.5 oz./yd² (153 g/m²), symmetrical, interlaced open-weave glass fiber fabric made with alkaline resistant coating for compatibility with Sto materials (achieves Standard Impact Classification when used with foam trim).

2.09 FINISH COAT

A. Sto Finish—Sto Essence or Any Sto acrylic or silicone enhanced acrylic based textured wall coating.

2.10 ACCESSORIES (supplied by others)

A. Starter Track—Vent Screen TRAC® a rigid PVC (polyvinyl chloride) plastic track with double row of drainage holes, Part No. VST-75 as furnished by Plastic Components, Inc.

B. Surface Mounted “L” Bead—a rigid PVC (polyvinyl chloride) surface mounted “L” shaped bead for terminations, openings, etc, Part No. 2221-50 as furnished by Plastic Components, Inc.

C. Casing Bead—CB Casing Bead, a rigid PVC (polyvinyl chloride) plastic accessory for sheathing termination points Part No. CB-75-16 as furnished by Plastic Components, Inc.

D. Corner Bead—Corner Bead a rigid PVC (polyvinyl chloride) plastic accessory for smooth transitions at exterior corners, Part No. 2209 as furnished by Plastic Components, Inc.

E. Control Joint—Control Joint a rigid PVC (polyvinyl chloride) plastic accessory for designed control joints, Part No. 220027-16 as furnished by Plastic Components, Inc.

F. Furring Strips—Strip-Lath®, a rust proof, and self-furring, damage-resistant, ULTRA-LATH® strips of plastic lath for allowing drainage of incidental moisture to the exterior. Part Nos. PDM3 or PDM4 as furnished by Plastic Components, Inc.

2.10 JOB MIXED INGREDIENTS

A. Water—clean and potable.

B. Portland cement – ASTM C 150, Type I, Type II or Type I-II

2.12 MIXING

A. Sto Primer Adhesive-B—Mix automatically using Sto’s continuous mixer, or mix manually by adding one 50 lbs. (23 kg) bag of Sto Primer/Adhesive-B to 5-6.5 quarts (4.7-6.2 L) of clean, potable water in a clean mixing pail. Mix with a clean, rust-free electric drill and paddle. Allow to set approximately five minutes, adjust mix if necessary by adding up to
12 fl. oz. (0.35 L) of water per bag, and remix to a uniform consistency. Avoid retempering after mixing of product. Do not exceed maximum amount of water in mix ratio.

B. Sto Primer--mix with a clean, rust-free high speed mixer to a uniform consistency.

C. Sto Finish --mix with a clean, rust-free high speed mixer to a uniform consistency. A small amount of water may be added to adjust workability. Limit addition of water to amount needed to achieve the finish texture.

D. Mix only as much material as can readily be used.

E. Do not use anti-freeze compounds or other additives.

PART 3 EXECUTION

3.01 ACCEPTABLE INSTALLERS

A. Pre-qualify under Quality Assurance requirements of this specification (section 1.06 B).

3.02 SHEATHING INSTALLATION

A. Comply with applicable code for installation of gypsum-based sheathings.

3.03 WATER-RESISTIVE BARRIER INSTALLATION

A. Comply with applicable code. Typically attach asphalt saturated felt horizontally to framing with minimum number of fasteners needed to keep in place, lap shingle style with minimum 2 inch (51mm) horizontal laps, and minimum 6 inch (152mm) vertical laps. Prevent tears or breaks in the continuity of the water-resistive barrier. Lap over flashing, starter track, and other accessories for drainage to exterior.

3.04 EXAMINATION

A. Inspect framed wall assembly for:

1. Attachment of sheathing and installation of water-resistive barrier in compliance with the applicable code.
2. Damage or deterioration of sheathing; damage, breaks or tears in the water-resistive barrier.
3. Presence of flashing at decks, sills, roof/wall intersections and other areas requiring flashing.
4. Straightness and trueness of wall assembly to receive the cement board stucco system.

B. Report deviations from the requirements of project specifications or other conditions that might adversely affect the cement board stucco installation to the General Contractor.
3.05 INSTALLATION OF CEMENT BOARD STUCCO SYSTEM

A. Starter Track and Back Mount Casing Beads

1. Strike a level line at the base of the wall to mark where the top of the starter track terminates.
2. Attach the starter track even with the line onto the structure a maximum of 16 inches (406 mm) on center with the proper fastener: Type S-12 corrosion resistant screws for steel framing with minimum 3/8 inch (9 mm) penetration, and galvanized or zinc coated nails for wood framing with minimum 3/4 inch (19 mm) penetration. Blocking installed between the studs may be necessary to secure the track flat against the wall surface. For solid sheathing attach directly into sheathing at 12 inches (305 mm) on center maximum.
3. Butt sections of starter track together. Miter cut outside corners and abut. Snip front flange of one inside corner piece (to allow the cement board to be seated inside of track) and abut.
4. Install Starter Track at other cement board system terminations as designated on detail drawings: above windows and doors, at floor lines, above roof along dormers or gable end walls, and beneath window sills with concealed flashing.
5. Install casing beads similarly at cement board termination points—window and door jambs and other through wall penetrations, unless using surface mount accessories for these areas (see section 3.05C).

B. Installation of Cement Board

1. Install cement board horizontally or vertically but perpendicular to the direction of the supporting sheathing. Insert bottom edge of board into the starter track, and then attach the board through the sheathing to the studs with approved fasteners spaced 8 inches (203mm) on center at the perimeter and in the field of the board. Similarly install cement board in to back mount accessories at termination points.
2. Install cement board with ends and edges closely butted but not forced together. “L” cut boards around openings such as windows, doors, etc.
3. Stagger cement board joints by 16 inches (406mm) minimum from sheathing joints. Do not create planes of weakness by allowing cement board joints to coincide with sheathing joints.
4. Provide for expansion and control joints in cement board layout (see Design Requirements, Section 1.04)

C. Surface Mounted Accessories

1. Install surface mount “L” beads at stucco terminations—doors, windows, and other through wall penetrations. Use only casing bead/accessory with weeps at heads of doors, windows, etc.
2. Install two piece expansion joints (or back to back “L” beads) at floor lines, dissimilar materials, where framing material changes, changes in building height, shape or structural system, and at expansion joints in the framing or building. Abut horizontal into vertical joint accessories.
3. Install one piece control joints at intervals of 25 ft (7.6 m) maximum in each direction with length/width ratio not to exceed 2-1/2:1. Maximum allowable area
without a control joint is 625 ft² (58m²). When using dark color finishes (lightness value less that 50) the allowable control joint interval/area is reduced to 16 ft²/256ft² (4.8 m²/23.5 m²). Abut horizontal into vertical joint accessories.

4. Install corner bead at outside corners.
5. Install full accessory pieces where possible and avoid small pieces.

D. Joint Reinforcement, Diagonal Corner Reinforcement of Openings, and Reinforcement of Surface Mount Accessories

1. Center minimum 4 inch (102 mm) wide self-adhesive mesh over board joints. Overlap mesh seams minimum 2-1/2 inches (64mm).
2. Apply minimum 9x12 inch (225x300 mm) diagonal strips of self-adhesive mesh at corners of windows, doors, and all penetrations through the system.
3. Apply minimum 4 inch (102 mm) wide self-adhesive mesh over perforated flange of surface mount accessories. Overlap mesh seams minimum 2-1/2 inches (64 mm).
4. Skim coat self-adhesive mesh with base coat, feather along edges, and allow to dry.

E. Base Coat and Reinforcing Mesh Application

1. Apply base coat over the cement board, including areas with self-adhesive or detail mesh and areas of unreinforced foam trim/build-outs, with a stainless steel trowel to a uniform thickness of approximately 1/8 inch (3 mm). Work horizontally or vertically in strips of 40 inches (1016mm), and immediately embed the mesh into the wet base coat by troweling from the center to the edge of the mesh. Overlap mesh not less than 2-½ inches (64 mm) at mesh seams and fully overlap self-adhesive or detail mesh (and backwrap reinforcing mesh along foam trim/build-outs if these surfaces have not yet been reinforced with base coat/mesh). Feather seams and edges. Double wrap all inside and outside corners with minimum 2-½ inch (64 mm) overlap in each direction where mesh is used in lieu of an accessory. (Alternate corner treatment with mesh: embed corner mat in base coat, allow to dry, and then overlap up to corner with standard reinforcing mesh embedded in base coat). Avoid wrinkles in the mesh. The mesh must be fully embedded so that no mesh color shows through the base coat when it is dry. Re-skim with additional base coat if mesh color is visible or if necessary to correct planar irregularities in the wall surface. Allow base coat to thoroughly dry before applying primer or finish.

2. Sloped Surfaces: for foam trim, reveals, aesthetic bands, cornice profiles, sills or other architectural features that project beyond the vertical wall plane more than 2 inches (51 mm) apply waterproof base coat with a stainless steel trowel to the weather exposed sloped surface and minimum four inches (100 mm) above and below it. Embed standard mesh or detail mesh in the waterproof base coat and overlap mesh seams a minimum of 2-½ inches (65 mm). Allow base coat to thoroughly dry before applying primer or finish.
H. Finish Coat Application

1. Apply finish directly over the base coat (or primed base coat) when dry. Apply finish by spraying or troweling with a stainless steel trowel, depending on the finish specified. Follow these general rules for application of finish:

   a. Avoid application in direct sunlight.
   b. Apply finish in a continuous application, and work to an architectural break in the wall.
   c. Weather conditions affect application and drying time. Hot or dry conditions limit working time and accelerate drying. Adjustments in the scheduling of work may be required to achieve desired results; cool or damp conditions extend working time and retard drying and may require added measures of protection against wind, dust, dirt, rain and freezing. Adjust work schedule and provide protection.
   d. Float "R" (rilled texture) finishes with a plastic trowel to achieve their rilled texture.
   e. Do not install separate batches of finish side-by-side.
   f. Do not apply finish into or over sealant joints. Apply finish to outside face of wall only.
   g. Do not apply finish over irregular or unprepared surfaces, or surfaces not in compliance with the requirements of the project specifications.

3.04 PROTECTION

A. Provide protection of installed materials from water infiltration into or behind them.

B. Provide protection of installed materials from dust, dirt, precipitation, freezing and continuous high humidity until they are fully dry.

END OF SECTION 072400
SECTION 07 27 26 – FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes the following:
      1. Fluid-applied membrane air barrier, vapor permeable.
   B. Related Sections include the following:
      1. Division 04 Section "Unit Masonry" for embedded flashings.
      2. Division 06 Section "Sheathing" for wall sheathings, wall sheathing joint-and-penetration treatments.
      3. Division 07 Section "Sheet Metal Flashing and Trim" for sheet metal flashings.
      4. Division 07 Section "Joint Sealants" for joint-sealant materials and installation.

1.3 DEFINITIONS
   A. ABAA: Air Barrier Association of America.
   B. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PERFORMANCE REQUIREMENTS
   A. General: Air barrier shall be capable of performing as a continuous vapor-permeable air barrier. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

1.5 PRECONSTRUCTION TESTING
   A. Mockup Testing: Air barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.
      1. Owner will engage a qualified testing agency.
      2. Quantitative Air Leakage Testing: Testing of the mockup for air leakage will be conducted not to exceed the test pressure differential, positive and negative, indicated in
"Performance Requirements" Article for air barrier assembly air leakage when tested according to ASTM E 283.

3. Notify Architect seven days in advance of the dates and times when mockup testing will take place.

1.6 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
   1. Include details of interfaces with other materials that form part of air barrier.
   2. Include details of mockups.

C. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.

D. Qualification Data: For Applicator.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

1.7 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance and that is an ABAA-licensed contractor, employs certified and registered installers, and complies with ABAA's Quality Assurance Program.

B. Mockups: Before beginning installation of air barrier, build mockups of exterior wall assembly, 150 sq. ft., incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.
   1. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed.
   2. Include junction with roofing membrane and building corner condition.
   3. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
   4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site.
1. Include installers of other construction connecting to air barrier, including roofing, waterproofing, architectural precast concrete, masonry, sealants, windows, glazed curtain walls, and door frames.
2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Store rolls according to manufacturer's written instructions.

D. Protect stored materials from direct sunlight.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 FLUID-APPLIED MEMBRANE AIR BARRIER


1. Products: Subject to compliance with requirements, provide one of the following:

   a. Acrylic Membrane:

      1) Henry Company.
      2) W.R. Grace Perm-A-Barrier VP.

2. Physical and Performance Properties:

   a. Membrane Air Permeance: Not to exceed 0.004 cfm/ sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.

   b. Membrane Vapor Permeance: Not less than 11.2 perms; ASTM E 96.
2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne primer recommended for substrate by manufacturer of air barrier material.

C. Counterflashing Strip: Modified bituminous, 40-mil- thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil- thick, crosslaminated polyethylene film with release liner backing.

D. Joint Reinforcing Strip: Air barrier manufacturer's glass-fiber-mesh tape.

E. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

F. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

G. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

H. Adhesive-Coated Transition Strip: Vapor-permeable, 17-mil- thick, self-adhering strip consisting of an adhesive coating over a permeable laminate with a permeance of 37 perms.

I. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

J. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Division 07 Section "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.
5. Proceed with installation only after unsatisfactory conditions have been corrected.
### 3.2 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

### 3.3 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prime substrate and apply a single thickness of preparation coat strip extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of air barrier membrane and embed a joint reinforcing strip in preparation coat.

B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and with air barrier manufacturer's written instructions. Apply first layer of fluid air barrier membrane at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air barrier membrane over joint reinforcing strip.

### 3.4 TRANSITION STRIP INSTALLATION

A. Install strips, transition strips, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.

2. Install rubberized asphalt strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.
B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprimed areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply rubberized asphalt transition strip so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

1. Rubberized asphalt transition strip: Roll firmly to enhance adhesion.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.

H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

I. Seal top of through-wall flashings to air barrier with an additional 6-inch-wide, rubberized asphalt strip.

J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.5 AIR BARRIER MEMBRANE INSTALLATION

A. Apply air barrier membrane to form a seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions.

B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.

C. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprimed areas exposed for more than 24 hours.
1. Prime glass-fiber-surfac ed gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

D. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.
1. Vapor-Permeable, Low-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, applied in one or more equal coats. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.

E. Apply strip and transition strip over cured air membrane overlapping 3 inches onto each surface according to air barrier manufacturer's written instructions.

F. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.6 FIELD QUALITY CONTROL

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

B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Tests: Testing to be performed will be determined by Owner's testing agency from among the following tests:
1. Qualitative Testing: Air barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, smoke pencil with pressurization or depressurization.

2. Quantitative Air Leakage Testing: Testing not to exceed the test pressure differential, positive and negative, indicated in "Performance Requirements" Article for air barrier assembly air leakage according to ASTM E 283.

D. Remove and replace deficient air barrier components and retest as specified above.

3.7 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than recommended by manufacturer.

2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 07 27 26
SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes standing-seam metal roof panels.

B. Related Sections:

1. None

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.

2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.

4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.

5. Review structural loading limitations of deck purlins and rafters during and after roofing.

6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.

7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.

8. Review temporary protection requirements for metal panel systems during and after installation.


10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical roof area and eave, including fascia, and soffit as shown on Drawings; approximately 48 inches square by full thickness, including attachments, underlayment, and accessories.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for low-slope roof products.

B. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:

1. Three-year, aged solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
2. Three-year, aged Solar Reflectance Index of not less than 64 when calculated according to ASTM E 1980.

C. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

D. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 at the following test-pressure difference:

E. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 or ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

F. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

G. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.


H. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.

B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Cee-Lock Standing Seam Roof Panel as manufactured by Berridge or a comparable product by one of the following:

   a. Advanced Architectural Products.
   b. AEP Span; A BlueScope Steel Company.
   c. Architectural Building Components.
   d. Architectural Metal Systems.
   e. Berridge Manufacturing Company.
   f. CENTRIA Architectural Systems.
   g. Dimensional Metals, Inc.
   h. Drexel Metals.
   i. Englert, Inc.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
   a. Nominal Thickness: 0.034 inch.
   c. Color: As selected by Architect from manufacturer's full range.

3. Clips: One-piece fixed to accommodate thermal movement.
   a. Material: 0.028-inch- nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.

5. Panel Height: 1.5 inch.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Drexel Metals.
   c. GCP Applied Technologies Inc. (formerly Grace Construction Products).
   d. Henry Company.
B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match roof fascia and rake trim.

E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot-long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

F. Panel Fasteners: Self-tapping screws designed to withstand design loads.

G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.


2.5 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.


3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.

5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

   a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.
2.6 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:
   1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
   1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
   2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
      a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

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

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.
3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with
temperature restrictions of underlayment manufacturer for installation. Apply at locations
indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less
than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2
inches. Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the entire roof surface.

B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

C. Flashings: Install flashings to cover underlayment to comply with requirements specified in
Section 076200 "Sheet Metal Flashing and Trim."

3.4 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation,
sizes, and locations indicated. Install panels perpendicular to supports unless otherwise
indicated. Anchor metal panels and other components of the Work securely in place, with
provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws.
   Do not begin installation until air- or water-resistive barriers and flashings that will be
   concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices
   and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws.
   Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use
galvanized-steel fasteners for surfaces exposed to the interior.
2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the
   exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
3. Copper Panels: Use copper, stainless-steel, or hardware-bronze fasteners.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place,
using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect
against galvanic action as recommended in writing by metal panel manufacturer.
E. **Standing-Seam Metal Roof Panel Installation:** Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. **Snap Joint:** Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. **Watertight Installation:**
   a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
   b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
   c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. **Clipless Metal Panel Installation:** Fasten metal panels to supports with screw fasteners at each lapped joint at location and spacing recommended by manufacturer.

G. **Accessory Installation:** Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

H. **Flashing and Trim:** Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
2. **Expansion Provisions:** Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

I. **Gutters:** Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
J. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.

K. Roof Curbs: Install flashing around bases where they meet metal roof panels.

L. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113.16
SECTION 074293 - SOFFIT PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes metal soffit panels.

B. Related Sections:

1. Section 074113.16 "Formed Metal Roof Panels" for lap-seam metal roof panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.
1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Product Test Reports: For each product, tests performed by a qualified testing agency.
C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Build mockup of typical roof eave, including fascia, and soffit as shown on Drawings; approximately four panels wide by full eave width, including attachments and accessories.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
D. Retain strippable protective covering on metal panels during installation.
E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.
1.9 FIELD CONDITIONS
A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION
A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY
A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including rupturing, cracking, or puncturing.
   b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient;

2.2 METAL SOFFIT PANELS

A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Flush-Profile Metal Soffit Panels : Basis of Design: Berridge FW-1025 with flush joint between panels or Equal.

1. Material: Same material, finish, and color as metal roof panels.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
   a. Nominal Thickness: 0.034 inch
   b. Exterior Finish: Three-coat fluoropolymer
   c. Color: As selected by Architect from manufacturer's full range

3. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
   a. Thickness: 0.032 inch
   b. Surface: Smooth, flat
   c. Exterior Finish: Three-coat fluoropolymer
   d. Color: As selected by Architect from manufacturer's full range

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50
SOFFIT PANELS

aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.


2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
SOFFIT PANELS

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
   a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
4. Metallic Fluoropolymer: AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color
coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

5. **FEVE Fluoropolymer: AAMA 621.** Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

6. **Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat;** with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.

7. **Concealed Finish:** Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

D. **Aluminum Panels and Accessories:**

1. **Two-Coat Fluoropolymer: AAMA 2605.** Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. **Three-Coat Fluoropolymer: AAMA 2605.** Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. **Mica Fluoropolymer: AAMA 2605.** Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

4. **Metallic Fluoropolymer: AAMA 2605.** Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

5. **FEVE Fluoropolymer: AAMA 2605.** Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

6. **Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat;** with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.

**PART 3 - EXECUTION**

3.1 **EXAMINATION**

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.
2. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.
   a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

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

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

   1. Soffit Framing: Wire tie[ or clip] furring channels to supports[, as required to comply with requirements for assemblies indicated].

3.3 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

   1. Shim or otherwise plumb substrates receiving metal panels.
   2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
   3. Install screw fasteners in predrilled holes.
   4. Locate and space fastenings in uniform vertical and horizontal alignment.
   5. Install flashing and trim as metal panel work proceeds.
   6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
   7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

   1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
   2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
   3. Copper Panels: Use copper, stainless-steel, or hardware-bronze fasteners.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

E. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On
completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074293
SECTION 074643 - REAR VENTILATED FAÇADE SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wood plastic composite (WPC) board cladding for use in rainscreen applications to provide a rear-ventilated façade system (RVFS).

1.2 RELATED REQUIREMENTS

A. Section 013000 - Submittals.
B. Section 054000 - Cold-Formed Metal Framing. For corrosion-resistant metal furring supporting WPC board cladding.
C. Section 061600 - Sheathing. For glass-mat gypsum wall sheathing to receive WPC cladding.
D. Section 072726 - Weather Barriers. For water-resistant barrier (WRB) materials installed over wall sheathing.
E. Section 072726 - Fluid-Applied Membrane Air Barriers. For water-resistant barrier (WRB) materials installed over wall sheathing.

1.3 REFERENCES

A. ASTM C1002: Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.


M. AWPA E10: Laboratory Method for Evaluating the Decay Resistance of Wood-Based Materials Against Pure Basidio Mycote Cultures: Soil/Block Test.

N. TAS 201: Impact Test Procedures.


P. TAS 203: Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.


1.4 DEFINITIONS

A. Rainscreen: An exterior open-joint cladding system incorporating a continuous air cavity created by furring, a water-resistive barrier to manage water intrusion through drainage and ventilation, and a physical air barrier (e.g. sheathing) to prevent air leakage into the building.

B. RVFS: Rear-ventilated façade system.

C. WRB: Water-resistive barrier. A Code-acceptable material behind the WPC cladding that prevents moisture in the air cavity from intrusion into the exterior building wall assembly.

D. WPC: Wood and plastic composite material.

1.5 SUBMITTALS

A. General: Comply with Section 013000 - Submittals.

B. Product Data: For each product specified. Include the following:
1. Technical product data, including component descriptions, details, and performance criteria.
2. Manufacturer’s printed surface preparation and installation instructions.
3. Safety Data Sheets (SDS).

C. Selection Samples: Full range of samples for color selection.

D. Verification Samples: For selected color(s). Full board width by minimum 12 inch length in size.

E. Quality Assurance Submittals:
   1. Installer qualifications.
   2. Certified test reports showing compliance with specified performance criteria.
   3. Specimen copy of specified material warranties.

F. Closeout Submittals:
   1. Maintenance data for installed system.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm with a minimum of three years documented experience installing RVFS similar to RVFS required by this Section.

B. Project-Site Mockups: Erect project-site mockups incorporating materials and workmanship required. After mockups have been reviewed for acceptability, retain on site and suitably protected until the RVFS work has been completed. Accepted mockups will serve as quality control standards for judging acceptability of the installed work. Accepted mockups [may] [may not] be incorporated into the work.

   1. Provide mockups as indicated on Drawings

1.7 DELIVERY AND STORAGE

A. General: Deliver and store materials in manufacturer’s original packaging and clearly identified. Protect materials from harmful environmental elements, construction dust and other potentially detrimental conditions in a suitable dry, well-ventilated, weathertight storage location.

1.8 ENVIRONMENTAL CONDITIONS

A. Do not apply RVFS materials when the air temperature or relative humidity is outside the manufacturer’s range limitations.
1.9 WARRANTY

A. Manufacturer's Performance Warranty: Manufacturer’s written materials warranty for long-term performance against manufacturing defects, including checks, splinters, and delamination, or damage from rot and fungal decay.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Stain and Fade Warranty: Manufacturer’s written materials warranty for long-term performance against staining and color fade.

1. Color Fade: Color change from light and weathering exposure not to exceed 5 Delta E (Hunter) units.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CAPPED COMPOSITE CLADDING

A. Basis of Design: Fiberon “Symmetry”; Fiber Composites, LLC.

B. Composition: Wood and plastic composite (WPC) core boards with “PermaTech,” a patented polyethylene-based capping material for superior stain, fade, and scratch resistance. Manufactured through a continuous co-extrusion process.

C. Board Thickness: 0.935 inch total thickness; 0.015 inch capping material thickness.

D. Board Width: 5.4 inches.

E. Board Length: 20 feet.

F. Board Edges: 1/8 inch edge radius.

G. Gapping: The following open joint dimensions for the RVFS are required:

1. Butted Boards: 1/4 inch to 1/32 inch open joints, depending on temperature.
2. Edge-to-Edge Boards: 3/16 inch open joints.
3. Boards Adjacent to Walls or Posts: 1/4 inch open joints.
4. Boards at Roof Interface: 1 inch open joints.

H. Color: Warm Sienna

2.2 PERFORMANCE CRITERIA

A. Structural Performance Criteria for WPC Board Cladding Assembly:

B. Performance Criteria for WPC Board Cladding Product: Comply with ASTM D7031 and the following:

1. Surface Burning Characteristics: Maximum 200 Flame Spread Index (Class C) and maximum 350 Smoke Development Index; ASTM E84 and UL 723.
4. Specific Gravity: 1.10; ASTM D792.
5. Coefficient of Thermal Expansion: $1.67 \times 10^{-5}$ in/in/deg F; ASTM D6341.
7. Modulus of Rupture: 3,500 psi; ASTM D6109.
9. Creep Recovery: 84 percent average recovery with maximum unrecovered deflection not to exceed 1/16 inch for 151 lb. test load; ASTM D7032.
10. Maximum Load Deflection: Less than 0.120 inch; ASTM D7032.
12. Fungus Decay Resistance: No significant decay; AWPA E10.
15. Delamination - Submersion Test: No delamination after 30 days when tested fully submerged in water at 70 deg F and 150 deg F.
16. Delamination - High Heat and Humidity Test: No delamination after 30 days suspended directly above, but not immersed into, 150 deg F water.
17. Delamination - Soak/Freeze/Thaw Test: No delamination after 50 soak/freeze/thaw cycles. Soak in room temperature water, freeze for a minimum 4 hours, thaw, and repeat.

C. Performance Criteria for Mechanical Fasteners:

2. Withdrawal Capacity: 196 lbs. minimum; ASTM D1761 and ASDTM D7032.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide miscellaneous materials as recommended by the RVFS manufacturer.

B. Fasteners: Type 304 stainless steel or polymer-coated composite decking screw fasteners complying with ASTM C1002. Minimum #8 by 2-1/2 inch length for face fasteners and #8 by 2-3/4 inch length for WPC board ends.

1. ACQ Rated Fasteners: Provide fasteners acceptable for alkaline copper quaternary (ACQ) pressure preservative treated wood attachment substrates.
2. Polymer-Coated Screw Fasteners: Comply with ASTM B117 for corrosion-resistance.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive the RVFS work and conditions under which the work will be performed.

B. Verify:

1. Wall sheathing is in place and properly installed.
2. WRB (or air barrier) is in place, continuous, and properly installed.
3. RVFS furring is level, plumb, and true to line, correctly placed, securely attached to building substrates. Maximum furring spacing, whether horizontal or vertical, not to exceed 16 inches on center.
4. Air cavity is continuous with minimum 3/4 inch unobstructed width. Unobstructed air intake (bottom) and exit (top) of at least 3/4 inch.
5. Flashings for penetrations, head of openings, and base of air cavity are properly installed to redirect moisture to the exterior.
6. Wood blocking and insect screens are in place as required to prevent intrusion by pests and not diminish ventilation/drainage performance.

C. Commencement of RVFS work will constitute acceptance of substrates to receive the work.

3.2 PREPARATION

A. General: Comply with manufacturer’s printed installation instructions.

B. Protect adjacent substrates not to receive the RVFS.

3.3 INSTALLATION

A. General: Comply with RVFS manufacturer’s printed installation instructions and approved shop drawings.

B. Securely attach WPC boards to furring substrates. Fastener size, number, spacing, and minimum dimensions from board edges and ends according to RVFS manufacturer’s current recommendations.

1. Cut and rout WPC boards using only approved carbide-tipped blades, to preclude frayed edge cuts.
2. Cut board ends square. 45 degree scarf-running butt joints in the field of cladding courses are acceptable.
3. Predrill holes located closer than 1-1/2 inches from ends of boards and 1 inch from board edges. Pre-drill holes in cladding boards three inches wide or less.
4. Install fasteners perpendicular to cladding board substrates and flush with board surface.

C. Horizontal WPC Board Orientation:
1. Determine and begin at lowest point of cladding installation.
2. Butt joints to occur only over vertical furring and centered on furring. As WPC board courses are added, stagger butt joints in a consistent “stair step” manner.
3. Board lengths to span a minimum of three furring members.
4. Gapping: Provide minimum 3/16 inch spacing between board edges. Spacing at end of boards is temperature dependent; refer to RVFS manufacturer’s published technical data for spacing dimensions.

3.4 CLEANING AND PROTECTION

A. Clean WPC boards according to RVFS manufacturer’s printed maintenance instructions. Use only cleaning materials and methods acceptable to RVFS manufacturer.

B. Repair any damage to adjacent substrates and surfaces due to work of this Section.

C. Upon completion of RVFS work, protect for remainder of construction period.

END OF SECTION 074643
SECTION 07 54 23 - THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Adhered thermoplastic polyolefin (TPO) roofing system.
   2. Roof insulation.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For the following products:
   1. Sheet roofing, of color required.
   2. Walkway pads or rolls, of color required.

1.5 INFORMATIONAL SUBMITTALS

A. Research/Evaluation Reports: For components of roofing system, from ICC-ES.

B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.
1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide EverGuard TPO 60-mil Membrane as manufactured by GAF Materials Corporation or comparable product by one of the following:

1. Carlisle SynTec Incorporated.
2. Cooley Engineered Membranes.
3. Custom Seal Roofing.
4. Firestone Building Products.
5. Flex Roofing Systems.
6. GAF Materials Corporation.
9. Mule-Hide Products Co., Inc.
10. Versico Incorporated.

B. Source Limitations: Obtain components including roof insulation, fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.

B. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.

C. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
D. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

E. Energy Performance: Roofing system shall have an initial solar reflectance index of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

F. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 TPO ROOFING


1. Thickness: 60 mils, nominal.
2. Exposed Face Color: White.

2.4 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content:

   a. Plastic Foam Adhesives: 50 g/L.
   b. Gypsum Board and Panel Adhesives: 50 g/L.
   c. Multipurpose Construction Adhesives: 70 g/L.
   d. Fiberglass Adhesives: 80 g/L.
   e. Single-Ply Roof Membrane Adhesives: 250 g/L.
   f. Single-Ply Roof Membrane Sealants: 450 g/L.
   g. Nonmembrane Roof Sealants: 300 g/L.
   h. Sealant Primers for Nonporous Substrates: 250 g/L.
   i. Sealant Primers for Porous Substrates: 775 g/L.
   j. Other Adhesives and Sealants: 250 g/L.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.

C. Bonding Adhesive: Manufacturer's standard, water based.

D. Slip Sheet: Manufacturer's standard, of thickness required for application.
E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.

F. Miscellaneous Accessories: Provide metal termination bars, metal battens, pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.5 ROOF INSULATION

A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide EnergyGuard as manufactured by GAF Materials Corporation or comparable product by one of the following:
      b. Carlisle SynTec Incorporated.
      c. Dyplast Products.
      d. Firestone Building Products.
      e. GAF Materials Corporation.
      f. Hunter Panels.
      g. Insulfoam LLC; a Carlisle company.
      h. Johns Manville.
      i. Rmax, Inc.

B. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.

C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.6 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer.

C. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch thick.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corporation; GlasRoc Sheathing.
      b. Georgia-Pacific Corporation; Dens Deck.
      c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
d. Temple-Inland, Inc; GreenGlass Exterior Sheathing.
e. USG Corporation; Securock Glass Mat Roof Board.
f. GAF Materials Corporation.

2.7 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions.

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

C. Install roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition.

3.2 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Install tapered insulation under area of roofing to conform to slopes indicated.

C. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

D. Mechanically Fastened and Adhered Insulation: Install each layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
2. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
3. Set each subsequent layer of insulation in insulation adhesive, firmly pressing and maintaining insulation in place.
E. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.

1. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.3 ADHERED ROOFING INSTALLATION

A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

B. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

C. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.

D. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing.

E. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

F. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.4 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.
3.5 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.6 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075423
SECTION 07 62 00 – SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufactured reglets with counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed steep-slope roof sheet metal fabrications.
4. Step flashing.
5. Formed wall sheet metal fabrications.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Distinguish between shop- and field-assembled work.
3. Include identification of finish for each item.
4. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.
1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

B. Mockups: Build mockups to verify selections made under Sample submittals to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockup of typical roof edge and eave, including fascia trim, approximately 10 feet long.

1.7 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:


D. Recycled Content of Steel-Sheet Flashing and Trim: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designation; prepainted by coil-coating process to comply with ASTM A 755/A 755M.
   1. Exposed Coil-Coated Finish:
      a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   2. Color: As selected by Architect from manufacturer's full range.

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
      b. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Grace Ice and Water Shield HT.
      c. Henry Company; Blueskin PE200 HT.
      d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
      e. Metal-Fab Manufacturing, LLC; MetShield.
      f. Owens Corning; WeatherLock Specialty Tile & Metal Underlayment.
      g. Polyguard Products, Inc.; Deck Guard HT.
      h. Protecito Wrap Company; Protecito Jiffy Seal Ice & Water Guard HT.
      i. SDP Advanced Polymer Products Inc; Palisade SA-HT.
   3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft.minimum.
2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Solder:
1. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.


2.5 MANUFACTURED REGLETS

A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cheney Flashing Company.
2. Material: Stainless steel, 0.019 inch thick.
3. Finish: Mill.

2.6  FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Obtain field measurements for accurate fit before shop fabrication.
2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

F. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- long sections. Furnish flat-stock gutter brackets and gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.

B. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors

   1. Hanger Style: As shown on the drawings.
   2. Fabricate from the following materials:
      a. Galvanized Steel: 0.022 inch thick.

2.8 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:

   1. Galvanized Steel: 0.022 inch thick.

B. Valley Flashing: Fabricate from the following materials:

   1. Galvanized Steel: 0.028 inch thick.

C. Drip Edges: Fabricate from the following materials:

   1. Galvanized Steel: 0.022 inch thick.

D. Eave, Rake Flashing: Fabricate from the following materials:

   1. Galvanized Steel: 0.022 inch thick.

2.9 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12-foot- long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch- high, end dams. Fabricate from the following materials:

   1. Stainless Steel: 16 oz./sq. ft.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder metallic-coated steel sheet.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.

C. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c.

D. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of 4 inches in direction of water flow.
3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 042000 "Unit Masonry."

C. Reglets: Installation of reglets is specified in Section 042000 "Unit Masonry."

D. Opening Flashings in Frame Construction: Install continuous head, sill, jamb and similar flashings to extend 4 inches beyond wall openings.

3.6 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 07 62 00
SECTION 07 71 00 – ROOF SPECIALITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Copings.
   2. Reglets and counterflashings.

1.2 PERFORMANCE REQUIREMENTS

A. FM Approvals' Listing: Manufacture and install copings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-120. Identify materials with FM Approvals' markings.

B. SPRI Wind Design Standard: Manufacture and install copings tested according to SPRI ES-1 and capable of resisting the following design pressures:
   1. Design Pressure: As indicated on structural drawings.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: For roof specialties. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.
1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site.

1.7 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EXPOSED METALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

B. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.

1. Surface: Smooth, flat finish.
2. Exposed Coil-Coated Finishes: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

2.2 CONCEALED METALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

B. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.
2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

D. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 COPINGS

A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 12 feet, concealed anchorage; corner units, end cap units, and concealed splice plates with same finish as coping caps.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Architectural Products Company.
   b. ATAS International, Inc.
   c. Castle Metal Products.
   d. Cheney Flashing Company.
   e. Hickman Company, W. P.
   f. Johns Manville.
   g. Merchant & Evans, Inc.
   h. Metal-Era, Inc.
   i. Metal-Fab Manufacturing, LLC.
   j. MM Systems Corporation.
   k. National Sheet Metal Systems, Inc.
   l. Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.
   m. Petersen Aluminum Corporation.

2. Coping-Cap Material: Zinc-coated steel, nominal thickness as required to meet performance requirements.
a. Finish: Two-coat fluoropolymer.
b. Color: As selected by Architect from manufacturer's full range.

4. Coping-Cap Attachment Method: Snap-on, fabricated from coping-cap material.
5. Snap-on-Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches wide, with integral cleats.
6. Face Leg Cleats: Concealed, continuous galvanized-steel sheet.

2.6 REGLETS AND COUNTERFLASHINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Castle Metal Products.
2. Cheney Flashing Company.
3. Fry Reglet Corporation.
4. Heckmann Building Products Inc.
5. Hickman Company, W. P.
7. Metal-Era, Inc.
8. Metal-Fab Manufacturing, LLC.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Stainless Steel: 0.025 inch thick.
2. Corners: Factory mitered and continuously welded.
3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Stucco Type, Embedded: Provide reglets with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
5. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:

1. Stainless Steel: 0.025 inch thick.

D. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
E. Stainless-Steel Finish: No. 2B (bright, cold rolled, unpolished).

F. Zinc-Coated Steel Finish: Two-coat fluoropolymer.
   1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.
   1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
   2. Provide uniform, neat seams with minimum exposure of solder and sealant.
   3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
   4. Torch cutting of roof specialties is not permitted.
   5. Install underlayment with adhesive for temporary anchorage. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches. Roll laps of self-adhering sheet underlayment with roller; cover within 14 days.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of stainless-steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of self-adhering, high-temperature sheet underlayment.

   1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise shown on Drawings.
   2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal joints with sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.
G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches except reduce pre-tinning where pre-tinned surface would show in completed work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.2 COPING INSTALLATION
A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
B. Anchor copings to meet performance requirements.
   1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.

3.3 REGLET AND COUNTERFLASHING INSTALLATION
A. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.
B. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Fit counterflashings tightly to base flashings.

3.4 CLEANING AND PROTECTION
A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
B. Clean and neutralize flux materials. Clean off excess solder and sealants.
C. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION 07 71 00
SECTION 07 72 00 – ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Roof curbs.
   2. Equipment supports.
   3. Roof hatches.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of roof accessory indicated.
B. Shop Drawings: For roof accessories.
C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS
A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items.
B. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS
A. Operation and maintenance data.

1.5 WARRANTY
A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL MATERIALS
A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.
1. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat.

B. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.

C. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.

D. Sealants: As recommended by roof accessory manufacturer for installation indicated.

2.3 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units with integral spring-type vibration isolators and capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, integral metal cant and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AES Industries, Inc.
   b. Curbs Plus, Inc.
   c. Custom Solution Roof and Metal Products.
   d. Greenheck Fan Corporation.
   e. LM Curbs.
   f. Metallic Products Corp.
   g. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
   h. Pate Company (The).
   i. Roof Products, Inc.
   j. Safe Air of Illinois.
   k. Thybar Corporation.
   l. Vent Products Co., Inc.

B. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch thick.

   1. Finish: Baked enamel or powder coat.
2. Color: As selected by Architect from manufacturer's full range.

C. Construction:

1. Insulation: Factory insulated with 1-1/2-inch-thick glass-fiber board insulation.
2. Liner: Same material as curb, of manufacturer's standard thickness and finish.
3. Factory-installed wood nailer at top of curb, continuous around curb perimeter.
4. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
5. Fabricate curbs to minimum height of 18 inches unless otherwise indicated.
6. Top Surface: Level around perimeter with roof slope accommodated by sloping the deck-mounting flange.
7. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.

2.4 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, integral metal cant and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AES Industries, Inc.
   b. Curbs Plus, Inc.
   c. Custom Solution Roof and Metal Products.
   d. Greenheck Fan Corporation.
   e. LM Curbs.
   f. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
   g. Pate Company (The).
   h. Roof Products, Inc.
   i. Thybar Corporation.
   j. Vent Products Co., Inc.

B. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch thick.

1. Finish: Baked enamel or powder coat.
2. Color: As selected by Architect from manufacturer's full range.

C. Construction:

1. Insulation: Factory insulated with 1-1/2-inch-thick cellulosic-fiber board insulation.
2. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
3. Factory-installed continuous wood nailers 3-1/2 inches wide at tops of equipment supports.
4. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.

5. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.

6. Fabricate equipment supports to minimum height of 18 inches unless otherwise indicated.

7. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.5 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, integral metal cant and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AES Industries, Inc.
   b. Babcock-Davis.
   c. Bilco Company (The).
   d. Bristolite Skylights.
   e. Custom Solution Roof and Metal Products.
   f. Dur-Red Products.
   g. Hi Pro International, Inc.
   h. J. L. Industries, Inc.
   i. Metallic Products Corp.
   j. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
   k. Naturalite Skylight Systems; Vistawall Group (The).
   l. Nystrom.
   m. O'Keeffe's Inc.
   n. Pate Company (The).
   o. Precision Ladders, LLC.

B. Type and Size: Single-leaf lid, 30 by 36 inches.


D. Hatch Material: Zinc-coated (galvanized) steel sheet, 0.079 inch thick.

   1. Finish: Baked enamel or powder coat.
   2. Color: As selected by Architect from manufacturer's full range.

E. Construction:

   1. Insulation: Cellulosic-fiber board.
   2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
   3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
5. Fabricate curbs to minimum height of 18 inches unless otherwise indicated.
6. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.

F. Hardware: Galvanized-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.

1. Provide two-point latch on lids larger than 84 inches.

G. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder. Post locks in place on full extension; release mechanism returns post to closed position.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.

C. Seal joints with sealant as required by roof accessory manufacturer.

3.2 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 72 00
SECTION 078100 - APPLIED FIRE PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sprayed fire-resistive materials.

1.3 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Sprayed fire-resistive material.
2. Substrate primers.
4. Reinforcing mesh as required.
5. Sealer.

B. Shop Drawings: Framing plans or schedules, or both, indicating the following:

1. Extent of fire protection for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum sprayed fire-resistive material thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of sprayed fire-resistive material after application.
1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.
B. Product Certificates: For each type of sprayed fire-resistive material.
C. Evaluation Reports: For sprayed fire-resistive material, from ICC-ES.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fire protection when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
B. Ventilation: Ventilate building spaces during and after application of fire protection, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fire protection, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
B. Source Limitations: Obtain fire protection for each fire-resistance design from single source.
C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E119 or UL 263 testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Steel members are to be considered unrestrained unless specifically noted otherwise.
D. Asbestos: Provide products containing no detectable asbestos.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS

A. Sprayed Fire-Resistive Material UL D916. Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. Carboline Company; a subsidiary of RPM International.
   b. GCP Applied Technologies Inc.
   c. Isolatek International.
   d. Pyrok, Inc.
   e. Schundler Company (The).
   f. Southwest Fireproofing Products Co.

2. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.

3. Bond Strength: Minimum 200-lbf/sq. ft. and adhesive strength based on field testing according to ASTM E736.

4. Density: Not less than density specified in the approved fire-resistance design, according to ASTM E605.

5. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E605, whichever is thicker, but not less than 0.375 inch.


7. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 10 or less.
   b. Smoke-Developed Index: 10 or less.

8. Compressive Strength: Minimum 1200 lbf/sq. ft. according to ASTM E761.


10. Deflection: No cracking, spalling, or delamination according to ASTM E759.

11. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E760.

12. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours according to ASTM E859.

13. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G21.

14. Finish: Spray-textured finish
   a. Color: As indicated by manufacturer's designations

2.3 **AUXILIARY MATERIALS**

A. Provide auxiliary materials that are compatible with sprayed fire-resistive material and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by sprayed fire-resistive material manufacturer and complying with one or both of the following requirements:

1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Primer's bond strength in required fire-resistance design complies with specified bond strength for sprayed fire-resistive material and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E736.

C. Bonding Agent: Product approved by sprayed fire-resistive material manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

D. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by sprayed fire-resistive material manufacturer. Include pins and attachment.

E. Sealer: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by sprayed fire-resistive material manufacturer for each fire-resistance design.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.

1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fire protection with substrates under conditions of normal use or fire exposure.

2. Verify that objects penetrating fire protection, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.

3. Verify that substrates receiving fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.

B. Verify that concrete work on steel deck is complete before beginning Work.

C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning Work.

D. Conduct tests according to sprayed fire-resistive material manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fire protection materials during application.

B. Clean substrates of substances that could impair bond of fire protection.

C. Prime substrates where included in fire-resistance design and where recommended in writing by sprayed fire-resistive material manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fire protection.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fire protection. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fire protection assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fire protection Work.

B. Comply with sprayed fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fire protection with other construction to minimize need to cut or remove fire protection.
   1. Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
   2. Defer installing ducts, piping, and other items that would interfere with applying fire protection until application of fire protection is completed.

D. Metal Decks:
   1. Do not apply fire protection to underside of metal deck substrates until concrete topping, if any, is completed.
   2. Do not apply fire protection to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fire protection.

E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and sprayed fire-resistive material manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by sprayed fire-resistive material manufacturer.

F. Spray apply fire protection to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.
G. Extend fire protection in full thickness over entire area of each substrate to be protected.

H. Install body of fire protection in a single course unless otherwise recommended in writing by sprayed fire-resistant material manufacturer.

I. Where sealers are used, apply products that are tinted to differentiate them from fire protection over which they are applied.

J. Provide a uniform finish complying with description indicated for each type of fire protection material and matching finish approved for required mockups.

K. Cure fire protection according to sprayed fire-resistant material manufacturer's written instructions.

L. Do not install enclosing or concealing construction until after fire protection has been applied, inspected, and tested and corrections have been made to deficient applications.

M. Finishes: Where indicated, apply fire protection to produce the following finishes:

   1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
   2. Spray-Textured Finish: Finish left as spray applied with no further treatment.
   4. Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

   1. Test and inspect as required by the IBC, Subsection 1705.13, "Sprayed Fire-Resistant Materials."

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fire protection will be considered defective if it does not pass tests and inspections.

   1. Remove and replace fire protection that does not pass tests and inspections, and retest.
   2. Apply additional fire protection, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.
3.5 CLEANING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

3.6 PROTECTION

A. Protect fire protection, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fire protection is without damage or deterioration at time of Substantial Completion.

3.7 REPAIRS

A. As installation of other construction proceeds, inspect fire protection and repair damaged areas and fire protection removed due to work of other trades.

B. Repair fire protection damaged by other work before concealing it with other construction.

C. Repair fire protection by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078100
SECTION 07 84 13 – PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

B. Related Sections include the following:
1. Division 21 Sections specifying fire-suppression piping penetrations.
2. Division 22 and 23 Sections specifying duct and piping penetrations.
3. Division 26, 27, and 28 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
   a. Penetrations located outside wall cavities.
   b. Penetrations located outside fire-resistance-rated shaft enclosures.
3. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 3.0 cfm/sq. ft at both ambient temperatures and 400 deg F.
C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

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

B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

D. Qualification Data: For Installer.

E. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.

F. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.
1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."

B. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

C. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistant joint systems in Project to a single qualified installer.

D. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

E. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.

2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:

a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.

b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:

1) UL in its "Fire Resistance Directory."

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.
B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers:

3. Hilti, Inc.
6. NUCO Inc.
7. RectorSeal Corporation (The).
8. Specified Technologies Inc.
9. 3M; Fire Protection Products Division.
10. Tremco; Sealant/Weatherproofing Division.
11. USG Corporation.
2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:
   a. Slag-/rock-wool-fiber insulation.
   b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
   c. Fire-rated form board.
   d. Fillers for sealants.

2. Temporary forming materials.
5. Steel sleeves.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

I. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
   2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
3.4 IDENTIFICATION

A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:

1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.

B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.6 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.7 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.
B. Where OPL-classified systems are indicated, they refer to alpha-numeric design numbers in OPL's "Directory of Listed Building Products, Materials, & Assemblies."

C. Where ITS-listed systems are indicated, they refer to design numbers listed in ITS's "Directory of Listed Products," "Firestop Systems" Section.

D. Firestop Systems with No Penetrating Items:
   1. Type of Fill Materials: One or more of the following:
      a. Latex sealant.
      b. Silicone sealant.
      c. Intumescent putty.
      d. Mortar.

E. Firestop Systems for Metallic Pipes, Conduit, or Tubing:
   1. Type of Fill Materials: One or more of the following:
      a. Latex sealant.
      b. Silicone sealant.
      c. Intumescent putty.
      d. Mortar.

F. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing:
   1. Type of Fill Materials: One or more of the following:
      a. Latex sealant.
      b. Silicone sealant.
      c. Intumescent putty.
      d. Intumescent wrap strips.
      e. Firestop device.

G. Firestop Systems for Electrical Cables:
   1. Type of Fill Materials: One or more of the following:
      a. Latex sealant.
      b. Silicone sealant.
      c. Intumescent putty.
      d. Silicone foam.
      e. Pillows/bags.

H. Firestop Systems for Cable Trays:
   1. Type of Fill Materials: One or more of the following:
      a. Latex sealant.
      b. Intumescent putty.
      c. Silicone foam.
      d. Pillows/bags.
      e. Mortar.

I. Firestop Systems for Insulated Pipes:
   1. Type of Fill Materials: One or more of the following:
a. Latex sealant.
b. Intumescent putty.
c. Silicone foam.
d. Intumescent wrap strips.

J. Firestop Systems for Miscellaneous Electrical Penetrants:
1. Type of Fill Materials: One or more of the following:
   a. Latex sealant.
   b. Intumescent putty.
   c. Mortar.

K. Firestop Systems for Miscellaneous Mechanical Penetrants:
1. Type of Fill Materials: One or both of the following:
   a. Latex sealant.
   b. Mortar.

L. Firestop Systems for Groupings of Penetrants:
1. Type of Fill Materials: One or more of the following:
   a. Latex sealant.
   b. Mortar.
   c. Intumescent wrap strips.
   d. Firestop device.
   e. Intumescent composite sheet.

END OF SECTION 07 84 13
SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Silicone joint sealants.

B. Related Sections:
   1. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
   2. Division 08 Section "Glazing" for glazing sealants.
   3. Division 09 Section "Gypsum Board" for sealing perimeter joints.
   4. Division 09 Section "Tiling" for sealing tile joints.

1.3 PRECONSTRUCTION TESTING
A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
   1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
   2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
   3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
   4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
   5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
   1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
   2. Conduct field tests for each application indicated below:
a. Each kind of sealant and joint substrate indicated.

3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.


      1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.4 SUBMITTALS

   A. Product Data: For each joint-sealant product indicated.

   B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

   C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

   D. Joint-Sealant Schedule: Include the following information:

      1. Joint-sealant application, joint location, and designation.
      2. Joint-sealant manufacturer and product name.

   E. Qualification Data: For qualified Installer.

   F. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

   G. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

   H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
I. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

J. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

K. Field-Adhesion Test Reports: For each sealant application tested.

L. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

E. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
1.7 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer’s Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
   
a. Dow Corning Corporation; 790.
   b. GE Advanced Materials - Silicons; SilPruf LM SCS2700.
   d. Pecora Corporation; 301 NS.
   e. Sika Corporation, Construction Products Division; SikaSil-C990.
   f. Tremco Incorporated; Spectrem 1.

2.3 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

   a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
   a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
   b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.

   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:
   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:
   a. Isolation and contraction joints in cast-in-place concrete slabs.
   b. Joints between different materials listed above.
   c. Other joints as indicated.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.


1. Joint Locations:
   b. Control and expansion joints in unit masonry.
   c. Joints between different materials listed above.
   d. Perimeter joints between materials listed above and frames of doors, windows and louvers.
   e. Control and expansion joints in ceilings and other overhead surfaces.
   f. Other joints as indicated.

2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:
   b. Control and expansion joints in tile flooring.
   c. Other joints as indicated.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.


1. Joint Locations:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Perimeter joints of exterior openings where indicated.
c. Tile control and expansion joints.
d. Vertical joints on exposed surfaces of walls and partitions.
e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
f. Other joints as indicated.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Sealant Location:
   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated.
   c. Other joints as indicated.

2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 92 00
SECTION 08 11 13 – HOLLOW METAL DOOR AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Standard hollow metal doors and frames.

B. Related Sections:
   1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
   2. Division 08 Section "Door Hardware (Scheduled by Describing Products)" for door hardware for hollow metal doors.
   3. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.
   4. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings and finishes.

B. Shop Drawings: Include the following:
   1. Elevations of each door design.
   2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of anchorages, joints, field splices, and connections.
   7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification:
   1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
   2. For the following items, prepared on Samples about 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:
      a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
      b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow metal panels and glazing if applicable.

E. Other Action Submittals:
   1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

F. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10B.
   1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
   2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.
D. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amweld Building Products, LLC.
2. Benchmark; a division of Therma-Tru Corporation.
3. Ceco Door Products; an Assa Abloy Group company.
4. Curries Company; an Assa Abloy Group company.
5. Deansteel Manufacturing Company, Inc.
7. Fleming Door Products Ltd.; an Assa Abloy Group company.
10. Kewanee Corporation (The).
11. Mesker Door Inc.
2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.

   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

H. Glazing: Comply with requirements in Division 08 Section "Glazing."

I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD HOLLOW METAL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

   1. Design: Flush panel.

   2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
a. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

1) Locations: Exterior doors.


4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.


B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.


1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as full profile welded unless otherwise indicated.
3. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as full profile welded unless otherwise indicated.
3. Fabricate knocked-down, drywall slip-on frames for in-place gypsum board partitions.
4. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.
5. Frames for Wood Doors: 0.053-inch-thick steel sheet.
6. Frames for Borrowed Lights: 0.053-inch- thick steel sheet.
2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

D. Terminated Stops: Where indicated on interior door frames, terminate stops 6 inches above finish floor with a 90-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

1. Provide terminated stops unless otherwise indicated.

2.7 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch-wide steel.
C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.8 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
2. Glazed Lites: Factory cut openings in doors.
3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Sidelight Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
6. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      1) Three anchors per jamb from 60 to 90 inches high.
   b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      1) Three anchors per jamb up to 60 inches high.
      2) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
   c. Compression Type: Not less than two anchors in each jamb.
d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.9 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer’s written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

   a. At fire-protection-rated openings, install frames according to NFPA 80.
b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
c. Install frames with removable glazing stops located on secure side of opening.
d. Install door silencers in frames before grouting.
e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
   a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:
a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION 08 11 13
SECTION 08 12 16 – ALUMINUM FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Interior aluminum frames for doors and windows.

B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for carpentry for wood blocking.
2. Division 07 Section "Joint Sealants" for joint sealants installed with interior aluminum frames and for sealants to the extent not specified in this Section.
3. Division 08 Section "Flush Wood Doors" for wood doors installed in interior aluminum frames.
4. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for aluminum-framed doors installed in interior aluminum frames.
5. Division 08 Section "Door Hardware" for door hardware.
6. Division 08 Section "Glazing" for glass in interior aluminum frames.
7. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for partitions.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of interior aluminum frame indicated.

B. Shop Drawings: For interior aluminum frames. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: 12-inch-long framing member with factory-applied finish for each type of interior aluminum frame indicated.

E. Fabrication Sample: For each vertical-to-horizontal intersection of systems, made from 12-inch lengths of full-size components and showing details of assembly.

F. Maintenance Data: For interior aluminum frames to include in maintenance manuals.
1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of interior aluminum frames and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Fire-Rated Door-Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated.
   1. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 10B.
   2. Fire Rating: As scheduled.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: The design for interior aluminum frames is based on “Classic Series” as manufactured by RACO Interior Products, Inc. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
   1. Custom Components Company.
   2. Dual Lock Partition Systems, Inc.
   3. Frameworks Manufacturing.
   4. Modulex, Inc.
   5. Versatrac.
   6. Western Integrated Materials, Inc.

2.2 COMPONENTS

A. Aluminum Framing, General: ASTM B 221, Alloy 6063-T5 or alloy and temper required to suit structural and finish requirements, not less than 0.062 inch thick.

B. Door Frames: Reinforced for hinges and strikes.
   1. Fabricate frame members for 90-minute fire-protection rating with interior cold-formed, primed, steel liner.

C. Glazing Frames: For glazing thickness indicated.

D. Ceiling Tracks: Extruded aluminum.

E. Trim: Extruded aluminum, not less than 0.062 inch thick, with removable snap-in casing trim, glazing stops and door stops without exposed fasteners.
2.3 ACCESSORIES

A. Fasteners: Aluminum, nonmagnetic stainless-steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.

B. Sound Seals: Manufacturer's standard continuous mohair, wool pile, or vinyl seals.

C. Glazing Gaskets: Manufacturer's standard extruded or molded plastic, to accommodate glazing thickness indicated.

D. Glazing: Comply with requirements in Division 08 Section "Glazing."

E. Hardware: Comply with requirements in Division 08 door hardware Sections.

2.4 FABRICATION

A. Machine jambs and prepare for hardware, with concealed reinforcement plates, drilled and tapped as required, and fastened within frame with concealed screws.

B. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted or mitered connections.

C. Fabricate frames for glazing with removable stops to allow glazing replacement without dismantling frame.

D. Fabricate all components to allow secure installation without exposed fasteners.

2.5 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and ceilings, with Installer present, for conditions affecting performance of work.
1. Verify that wall thickness does not exceed standard tolerances allowed by throat size indicated.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with frame manufacturer's written installation instructions.

B. Install frames plumb and square, securely anchored to substrates.

C. Install frame components in the longest possible lengths; components up to 72 inches long must be 1 piece.
   1. Fasten to suspended ceiling grid on maximum 48-inch centers, using sheet metal screws or other fasteners approved by frame manufacturer.
   2. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
   3. Secure clips to main structural extrusion components and not to snap-in or trim members.
   4. Do not leave screws or other fasteners exposed to view when installation is complete.

3.3 CLEANING

A. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended by frame manufacturer and according to AAMA 609 & 610.

B. Touch up marred frame surfaces so touchup is not visible from a distance of 48 inches. Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

END OF SECTION 08 12 16
SECTION 08 14 16 – FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer and plastic-laminate faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 083473.16 "Wood Sound Control Door Assemblies" for acoustic flush wood doors.
2. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of door. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples: For plastic-laminate door faces and factory-finished doors.

1.3 INFORMATIONAL SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is a certified participant in AWI's Quality Certification Program.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Algoma Hardwoods, Inc.
2. Ampco.
3. Chappell Door Co.
4. Eggers Industries.
5. General Veneer Manufacturing Co.
7. Haley Brothers, Inc.
8. Ipik Door Company.
10. Marlite.
11. Marshfield Door Systems, Inc.
12. Mohawk Doors; a Masonite company.
15. Vancouver Door Company.
16. VT Industries, Inc.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.

B. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.

C. WDMA I.S.1-A Performance Grade:

1. Heavy Duty unless otherwise indicated.
2. Extra Heavy Duty: public toilets, janitor's closets, assembly spaces and exits.

D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

E. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-1, made with binder containing no urea-formaldehyde.
2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
3. Provide doors with glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade AA faces.
5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Core: Particleboard.
8. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
9. Construction: Seven plies, either bonded or nonbonded construction.

2.4 PLASTIC-LAMINATE-FACED DOORS

A. Interior Solid-Core Doors:

1. Grade: Premium.
2. Plastic-Laminate Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HGS.
3. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range of products.
4. Exposed Vertical Edges: Plastic laminate that matches faces, applied before faces.
5. Core: Particleboard.
6. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before faces and crossbands are applied. Faces are bonded to core using a hot press.

2.5 LIGHT FRAMES AND LOUVERS

A. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for
use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.6 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.7 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Transparent Finish:

1. Grade: Premium.
2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 11, catalyzed polyurethane.
4. Effect: Open-grain finish.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware: For installation, see Section 087111 "Door Hardware (Descriptive Specification)."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.
C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.

   a. Comply with NFPA 80 for fire-rated doors.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 08 14 16
SECTION 08 31 13 – ACCESS DOOR AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Access doors and frames for walls and ceilings.

B. Related Sections include the following:
   1. Division 04 Section "Unit Masonry" for anchoring and grouting access door frames set in masonry construction.
   2. Division 07 Section "Roof Accessories" for roof hatches.

1.3 SUBMITTALS

A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.

D. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

E. Ceiling Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of access door(s) and frame(s) through one source from a single manufacturer.

B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. NFPA 252 or UL 10B for vertical access doors and frames.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

1. ASTM A 123/A 123M, for galvanizing steel and iron products
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

C. Steel Sheet: Uncoated or electrolytic zinc-coated, ASTM A 591/A 591M with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS) with A60 zinc-iron-alloy (galvannealed) coating or G60 mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M.

E. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

2. Surface Preparation for Metallic-Coated Steel Sheet: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

3. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.

F. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acudor Products, Inc.
2. Babcock-Davis; A Cierra Products Co.
4. Cendrex Inc.
5. Dur-Red Products.
6. Elmdor/Stoneman; Div. of Acorn Engineering Co.
7. Jensen Industries.
8. J. L. Industries, Inc.
11. MIFAB, Inc.
12. Milcor Inc.


1. Locations: Masonry wall surfaces.
2. Door: Minimum 0.060-inch-thick sheet metal, set flush with exposed face flange of frame.
3. Frame: Minimum 0.060-inch-thick sheet metal with 1-inch-wide, surface-mounted trim.
5. Latch: Cam latch operated by screwdriver with interior release.

C. Flush Access Doors and Trimless Frames: Fabricated from steel sheet.

1. Locations: Gypsum board and tile wall and ceiling surfaces.
2. Door: Minimum 0.060-inch-thick sheet metal, set flush with surrounding finish surfaces.
3. Frame: Minimum 0.060-inch-thick sheet metal with drywall bead flange.
5. Latch: Cam latch operated by screwdriver with interior release.


1. Locations: Wall surfaces.
2. Door: Minimum 0.040-inch-thick, metallic-coated steel sheet; flush panel construction with manufacturer's standard 2-inch-thick fiberglass insulation.
3. Frame: Minimum 0.060-inch-thick extruded aluminum.
5. Lock: Dual-action handles with key lock.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.

1. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
2. For trimless frames with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
3. Provide mounting holes in frames for attachment of units to metal or wood framing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13
SECTION 08 33 36   OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES
   A. Overhead coiling service doors.
   B. Springless rolling service doors

1.2 RELATED SECTIONS
   A. Section 05 50 00 - Metal Fabrications.
   B. Section 06 10 00 - Rough Carpentry.
   C. Section 26 02 00 – Basic Materials and Methods

1.3 REFERENCES
   E. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   F. ASTM A 666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   I. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   J. NEMA MG 1 - Motors and Generators.

1.4 DESIGN / PERFORMANCE REQUIREMENTS
A. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Details of construction and fabrication.
   4. Installation instructions.

C. Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.

F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

G. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years experience in the fabrication and installation of security closures.

B. Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.

C. Store materials in a dry, warm, ventilated weathertight location.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under
environmental conditions outside manufacturer's absolute limits.

1.9 COORDINATION
A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

1.10 WARRANTY
A. Warranty: FOR DOOR 625S: Manufacturer's limited door and operator system, to be free from defects in materials and workmanship for 3 years or 500,000 cycles, whichever occurs first.
B. Warranty: FOR DOOR 600: Manufacturer's limited door and operator system, except the counterbalance spring and finish, to be free from defects in materials and workmanship for 3 years or 20,000 cycles, whichever occurs first.
C. Warranty: Manufacturer's limited door system warranty for 2 years for all parts and components.
D. PowderGuard Finish
   1. PowderGuard Zinc Base Coat applied to guides, bottom bar, headplates plus PowderGuard Premium applied to curtain and top coat for guides, bottom bar, headplates: Manufacturer's limited Zinc Finish warranty for 4 years.

PART 2 PRODUCTS
2.1 MANUFACTURERS
A. Basis of Design Manufacturer: Overhead Door Corp.
B. Substitutions: Equivalent products allowable if meeting specifications.
C. Requests for substitutions will be considered in accordance with provisions of Section 01 25 00 – Substitution Procedures.

2.2 OVERHEAD COILING SERVICE DOORS
A. Light Commercial Doors: Overhead Door Corporation, Model 600 Coil-Away Service Doors. LOCATIONS: Interior Doors in ANNEX.
   1. Curtain: Interlocking roll-formed galvanized steel slats, flat crown profile type CAW, 26 gauge for widths up to 12 feet 4 inches (3.75 m), 24 gauge for widths up to 16 feet (4.88 m). End of each slat shall be locked from lateral movement by a staking lock system. (Galvanized alternate malleable end locks.)
   2. Finish:
      a. Curtain slats and hood shall be galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on polyester top coat.
         1) Polyester Top Coat.
            a) White polyester.
   5. Guides: Roll-formed galvanized steel shapes attached to continuous galvanized steel
wall angle.
   a. Finish: PowderGuard Premium powder coat, color as selected by Architect.
6. Brackets: Galvanized steel to support counterbalance and curtain.
   a. Finish: PowderGuard Premium powder coat, color as selected by Architect.
7. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel and
   supporting the curtain with deflection limited to 0.03 inch per foot of span. Spring
tension shall be adjustable.
9. Manual Operation:
   a. Chain hoist for doors over 100 SF.
10. Windload Design:
   a. See structural drawings
11. Operation: Design door assembly, including operator, to operate for not less than
   20,000 cycles.
12. Locking:
   a. Two interior bottom bar slide bolts for manually operated doors.

2.3 INSULATED OVERHEAD COILING SERVICE DOORS

A. EverServe Model 625S Insulated Springless Rolling Service Doors with Stormtite perimeter
seals by Overhead Door Corporation.
1. Curtain: Interlocking roll-formed metal slats as specified with endlocks attached to
each end of alternate slats to prevent lateral movement.
   a. Flat Profile insulated type F-265i with 24 gauge back covering steel or stainless
   steel; .024 inch (.06 mm) aluminum, for doors up to 20 feet wide fabricated of:
      1) 24 gauge powder coated steel.
   b. Insulation: Slat cavity shall be filled with CFC-free, foamed-in-place,
   polyurethane insulation.
   c. Insulated Vision Lites: Provide with uniformly spaced openings. Provide with
dual wall polycarbonate lites.
      1) Size: 10 inch by 1 inch (254 mm by 25.4 mm)
2. Performance:
   b. Through Curtain Sound Rating: Sound Rating: STC-28 (STC-30+ with HZ
   noise generator) as per ASTM E 90.
   c. Installed System Sound Rating: STC-21 as per ASTM E 90.
   d. U-factor: 0.91 NFRC test report, maximum U-factor of no higher than 1.00.
   e. Air Infiltration: Meets ASHRAE 90.1 & IECC 2012/2015 C402.4.3 Air leakage
   < 1.00 cfm/ft2.
3. Curtain and Hood Finish:
   a. Galvanized Steel: Slats and hood galvanized in accordance with ASTM A 653
   and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on
   prime paint, and 0.6 mils thick baked-on polyester top coat.
      1) Powder Coat:
         a) PowderGuard Premium powder coat color as selected by the
Architect.
4. Weatherseals:
   a. Vinyl bottom seal, exterior guide and internal hood seals.
b. Interior guide weatherseal.
c. Lintel weatherseal.

5. Bottom Bar: Two metal angles, minimum thickness 3/16 inch, bolted back to back to reinforce curtain in the guides.
a. Material:
   1) Steel.
   2) Extruded aluminum.
   3) Stainless steel with brushed finish.

6. Guides: Three Structural steel angles provided with high usage guide wear strip to minimize wear and reduce sound.
a. Material:
   1) Steel.
   2) High usage guide wear strips.

7. Brackets:
   a. Hot rolled prime painted steel to support counterbalance, curtain and hood.
   b. Galvanized steel to support counterbalance, curtain and hood.

8. Finish; Bottom Bar, Guides, Headplate and Brackets:
a. Finish: PowderGuard Premium powder coat color as selected by the Architect.

9. Motor: Direct drive, integrated gear motor/brake assembly sized for openings. Provide with a manual hand chain for operation during power outages. Operator and drive assembly is factory pre-assembled and provided with all wiring harnesses needed direct from the factory.
   b. Right hand mount.

10. Control Panel: Electronic controller with microprocessor self-diagnostics. Digital readout indicates door action, alarm conditions and fault conditions. Time delay self-close timer and non-resettable cycle counter are included. Enclosure is IP54 rated (NEMA 3 equivalent).

11. Door Roll: Directly driven, springless roll shall be steel tube with integral shafts, keyed on the Drive End and supported by self-aligning greaseable sealed bearings. Door shall not require any counterbalance device.

12. Hood: Protecting drive motor, barrel, chain, and sprocket from dirt and debris and extending between the support brackets. Provide with internal hood baffle weatherseal. Fabricated of:
   a. 24 gauge galvanized steel with intermediate supports as required.
   b. Provide with sloped hood and endcovers for exterior mounting.

13. Safety Devices: Provide door with following safety devices:
   a. Photoelectric sensors that cast an invisible beam across the door opening and reverses the downward motion of the door when an object enters the path of the beam.
      1) Electric sensing edge.

14. Actuators:
   a. One Open/Close/Stop push button station incorporated into Control Panel.
   b. Radio control.
   c. Interior Push buttons.
   d. Interior Key switch.
   e. Exterior Key switch.
   f. Loop detectors.
   g. Motion detectors.
   h. Warning light.
15. Windload: Design door assembly to withstand wind/suction load of 20 psf (958 Pa) in conformance with DASMA 108-2012 and as required by local codes without damage to door or assembly components.

PART 3 EXECUTION

3.1 EXAMINATION
A. Verify opening sizes, tolerances and conditions are acceptable.
B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION
A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
E. Coordinate installation of electrical service with Section 26 05 00 - Common Work Results for Electrical. Complete wiring from disconnect to unit components.
F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 90 00 - Joint Protection.
G. Install perimeter trim and closures.
H. Instruct Owner's personnel in proper operating procedures and maintenance schedule.

3.4 ADJUSTING
A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
B. Adjust hardware and operating assemblies for smooth and noiseless operation.

3.5 CLEANING
A. Clean curtain and components using non-abrasive materials and methods recommended by
manufacturer.

B. Remove labels and visible markings.

C. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 PROTECTION

A. Protect installed products until completion of project.

END OF SECTION
SECTION 08 41 13 – ALUMINUM FRAMED STOREFRONTS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Exterior storefront framing.
   B. Related Sections include the following:
      1. Division 8 Section “Glazing” for glazing for storefront and entrance door units.
      2. Division 8 Section “Glazed Aluminum Curtain Walls”
      3. Division 8 Section “Balanced Aluminum Doors”
      4. 

1.3 DEFINITIONS
   A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS
   A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
      1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
      2. Dimensional tolerances of building frame and other adjacent construction.
      3. Failure includes the following:
         a. Deflection exceeding specified limits.
         b. Thermal stresses transferring to building structure.
         c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
         d. Glazing-to-glazing contact.
         e. Noise or vibration created by wind and by thermal and structural movements.
         f. Loosening or weakening of fasteners, attachments, and other components.
g. Sealant failure.
h. Failure of operating units.

B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Structural Loads:

1. Wind Loads:
   a. Basic Wind Speed: See Drawing Sheet S1.00 Part E

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch, whichever is smaller.

E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.

3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..

G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

H. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

1. Maximum Water Leakage: According to AAMA 501.1. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.
I. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
   a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
   b. Low Exterior Ambient-Air Temperature: 0 deg F.

3. Interior Ambient-Air Temperature: 75 deg F.

J. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.

K. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.

L. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:

1. Sound Transmission Class (STC): Minimum 26 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
   2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
D. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
5. Flashing and drainage.

E. Other Action Submittals:

1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

F. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of aluminum-framed systems.
2. Include design calculations.

G. Qualification Data: For qualified Installer and testing agency.

H. Welding certificates.

I. Preconstruction Test Reports: For sealant.

J. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

K. Source quality-control reports.


M. Field quality-control reports.

N. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

O. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

D. Quality-Control Program for Structural-Sealant-Glazed System: Develop quality control program specifically for Project. Document quality-control procedures and verify results for aluminum-framed systems. Comply with ASTM C 1401 recommendations including, but not limited to, system material-qualification procedures, preconstruction sealant-testing program, procedures for system fabrication and installation, and intervals of reviews and checks.

E. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

   1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

F. Preconstruction Sealant Testing: For structural-sealant-glazed systems, perform sealant manufacturer's standard tests for compatibility with and adhesion of each material that will come in contact with sealants and each condition required by aluminum-framed systems.

   1. Test a minimum five samples each of metal, glazing, and other material.
   2. Prepare samples using techniques and primers required for installed systems.
   3. For materials that fail tests, determine corrective measures necessary to prepare each material to ensure compatibility with and adhesion of sealants including, but not limited to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.

G. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

H. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.


J. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

   1. Build mockup of typical wall area as shown on Drawings.
   2. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

K. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS
A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY
A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration caused by thermal movements.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   d. Adhesive or cohesive sealant failures.
   e. Water leakage through fixed glazing and framing areas.
   f. Failure of operating components.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: Five years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE
A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Series 6000 Thermal MultiPlane 2 x 6 Front Set as manufactured by Oldcastle or comparable product by one of the following:

1. Arcadia, Inc.
2. Arch Aluminum & Glass Co., Inc.
3. CMI Architectural
5. EFCO Corporation.
6. F-M Enterprises, Inc.
7. Leed Himmel Industries, Inc.
9. TRACO.
10. Tubelite.
11. United States Aluminum.
12. Vistawall.
13. YKK AP America Inc.
14. Kawneer

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
2. Glazing System: Retained mechanically with gaskets on four sides.
4. Size: 2” x 6” as shown on drawings.
5. Exterior glazed system.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.
   3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system, fabricated from stainless steel.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
   1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 08 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.5 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."
   1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

A. Dark Bronze Anodized Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.8 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to evaluate structural-sealant-glazed systems.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 08 Section "Glazing."

G. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:
   a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
   b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.
3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft., of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..

2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform and cyclic static-air-pressure difference of 0.67 times the static-air-pressure difference specified for laboratory testing under "Performance Requirements" Article, but not less than 4.18 lbf/sq. ft., and shall not evidence water penetration.

3. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 75 feet by 1 story of aluminum-framed systems designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 08 41 13
EXTRUDED ALUMINUM BALANCED DOOR ENTRANCES

PART 1 – GENERAL

1.01 DESCRIPTION
A. Work included: All entrance and vestibule doors and frames shall be integral “Balanced Door” units consisting of doors, jambs, frames (sidelight and transoms where applicable), thresholds, operating mechanism and all finish hardware as shown on the drawings and specified herein.

1.02 RELATED WORK
A. Section [07 92 00], joint sealants; at interface of entrance assemblies and other building components.
B. Section [08 44 13], curtain wall and glazed assemblies; for surrounding framing.
C. Section [08 71 00], door hardware; other than hardware specified as part of entrance assemblies, cylinders; coordination with security system.
D. Section [08 80 00], glass glazing; glass types, quality and requirements.
E. Section [23 00 00], mechanical and section [26 00 00] electrical; coordination with security, fire alarm systems.

1.03 QUALITY ASSURANCE
A. The manufacturer must have been regularly engaged in the manufacture of “Balanced Doors” for a period of no less than ten (10) years.
B. All door, frame and balanced hardware must be engineered and fabricated by the same manufacturer.
C. In order to ensure proper coordination between all elements of the balanced entrance system, the balanced hardware including the hydraulic check must be engineered, cast, machined and assembled in the same facility with the engineering and fabrication of the door and frame material.
D. The manufacturer must have a quality system registered to the ISO9001 standard including design engineering.

1.04 SUBMITTALS
A. Shop drawings including elevations and plans, one-half size detail sections of typical composite members, hardware arrangement details and interaction with surrounding material.
B. Two (2) finish samples shall be submitted:
   1. #313 Dark bronze anodized (light and dark limit).

1.05 WARRANTY
A. All finished hardware and material not fabricated by Ellison to carry manufacturer’s standard warranty.
B. All Ellison manufactured material furnished and installed to these specifications, including the door operating mechanisms, shall be warranted against defective material and workmanship for a period of ten (10) years from date of substantial completion.
   1. This warranty is not intended to cover adjustments made necessary by the shifting or settling of the building structure.
2. This warranty is not intended to cover the breakdown of protective coatings when furnished to the architect’s specification and applied as directed.
3. All labor to replace warranted parts is by others.

1.06 DELIVERY, STORAGE AND HANDLING
A. Materials shall be packed, unloaded, stored and protected to avoid abuse and damage.
B. Protect finished surfaces with wrapping and/or strippable coating.
C. When unloading, remove all paper type wrappings that are wet or which could become wet.
D. Store inside, if possible, in clean well drained area free of dust and corrosive fumes.
E. Stack vertically or on edge so that water cannot accumulate on or within materials, using wood or plastic shims between components to provide water drainage and air circulation.
F. Cover materials with tarpaulins or plastic hung on frames to provide air circulation.
G. When installing protect materials from lime, mortar, run-off from concrete and copper, weld splatter, acids, roofing tar, solvents and abrasive cleaners.

PART II – PRODUCTS

2.01 MANUFACTURERS
A. Acceptable Manufacturer, or equal: Ellison Bronze, Inc; 125 W. Main Street, Falconer, NY 14733. Phone: (800) 665-6445 Fax: (716) 665-5552 Web site: www.ellisonbronze.com. Email: info@ellisonbronze.com
B. Requests for substitutions will be considered in accordance with provisions of section [01 60 00].

2.02 MATERIALS AND FINISHES
A. Material:
   1. Extruded aluminum: alloy 6063-T6 with a minimum wall thickness of .125 inch (3 mm) thick.
   2. Aluminum sheet: alloy 5005-H15 or H34 temper with .125 inch (3 mm) minimum thickness.
B. Finish:
   1. #313 Dark bronze anodized.

2.03 BALANCED DOORS AND FRAMES
A. Doors:
   1. Door thickness: 2 inch (51 mm).
   2. Stiles:
      a. 3-1/2 inch (89 mm).
   3. Top rail:
      a. 3-1/2 inch (89 mm).
   4. Bottom rail:
      a. 10 inch (254 mm).
   5. Extruded aluminum doors shall be bolted and welded construction for maximum strength.
   6. Glass moldings shall be permanently fixed on exterior side and snap-on type on interior side with vinyl glazing bead.
   7. Glass: as specified in section [08 81 00].
B. Frames:
1. Frames for door jambs and header (sidelights and transom material where applicable) shall be:
   a. Minimum dimension of the door head frame:
      1. 6 inch high x 6 inch deep (required for Stanley Magic Force operator)
   b. Minimum dimension of the vertical jamb framing (sidelight or transom material where applicable) 3 inch face x 6 inch deep.
2. Frames shall be erected without the use of exposed screws where feasible.
3. Hinge shaft configuration:
   a. Exposed with hinge shaft clad in extruded aluminum (in matching finish to doors and /or frame).
4. Glass stops (at sidelight and transom areas, where applicable) to be applied to framing and shall be permanently fixed on exterior side and snap-on type on interior side with vinyl glazing bead.
5. Glass: as specified in section [08 80 00].

2.04 HARDWARE AND WEATHERSTRIPPING
A. Balanced hardware:
1. All balanced door hardware, including hydraulic check, shall be cast bronze and shall be cast, machined and assembled by the door and frame fabricator. Exposed hardware shall be finished as specified below.
2. Cast bronze mechanism and other integral parts must be heavy duty and must be designed to allow variation in adjustments to meet this particular job with respect to door size, door weight and varying or internal building pressures.
3. Balanced hardware shall consist of the following items:
   a. Cast bronze hydraulic check shall be concealed in the head frame and have first and second speed adjustment. The hydraulic check unit must be removable without requiring the removal of the door, head frame or any other hardware. Closer arms are unacceptable.
   b. Each door to have a heavy duty steel tube hinge shaft 1-3/4 inch (44 mm) diameter with 1/4 inch (6 mm) minimum wall thickness. Hinge shaft to be furnished complete with spring closing mechanism. The spring closer shall be adjustable at the floor to meet varying wind or building conditions. Top and bottom arms shall be one piece bronze castings, welded to hinge shaft. Two piece arms, aluminum arms, or steel painted arms will not be acceptable.
   c. Hardware shall include a spring-cushioned door roller bumper located in the guide channel. The operating mechanism in the head shall include ball bearing pivots, cast bronze hydraulic check and cast bronze door guide channel with minimum dimensions of 2-3/8 inch (60 mm) by 3/4 inch (19 mm) thick and a minimum wall thickness of 9/16 inch (14 mm).
   d. Means shall be provided which make possible field adjustment for proper perimeter clearance of each door leaf in relation to its finished framework to accommodate on-site conditions.
   e. All doors shall have a semi-automatic hold open device located in the bottom rail.
   f. Doors designated as handicapped entrances shall have a maximum of 8 lbs. spring tension adjustment at pull handle. The clear opening shall be a minimum of 32 inches (813 mm) or greater (depending on local codes). The Ellison hydraulic check shall be adjusted so that from an open position...
of 90 degrees, the time required to move the door to a position of 12 degrees from the latch is 5 seconds minimum.

g. Bronze hardware finish:
   (1) Cast bronze painted arms to match door and frame material.
   (2)

B. Finish hardware by door manufacturer (except permanent master keyed lock cylinders):
   1. Standard locking hardware:
      a. Adams-Rite deadlock and flushbolts (for pair of doors).
      b. Adams Rite deadlatch with lever handle or push paddle and flushbolts (for pair of doors).
   2. Standard push-pull hardware to be 1 inch (25 mm) diameter offset profile with 12 inch (305 mm) centers, [stainless steel] [bronze] [aluminum] in finish as selected from manufacturer’s standards.
   3. Panic hardware to be furnished by the door supplier. To be equal to Von Duprin touch pad type panic exit device in finish as selected from manufacturers standards:
      a. Concealed vertical rod type (for pair of doors).
      b. Rim type (for single door).
      c. Stainless Steel finish
   4. Temporary cylinders with keys to be provided for mechanical locking hardware.
   5. Permanent master keyed cylinders to be provided by others as specified in separate section.

C. Power Operation:
   1. The power operator, complete with actuators and safety devices shall be provided by the door manufacturer as part of the door unit package. The operator shall be completely concealed within the door header with no surface attached drive arm. The operator will push the door open (only) by means of an arm/roller assembly concealed when door is in the closed position. The operator arm/roller assembly will not be directly attached to the door top rail. All standard balanced hardware components shall remain (and be operable) to close the door.
      a. Power operator – one pair of entry doors only. Header to match at manual door:
         1. Stanley Magic Force (6 inch (152 mm) high minimum door header) extra heavy duty (low energy) concealed overhead electromechanical power operator with control box, conforming to ANSI/BHMA A156.19. Motor permanent magnet, DC 3/16 HP (minimum), 1.25 AMP, 120V, UL listed. Adjustable slow opening speed and adjustable time delay.
         b. Push Plate Actuator Switch: stainless steel 6 inch (152 mm) round wall mounted push plate actuator switch engraved with either handicap insignia and/or “press to open”.
            1. Optional wireless, battery operated transmitter that eliminates routing control wires.
         c. On-Off Key Switch: on-off, maintained contact, key switch removes power to push button switches and/or operator(s). Key removable in both positions. A momentary contact switch is available.
1. Optional wireless, battery operated transmitter that eliminates routing control wires.

d. Safety Sensor: safety sensor to be mounted on the swing side of the door header. It scans the safety zone (swing door area) and prevents the door from opening when the presence of a person in its safety zone (door swing area) is detected.

e. Electrical: Requirements for work specified in other sections. The general or electrical contractor shall furnish and install 120 VAC, 60 cycle, 1 phase, 15 AMP service to the operator. Two low voltage wires shall be furnished to connect each of the push plate actuator switches and key switches to the operator.

D. Thresholds:
1. Provide at all doors unless otherwise detailed.
2. Provide woodscrew and rawl plug type fastenings approximately 15 inches (381 mm) on center.
3. Thresholds shall be set on the finished floor and adequately caulked against water seepage.
4. Profile:
   a. Thresholds shall be 1/2 inch (13 mm) high x 6 inch (152 mm) wide saddle type.
   b. Thresholds shall be width and configuration as indicated on drawings.
5. Material:
   a. Extruded aluminum.

E. Weatherstrip:
1. Shall be manufacturer’s standard polypropylene pile.
2. Shall occur:
   a. Vertically at meeting stiles on pairs of doors.
   b. Concealed at door top and bottom rails.
   c. At door stops at both hinge and strike jambs.
   d. At both sides of exposed hinge shaft if used.

2.05 SHOP INSPECTION
A. Prior to leaving factory, all balanced doors and immediate framing shall be assembled and “hung”. At this time, adjustment shall be made to provide proper perimeter clearance between door and frame and all coordination between door, frame and finish hardware shall be tested.

PART III – EXECUTION

3.01 EXAMINATION
A. The installer/erector shall examine substrates, supports and conditions under which this work is to be performed and notify contractor, in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.
B. The floor material shall be solid (not susceptible to either deterioration or heaving), smooth and level and the adjacent work in its proper place prior to the installation of the door and frame system.
C. Coordination dimensions, tolerances and method of attachment with other work.
D. Verify electric power is available and of correct characteristics, if required.
3.02 INSTALLATION/ERECTION
A. The installer/erector to install all materials by factory-trained personnel in strict accordance with installation data provided by manufacturer and these specifications.
B. Provide attachments and shims required to fasten system to building structure.
C. Install entrances plumb, level, square in alignment and true plane.
D. Install glass in accordance with manufacturer’s instructions.
E. Install perimeter type sealant, backing materials to installation requirements.

3.03 ADJUSTING AND CLEANING
A. The installer/erector to fit, align and adjust door assembly.
B. Adjust door installation and hardware so that doors open and close smoothly.
C. Adjust speed to comply with applicable codes.
D. Remove protective materials from finished metal surfaces.
E. Clean exposed surfaces using materials and methods recommended by manufacturer, exercising care to avoid damage to coatings.
F. Touch-up damaged coatings and finishes.

3.04 OPERATOR ADJUSTMENT
A. Ellison includes having the operator manufacturer’s local technician field hook-up and test the power operator(s) and related devices. Note: Local manufacturer’s technician must perform the field hook-up and testing, if not, the operator warranty will be void.
B. The electrical coordination of locking features between the operator(s) and all other electronic devices (if specified) is not by Ellison or the operator manufacturer’s local technician.

3.05 PROTECTION
A. The contractor to institute protective measures required throughout the remainder of the construction period to ensure that the balanced door units will be without damage or deterioration, other than normal weathering, at the time of substantial completion.
SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Glazed aluminum curtain wall systems:
      a. Conventionally glazed.
      b. Two-sided, structural-sealant-glazed.

B. Related Requirements:
   1. Section 014339 "Mockups" for preconstruction laboratory mockup testing.
   2. Section 019119.43 "Exterior Enclosure Commissioning."
   3. Section 079200 "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
   4. Section 088000 "Glazing" for curtain wall glazing.

1.3 ALLOWANCES

A. [Preconstruction laboratory mockup] [Source quality-control] [and] [field quality-control] testing is part of testing and inspecting allowance.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.

2. Include full-size isometric details of each type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
   a. Joinery, including concealed welds.
   b. Anchorage.
   c. Expansion provisions.
   d. Glazing.
   e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:
   1. Joinery, including concealed welds.
   2. Anchorage.
   5. Flashing and drainage.

F. Delegated-Design Submittal: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Mockup Testing Submittals:
   1. Testing Program: Developed specifically for Project.
   2. Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.
   3. Record Drawings: As-built drawings of preconstruction laboratory mockups showing changes made during preconstruction laboratory mockup testing.

B. Qualification Data:
   1. For Installer and field testing agency.
   2. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

C. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.
1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

D. Product Test Reports: For glazed aluminum curtain walls, for tests performed by manufacturer and witnessed by a qualified testing agency.

E. Quality-Control Program: Developed specifically for Project, including fabrication and installation, in accordance with recommendations in ASTM C1401. Include periodic quality-control reports.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C1401 recommendations for post-installation-phase quality-control program.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors.

B. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

D. Structural-Sealant Glazing: Comply with ASTM C1401 for design and installation of structural-sealant-glazed curtain wall assemblies.
1.9 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Testing shall be performed on mockups in accordance with requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on laboratory mockups.

1. Build preconstruction laboratory mockups at testing agency facility; use personnel, products, and methods of construction that will be used at Project site.
2. Size and Configuration: As indicated on Drawings.
3. Notify Architect seven days in advance of the dates and times when preconstruction laboratory mockups will be constructed and tested.

B. Preconstruction Laboratory Mockup Testing: Test preconstruction laboratory mockups according to requirements in "Performance Requirements" Article. Perform the following tests in the following order:

1. Structural, 50 percent: ASTM E330/E330M at 50 percent of positive test load.
3. Water Penetration under Static Pressure: ASTM E331.
5. Structural, 100 percent: ASTM E330/E330M at 100 percent of positive and negative test loads. Repeat the following:
   b. Water Penetration under Static Pressure: ASTM E331.
6. Interstory Drift: AAMA 501.4 at 100 percent of design displacement. Repeat the following:
   b. Water Penetration under Static Pressure: ASTM E331.
7. Vertical Interstory Movement: AAMA 501.7. Repeat the following:
   b. Water Penetration under Static Pressure: ASTM E331.
8. Thermal Cycling: In accordance with AAMA 501.5. Repeat the following:
   b. Water Penetration under Static Pressure: ASTM E331.

9. Structural, 100 and 150 percent: ASTM E330/E330M at 100 and 150 percent of positive and negative test loads. Repeat the following:
   b. Water Penetration under Static Pressure: ASTM E331.

C. Preconstruction Adhesion and Compatibility Testing: Submit to structural glazing sealant manufacturer, for testing indicated below, Samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that is in close proximity to or is touching the structural or nonstructural sealants of a structural glazed system.

1. Compatibility: Test materials or components using ASTM C1087.
2. Adhesion: Test for adhesion or lack of adhesion of a structural sealant to the surface of another material or component using ASTM C1135.
3. Submit no fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
6. Testing will not be required if data based on previous testing of current sealant products match those submitted.

1.11 WARRANTY

A. Special Assembly Warranty: Installer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration created by wind and thermal and structural movements.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   d. Water penetration through fixed glazing and framing areas.
   e. Failure of operating components.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:
a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

   a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
   b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
   c. Cracking, peeling, or chipping.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.

2. Failure also includes the following:

   a. Thermal stresses transferring to building structure.
   b. Glass breakage.
   c. Noise or vibration created by wind and thermal and structural movements.
   d. Loosening or weakening of fasteners, attachments, and other components.
   e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans of greater than 13 feet 6 inches.

2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
   a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

3. Cantilever Deflection: Limited to 2l/175 at unsupported cantilevers.

E. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.

3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.

G. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.

2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters or water that is drained to exterior.

H. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Design Displacement: As indicated on Drawings

2. Test Performance: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.4 at design displacement and 1.5 times the design displacement.

3. Vertical Interstory Movement: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.7 at design displacement and 1.5 times the design displacement.

I. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:
1. Thermal Transmittance (U-factor):
   a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.50 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.

2. Solar Heat Gain Coefficient (SHGC):
   a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.25 as determined in accordance with NFRC 200.

3. Air Leakage:
   a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.

4. Condensation Resistance Factor (CRF):
   a. Fixed Glazing and Framing Areas: CRF for the system of not less than 80 as determined in accordance with AAMA 1503.

J. Noise Reduction: Test in accordance with ASTM E90, with ratings determined by ASTM E1332, as follows:
   2. Sound Transmission Class: Minimum 31

K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
   2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.

   a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
   b. Low Exterior Ambient-Air Temperature: 0 deg F.

2.2 SOURCE LIMITATIONS

A. Obtain all components of curtain-wall system and storefront system, including framing and accessories, from single manufacturer.

2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Manufacturers: Basis of Design: Oldcastle Reliance, Outside Glazed 2 ½” x 7 ¼”

B. Subject to compliance with requirements, provide products by one of the following:
1. Kawneer North America, an Arconic company.
2. Oldcastle BuildingEnvelope (OBE); CRH Americas.
3. Tubelite Inc.

C. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken
2. Glazing System: Retained mechanically with gaskets on four sides
3. Glazing Plane: Front
4. Finish: Dark Bronze Anodized
5. System: Either stick or unitized system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

D. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

F. Insulated Spandrel Panels:

G. Entrance Door Systems: Comply with Section 084236 "Extruded Aluminum Balanced Doors".

2.4 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: ASTM C509 or ASTM C864. Manufacturer's standard

1. Color: Dark Bronze

C. Glazing Sealants: As recommended by manufacturer.

D. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes into contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.


2.5 MATERIALS

A. Sheet and Plate: ASTM B209.
B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:
   1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
   2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
   3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.6 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.
   3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
   1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.

D. Fabricate components to resist water penetration as follows:
   1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.

F. Factory-Assembled Frame Units:
   1. Rigidly secure nonmovement joints.
   2. Prepare surfaces that are in contact with structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
   3. Seal joints watertight unless otherwise indicated.
   4. Install glazing to comply with requirements in Section 088000 "Glazing."
      a. Retain bracing or stiffening until erected to prevent racking of units during transportation and erection.

G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.8 ALUMINUM FINISHES
   1. Color: Dark Bronze Anodized

2.9 SOURCE QUALITY CONTROL
   A. Structural Sealant: Perform quality-control procedures complying with ASTM C1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

G. Seal joints watertight unless otherwise indicated.

H. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.

2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.4 ERECTION TOLERANCES

A. Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.

2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.

3. Alignment:

   a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.

c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on mockups.

C. Field Quality-Control Testing: Perform the following test on mockups

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.

   a. Perform a minimum of two tests in areas as directed by Architect.

2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

   a. Perform a minimum of two tests in areas as directed by Architect.

3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.

D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 084413
SECTION 08 51 13 – ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes fixed aluminum-framed windows for exterior locations.

B. Related Sections include the following:

1. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.

2. Division 08 Section “Glazed Aluminum Curtain Walls” for coordinating finish among aluminum fenestration units.

3. Division 08 Section "Glazing" for incorporating glazing aluminum window units.

1.3 DEFINITIONS

A. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:

1. AW: Architectural.
2. HC: Heavy Commercial.
3. C: Commercial.
4. LC: Light Commercial.
5. R: Residential.

B. Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:

1. Design pressure number in pounds force per square foot used to determine the structural test pressure and water test pressure.

C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.

D. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.
1.4 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size indicated below:


B. Structural Performance: Provide aluminum windows capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/1.S.2/NAFS, Uniform Load Structural Test:

1. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
   a. Basic Wind Speed: See Drawing Sheet S1.00 Part E

2. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on testing performed according to AAMA/WDMA 101/1.S.2/NAFS, Uniform Load Deflection Test or structural computations.

C. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.

1. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:

1. Mullion details, including reinforcement and stiffeners.
2. Joinery details.
4. Flashing and drainage details.
5. Weather-stripping details.
7. Glazing details.
8. Window cleaning provisions.
9. For installed products indicated to comply with design loads, include structural analysis data prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of aluminum windows and used to determine the following:
   a. Structural test pressures and design pressures from wind loads indicated.
   b. Deflection limitations of glass framing systems.

C. Samples for Verification: For aluminum windows and components required, prepared on Samples of size indicated below.
   1. Main Framing Member: 12-inch-long, full-size sections of extrusions with factory-applied color finish.
   2. Window Corner Fabrication: 12-by-12-inch-long, full-size window corner including full-size sections of extrusions with factory-applied color finish, weather stripping, and glazing.

D. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

E. Qualification Data: For manufacturer.

F. Field quality-control test reports.

G. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency for each type, class, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.

H. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
   1. Installer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
   2. Engineering Responsibility: Preparation of data for aluminum windows, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

D. Product Options: Information on Drawings and in Specifications establishes requirements for aluminum windows' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies.
as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

E. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum windows and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements." Do not modify size and dimensional requirements.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.


1. Provide AAMA-certified aluminum windows with an attached label.

G. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

H. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup for type(s) of window(s) indicated, in location(s) shown on Drawings.

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

J. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to aluminum windows including, but not limited to, the following:

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for structural anchorage, glazing, flashing, weeping, sealants, and protection of finishes.
4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Failure to meet performance requirements.
   b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
   c. Faulty operation of movable sash and hardware.
   d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
   e. Failure of insulating glass.

2. Warranty Period:
   a. Window: Five years from date of Substantial Completion.
   b. Metal Finish: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide series 601UT as manufactured by Kawneer North America or comparable product by one of the following:

1. All Seasons Windows & Doors; All Seasons Commercial Division, Inc.
2. Boyd Aluminum Manufacturing.
3. Custom Window Company.
4. DeSCo Windows.
5. EFCO Corporation.
6. EXTECH Exterior Technologies, Inc.
7. Fleetwood Aluminum Products, Inc.
8. F-M Enterprises, Inc.
11. Mannix; a division of Interstate Window Corp.
12. Peerless Products Inc.
14. TRACO.
15. Wausau Window and Wall Systems.
17. Window Technologies, Inc.; Century Manufacturing, Inc.
18. Vistawall.
19. YKK AP America Inc.
20. Oldcastle

2.2 MATERIALS

A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength, not less than 16,000-psi minimum yield strength, and not less than 0.062-inch thickness at any location for the main frame and sash members.

B. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

2. Glazing System: Retained mechanically with gaskets on four sides.
4. Size: 2-3/4” x 5”.
5. Exterior glazed system.

C. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.

1. Reinforcement: Where fasteners screw anchor into aluminum less than 0.125 inch thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, splined grommet nuts.
2. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

D. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

E. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

F. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.3 WINDOW

A. Window Type: Fixed.
B. AAMA/WDMA Performance Requirements: Provide aluminum windows of performance indicated that comply with AAMA/WDMA 101/I.S.2/NAFS unless more stringent performance requirements are indicated.
   1. Performance Class: AW.

C. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.

D. Thermal Transmittance: Provide aluminum windows with a whole-window, U-factor maximum indicated at 15-mph exterior wind velocity and winter condition temperatures when tested according to AAMA 1503.
   1. U-Factor: 0.40 Btu/sq. ft. x h x deg F or less.

E. Solar Heat-Gain Coefficient (SHGC): Provide aluminum windows with a whole-window SHGC maximum of 0.40, determined according to NFRC 200 procedures.

F. Sound Transmission Class (STC): Provide glazed windows rated for not less than 26 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

G. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA 101/I.S.2/NAFS, Air Infiltration Test.
   1. Maximum Rate: 0.3 cfm/sq. ft. of area at an inward test pressure of 1.57 lbf/sq. ft.

H. Water Resistance: No water leakage as defined in AAMA/WDMA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA 101/I.S.2/NAFS, Water Resistance Test.
   1. Test Pressure: 15 percent of positive design pressure, but not less than 2.86 lbf/sq. ft. or more than 15 lbf/sq. ft.

I. Forced-Entry Resistance: Comply with Performance Grade 10 requirements when tested according to ASTM F 588.

J. Life-Cycle Testing: Test according to AAMA 910 and comply with AAMA/WDMA 101/I.S.2/NAFS.

2.4 GLAZING

A. Glass and Glazing Materials: Refer to Division 08 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.

2.5 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.
C. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.

1. Provide thermal-break construction that has been in use for not less than three years and has been tested to demonstrate resistance to thermal conductance and condensation and to show adequate strength and security of glass retention.

2. Provide thermal barriers tested according to AAMA 505; determine the allowable design shear flow per the appendix in AAMA 505.

3. Provide hardware with low conductivity or nonmetallic material for hardware bridging thermal breaks at frame or vent sash.

D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

E. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.

F. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inch- thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units. Provide subframes capable of withstanding design loads of window units.

G. Glazing Stops: Provide snap-on glazing stops coordinated with Division 08 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. ALUMINUM FINISHES

1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.

1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
2. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

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

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502, Test Method [A] [B], by applying same test pressures required to determine compliance with AAMA/WDMA 101/1.S.2/NAFS in Part I "Performance Requirements" Article.
2. Testing Extent: Three windows as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested immediately after installation.
3. Test Reports: Shall be prepared according to AAMA 502.

C. Remove and replace noncomplying aluminum window and retest as specified above.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

C. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 08 51 13
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Fixed, transaction security windows

1.3 PERFORMANCE REQUIREMENTS

A. Ballistics-Resistance Performance: Provide units identical to those tested for compliance with requirements indicated, and as follows:
   1. Listed and labeled as bullet resisting according to UL 752.
   2. Tested for ballistics resistance according to UL 752 by a testing agency acceptable to authorities having jurisdiction.
   3. Certified as complying with SD-STD-01.01, by the U.S. State Department, for ballistics resistance when tested by a qualified testing agency.

B. Forced-Entry-Resistance Performance: Provide units identical to those tested for compliance with requirements indicated, and as follows:
   1. Tested for forced-entry resistance according to HPW-TP-0500.03 by a testing agency acceptable to authorities having jurisdiction.
   2. Certified as complying with SD-STD-01.01, by the U.S. State Department, for forced-entry resistance when tested by a qualified testing agency.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for window units.

B. Shop Drawings: For security windows. Include plans, elevations, sections, details, and attachments to other work.
   1. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
   2. Location of weep holes.
   3. Hardware for sliding window units.
5. Details of deal tray, transaction counter and speaking aperture.

C. Samples for Initial Selection: For frame members with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Framing: 12-inch- long sections of frame members.
2. Transaction Drawer: 6 inches square.

E. Cutaway Sample: Corner of security window, made from 12-inch lengths of full-size components, and showing details of the following:

1. Joinery.
2. Anchorage.
4. Flashing and drainage.

F. Qualification Data: For qualified Installer and testing agency.

G. Welding certificates.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of security window and accessory indicated as ballistics or forced-entry resistant.

I. Configuration Disclosure Drawing: For each type of forced-entry-resistant security window, complying with ASTM F 1233.

J. Warranty: Sample of special warranty.

K. Other Informational Submittals:

1. Examination reports documenting inspections of substrates, areas, and conditions.
2. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 and experienced in ballistics and forced-entry-resistance testing.

C. Source Limitations: Obtain security windows from single source from single manufacturer.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
4. AWS D1.6, "Structural Welding Code - Stainless Steel."

E. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Pack security windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.

B. Label security window packaging with location in Project.

C. Store crated security windows on raised blocks to prevent moisture damage.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate installation of anchorages for security windows. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.9 SEQUENCING

A. Field Painting: Except where security windows have been preglazed before installation, complete field painting of security windows before glazing installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace security windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including deflections exceeding 1/4 inch.
   b. Failure of welds.
   c. Faulty operation of transaction drawers.
   d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221. Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength and not less than 0.125 inch thick at any location for main frame and sash members.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B.

E. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 240/A 240M or ASTM A 666, austenitic stainless steel, Type 304, stretcher-leveled standard of flatness.

F. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.

G. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

H. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

I. Sealants: For sealants required within fabricated security windows, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, nonshrinking, and nonmigrating.

2.2 WINDOW COMPONENTS

A. Glazing: Comply with requirements in Division 08 Section "Security Glazing" for performance indicated.

1. Comply with requirements of UL listing for ballistics-resistance level.

B. Compression-Type Glazing Strips and Weather Stripping: Unless otherwise indicated, provide compressible stripping for glazing and weather stripping, such as molded EPDM or neoprene gaskets complying with ASTM D 2000, Designations 2BC415 to 3BC620; molded PVC gaskets complying with ASTM D 2287; or molded, expanded EPDM or neoprene gaskets complying with ASTM C 509, Grade 4.

C. 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: Type recommended 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 required by glass manufacturer to maintain glass lites in place for installation indicated.

4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

D. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B 633; provide sufficient strength to withstand design pressure indicated.

2.3 FIXED, TRANSACTION SECURITY WINDOWS

A. Fixed, Transaction Security Windows: Provide fixed, framed transaction windows with operable sash or ventilator capable of allowing transfer of currency and documents.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model BWPB as manufactured by Overly Manufacturing Company or comparable product by one of the following:

   b. Collier Safe Company, Inc.
   c. Creative Industries, Inc.
   d. Diebold, Incorporated.
   e. General Electric Company; GE Polymershapes Insulgard.
   g. Laurence, C. R. Co. Inc.
   h. National Bullet Proof, Inc.
   i. Norshield Products Group.
   j. Safeguard Security Services, Ltd.
   k. Quikserv Corp.

B. Configuration: As indicated on Drawings.

C. Ballistics Resistance: Level 3 when tested according to UL 752.

D. Forced-Entry Resistance: Level III when tested according to HPW-TP-0500.03.

E. Framing: Fabricate perimeter framing, mullions, and glazing stops from metal sheet as follows:

   1. Material: Cold-rolled steel sheet, factory primed for field-painted finish.
   2. Profile: Manufacturer's standard, with minimum face dimension indicated.
   4. Framing Depth:
a. Adjustable for varying wall thicknesses by use of a two-piece, split frame that is attached to wall by clamping action induced by tightening screws.

F. Voice-Communication-Type Sill: Formed from stainless steel and designed to allow passage of speech at normal speaking volume without distortion.
   1. Transaction Counter: Stainless steel, 12 inches deep by width of security window, with integral deal tray centered in opening.

2.4 ACCESSORIES

A. Speaking Apertures: Fabricate from stainless steel, designed to allow passage of speech at normal speaking volume without distortion.
   1. Shape: Circular.
   2. Ballistics Resistance: Same as security window.
   3. Listed and labeled as bullet resisting according to UL 752.

2.5 FABRICATION

A. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.
   1. Provide units that are reglazable from the secure side without dismantling the nonsecure side of framing.
   2. Prepare security windows for glazing unless preglazing at the factory is indicated.

B. Provide weep holes and internal water passages for exterior security windows to conduct infiltrating water to the exterior.

C. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.
   1. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for security windows to comply with ballistics-resistance performance indicated.

D. Glazing Stops: Finish glazing stops to match security window framing.

E. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

F. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

G. Factory-cut openings in glazing for speaking apertures.
H. Preglazed Fabrication: Preglaze window units at factory, where required for applications indicated. Comply with requirements in Division 08 Section "Security Glazing."

I. Weather Stripping: Factory applied.

2.6 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
   1. Run grain of directional finishes with long dimension of each piece.
   2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
   3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of security windows.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of security window connections before security window installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of security windows.

D. Inspect built-in and cast-in anchor installations, before installing security windows, to verify that anchor installations comply with requirements. Prepare inspection reports.
   1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
   2. Perform additional inspections to determine compliance of replaced or additional work. Prepare anchor inspection reports.

E. For glazing materials whose orientation is critical for performance, verify installation orientation.

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

3.2 PREPARATION

A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other security window anchors whose installation is specified in other Sections.
1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.

3.3 INSTALLATION

A. Voice-Communication-Type Framing: Attach removable glass spacers to jambs and head of glazing, located not more than 6 inches from each corner and spaced not more than 12 inches o.c.

B. Glazed Framing: Provide sealant-glazed framing. Comply with installation requirements in Division 08 Section "Security Glazing."

C. Removable Glazing Stops and Trim: Fasten components with security fasteners.

D. Fasteners: Install security windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials.

E. Sealants: Comply with requirements in Division 07 Section "Joint Sealants" for installing sealants, fillers, and gaskets.
   1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
   2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.

F. Metal Protection: 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. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.4 ADJUSTING

A. Adjust horizontal-sliding, transaction security windows to provide a tight fit at contact points for smooth operation and a secure enclosure.

B. Adjust transaction drawers to provide a tight fit at contact points for smooth operation and secure enclosure.

C. Remove and replace defective work, including security windows that are warped, bowed, or otherwise unacceptable.

3.5 CLEANING AND PROTECTION

A. Clean surfaces promptly after installation of security windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.
   1. Lubricate sliding security window hardware.
   2. Lubricate transaction drawer hardware.
B. Provide temporary protection to ensure that security windows are without damage at time of Substantial Completion.

END OF SECTION 08 56 53
SECTION 08710 – FINISH HARDWARE

PART 1 – GENERAL:

1.01 SUMMARY:

A. Section includes the supply and installation of the Finish Hardware.
   1. Include the termination of all Electrified Hardware.
   2. Include field verification of any existing doors, frames or hardware.

B. Related Sections
   1. Division 1
   2. Sealants – Division 7 / Division 7
   3. Openings – Division 8 / Division 8
   4. Finishes – Division 9 / Division 9
   5. Fire Alarm – Division 13 / Division 28
   6. Electrical – Division 16 / Division 26
   7. Security – Division 16 / Division 28

1.02 REFERENCES:

A. Documents and Institutes that shall be used in estimating, detailing and installing the items specified.
   1. International Building Code – Current/Adopted Edition
   2. ICC/ANSI A117.1 – Accessible and Usable Building and Facilities - Current/Adopted Edition
   3. NFPA 70 – Current/Adopted Edition
   7. ANSI - American National Standards Institute
   8. BHMA – Builders Hardware Manufacturers Association
   9. UL – Underwriters Laboratory
   10. DHI – Door and Hardware Institute
   11. Texas Accessibility Standards – Current Adopted Edition
   12. Local Building Codes

1.03 SUBMITTALS

A. Comply with pertinent provisions of Division 01.

B. Finish Hardware Schedule to be in vertical format to include:
   1. Heading #/Hardware Set
   2. Door #, Location, Hand, Degree of Opening, Door Size and Type, Frame Size and Type, Fire Rating
   3. Quantity, type, style, function, product, product number, size, fasteners, finish and manufacturer of each hardware item.
   4. Location of hardware set cross-referenced to indications on Drawings both on floor plans and in door and frame schedule.
   5. Keying schedule
   6. Title Sheet, Index, Abbreviations, Manufacturers List, Template List and Templates.
   7. Mounting locations for hardware.
   8. Explanation of abbreviations, symbols, and codes contained in schedule.
9. Date of the Finish Hardware Specification and Drawing / Door Schedule used in completing the Finish Hardware Schedule.
10. In Name, Company and Date of Field Verification if required.
11. Door Index; include door number, heading number, and hardware group.
12. Name and phone number for local manufacturer’s representative for each product.
13. Submit in conjunction with Door and Frame Submittal.
14. Operation Description of openings with electrified hardware.

C. LEED Submittals:
1. Refer to Division 1 for any LEED submittal requirements.

D. Product Data: Provide product data in the form of a binder, manufacturer’s technical product fact sheets for each item of hardware. Include whatever information may be necessary to show compliance with requirements, including instructions for installation and for maintenance of operating parts and finish.

E. Wiring Diagrams: Provide Riser/Elevation and Point to Point Wiring Diagrams for all openings with electrified hardware. Include all information that is necessary for coordination with other trades.

F. Samples: Provide samples as requested by Owner or Architect with Heading # and Door# marked on boxes. All samples will be returned to the contractor and used on doors for which they were marked.

G. Templates: Provide templates of finish hardware items to each fabricator of doors, frames and other work to be factory or shop prepared for the installation of hardware.

H. Keying Schedule: After meeting with the Owner, a keying schedule shall be submitted using keyset symbols referenced in DHI manual "Keying Systems and Nomenclature." The keying schedule shall be indexed by door number, keyset, hardware heading number, cross keying instructions and special key stamping instructions.

I. Operations and maintenance data: At the completion of the job, provide to the Owner one hard copies or one electronic copy of an Owner’s operation and maintenance manual. The manual shall consist of a labeled hardcover three ring binder with the following technical information:
1. Title page containing: Project name, address and phone numbers. Supplier’s name, address and phone numbers.
2. Table of Contents.
3. Copy of final (file and field use/as-installed) Finish Hardware Schedule.
4. Final Keying Schedule.
5. Maintenance instruction, adjustment, and preservation of finishes for each item of hardware.
6. Catalog pages for each items of hardware.
7. Installation Instructions for each item of hardware
8. Parts List for each item of hardware.
9. As installed point to point wiring diagrams for electrified hardware.
10. Warranties include Order #.

1.04 QUALITY ASSURANCES

A. Substitutions: Request for substitutions shall not be accepted within this project. Architect, Owner and Finish Hardware Consultant have selected one (1) specified and two (2) equals listed hereinafter in the Hardware Schedule. By this selection
process they have established three (3) equal products for competitive pricing, while insuring no unnecessary delays by a substitution process. If any specified product is listed as a “No Substitution” product, this product will be supplied as specified, with no alteration or request of substitution. The reason for this is to comply with the uniformity established at this project. Parts and supplies are inventoried for these particular products for ease and standardization of replacement.

B. Supplier Qualifications: Supplier shall be recognized architectural finish hardware supplier, with warehousing facilities, who have been furnishing hardware in the project vicinity for a period of not less than 2 year and who is or employs a DHI Certified AHC, DHC, DHSC or person with a minimum of 10 years of experience as a hardware supplier. This person shall be available at reasonable times during the course of the work for consultation about products hardware requirements, to the Owner, Architect and General Contractor.

C. Installer Qualifications (Mechanical Hardware): All finish hardware shall be installed by the Finish Hardware Installer with a minimum of at least two (2) years documented experience. Installer shall attend a pre-installation meeting between the General Contractor, Finish Hardware Supplier/s, hardware manufacturer’s representative for locks, closers and exit devices, and all door / frame suppliers. The Finish Hardware Installer shall be responsible for the proper installation and function of all doors and hardware.

D. Installer Qualifications (Electrified Hardware): All electrified finish hardware (power source, electrified locking or control device, switching device, through wire device and monitoring device) shall be installed by an Electronic Access Control Installer licensed by the Texas Department of Public Safety. The Electrified Finish Hardware Installer shall have a minimum of at least two (2) years of documented experience. Installer shall attend a pre-installation meeting between the General Contractor, Finish Hardware Supplier/s, Electrical Contractor, Fire Alarm Contractor, Security Contractor, hardware manufacturer’s representative for electrified hardware, all door / frame suppliers. The Electrified Finish Hardware Installer shall be responsible for the proper installation, termination and function of all opening with electrified hardware. Installation shall include termination of all electrified products (including the required wire to the power supply and/or junction box).

1.05 DELIVERY, STORAGE AND HANDLING

A. Marking and packaging: Mark each item or package separately, with identification related to hardware set number, door number and keyset symbol.

B. Delivery:
1. Deliver individually packaged and properly marked finish hardware at the proper time and location to avoid any delays in construction or installation.
2. At time of delivery, inventory hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

C. Storage: Store hardware in enclosed, dry and locked area.

1.06 WARRANTY

A. All finish hardware products shall be covered by a 1 year factory warranty from the date of substantial completion of the project.
B. Supply warranty verification to the owner for all products that provide factory warranty. Warranty should include Factory Order # and date.

1.07 MAINTENANCE:

A. Maintenance Service
   1. None

B. Extra Materials:
   1. All extra screws, fasteners, and all special installation tools furnished with the hardware shall be turned over to the owner at the completion of the job.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Screws and Fasteners:
   1. All closers and exit devices provided for exterior doors, hollow metal doors, and all other required shall be provided with thru-bolts.
   2. All finish hardware shall be installed to manufacturer’s recommendations, using screws, attachments and installation tools provided with the hardware. No other screws or attachments are acceptable.
   3. All other products to meet door and frame conditions.

B. Hinges:
   1. Template: Provide templated units only.
   2. Exterior: All exterior hinges shall be stainless steel base with stainless steel pin and stainless steel finish.
   3. Interior: All interior hinges steel based.
   4. Interior corrosive: All interior hinges at corrosive areas shall be stainless steel base with stainless still pin and stainless steel finish.
   5. All hinges on doors over 36” wide, with exit devices, or with push/pull shall be heavy weight.
   7. Provide non-removable pins for outswinging doors that are locked or are lockable.
   8. All hinges on doors with door closers shall be ball bearing.
   9. All hinges shall be full mortise.
   10. Size: Provide 4 ½ x 4 ½ hinges on doors up to 3’0” in width. Provide 5 x 4 ½ hinges over 3’0” to 4’0” in width. Reference manufacturers catalog for all other sizes.
   11. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges for door leaf for doors 90” or less in height and one additional hinge for each 30” of additional height.
   12. Adjust hinge width as required for door, frame, trim and wall conditions to allow proper degree of opening.
   13. Provide hinges conforming to ANSI/BHMA A156.1.
   14. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.
   15. Supply from the following list of manufacturers:
   - Ives  IVE
   - Hager  HAG
   - Bommer  BOM
C. Continuous Hinges
1. Continuous hinges to be manufactured of 6063-T6 aluminum.
2. Continuous hinge shall be certified to ANSI 156.26, Grade 1.
3. Continuous hinge should be tested an approved UL10C.
4. Electrified – Provide minimum 8 wire with removable panel.
5. Provide hinges 1 inch shorter in length than nominal height of door, unless otherwise noted.
6. Provide reinforcing for doors weighing over 450 pounds and up to 600 pounds.
7. Supply from the following list of manufacturers:
   - Ives IVE
   - Select SEL
   - Stanley STA

D. Cylindrical Locks
1. All locks on this project should be manufactured by the same manufacturer.
2. All locks shall meet the new ANSI/BHMA A156.2, Series 4000, Grade 1.
3. All cylindrical locks shall be UL Listed for 3 hour fire door. Review lock for any height restriction.
4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with a 1/2 inch (13 mm) latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide standard ASA strikes unless extended lip strike is necessary for frame/trim or 7/8” lip strike is necessary at pair with overlapping astragal.
6. Provide dust box.
7. Lockset shall adjust to fit door thickness from 1 ¾” to 2 1/8”.
8. REX in electrified lock is required.
9. Supply from the following list of manufacturers:
   - Schlage SCH
   - Falcon FAL
   - Best BES

E. Exit Devices
1. All exit device types on this project should be manufactured by the same manufacturer.
2. Exit devices are to be architectural grade touch bar type. Touchpad to extend one half of door width.
3. Mechanism case to be smooth.
4. Exit devices shall meet ANSI A156.3, Grade 1.
5. All exit devices are UL listed Panic Exit or Fire Exit Hardware.
6. All lever trim to match lock trim in design and finish.
7. Dogging: Non-rated devices are to be provided with dogging. Less dogging where shown in Hardware Sets (some exterior, electrical rooms, electrified) Cylinder dogging as shown in hardware sets.
8. Exit devices are to be supplied and installed with thru-bolts for exterior, hollow metal doors, or as required for application.
9. Provide proper power supply for exit devices as required. Coordinate with Fire Alarm, Electrical and Security Contractor.
10. Push pads shall be metal, no plastic inserts allowed.
11. Exit devices shall have a flush end cap.
12. Exit devices shall be ordered with the correct strike for application.
13. Exit devices shall be order in the proper length to meet door width.
14. Exit devices shall have deadlatching.
15. Exit device shall be provided in width/height required based on door size.
16. Install exit devices with fasteners supplied by exit device manufacturer.
17. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits as required.

18. Provide proper concealed vertical rods for wood or hollow metal doors as required.

19. Factory or field drill weep holes for exit devices used in full exterior applications, highly corrosive areas, and where noted in the hardware sets.

20. Supply from the following list of manufacturers:
   Von Duprin VON 35/98 Series
   Falcon FAL
   Detex DET

F. Flush Bolts
1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2. Supply from the following list of manufacturers:
   Ives IVE
   Trimco TRI
   Rockwood ROC

G. Coordinators
1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.

2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers and surface vertical rod exit device strikes. Factory-prep coordinators for vertical rod devices and hardware as required.

3. Supply from the following list of manufacturers:
   Ives IVE
   Trimco TRI
   Rockwood ROC

H. Pull Plates/Pulls/Push Plate
1. Pull and Push Plates to meet ANSI 156.6 for .050” thickness.

2. Pull and Push Plate size to 4” x 16”.

3. Pull Plate to have 10” center and 1” round on pull plate with concealed fasteners.

4. Provide straight and offset pulls with fasteners as required

5. Provide concealed fasteners for all applications.

6. Prep plate for cylinder/lock as required.

7. Supply from the following list of manufacturers
   Ives IVE
   Trimco TRI
   Rockwood ROC

I. Door Closers
1. All door closers on this project should be manufactured by the same manufacturer.
2. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.

3. Door closers shall be furnished with standard cover. Provide full cover as shown in hardware sets.

4. Size in accordance with the manufacturers recommendations for door size and condition.

5. Door closers shall be furnished with delayed action, hold-open as listed in the Hardware Sets.

6. Door closers shall be mounted out of the line of sight wherever possible (i.e., room side of corridor doors, etc.) with parallel arm mounting on out swinging doors.

7. All closer installation shall include thru bolts on exterior, hollow metal doors or where required for application.

8. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

9. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.

10. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.

11. Supply from the following list of manufacturers
   LCN   LCN
   Falcon FAL
   Norton NOR

J. Door Protection Plates
   1. Protective plates shall meet ANSI A156.6 requirements for .050 thickness.
   2. Protection plates should be fabricated from stainless steel.
   3. Protection plate shall be height as shown in Hardware Sets. Width shall be 10" by 2" less than door width on single door or pair with a mullion and 1" less than door width on pair of doors without a mullion.
   4. Beveled 4 edges.
   5. Provide kickplate on all doors with closers, unless not required for aesthetic reasons.
   6. Prep protective plates for hardware as required.
   7. Supply from the following list of manufacturers:
      Ives   IVE
      Rockwood ROC
      Trimco TRI

K. Door Stops and Holders:
   1. Supply wall stops at all openings to protect doors or door hardware. Install so lock does not lock unintentionally. Install blocking in wall where wall stop will be mounted.
   2. When wall conditions do not permit use of wall stop provide floor stops with risers as needed to adjust for floor conditions.
   3. When wall conditions do not permit use of wall stop provide overhead stops. Jamb mount where required to not be visible from Corridor.
   5. Exterior Roof Doors: Provide heavy duty overhead stop.
   6. Supply from the following list of manufacturers:
      Glynn Johnson GLY
      Rockwood ROC
L. Silencers
1. Provide silencers on all doors without seal. 3 for single doors and 2 for pairs.
2. Provide silencers as required for frame conditions. SR64 for hollow metal frames. SR65/SR66 for wood frames.
3. At wood frames, insure height of stop is compatible with silencer.
4. Supply from the following list of manufacturer’s
   Ives    IVE
   Rockwood ROC
   Trimco   TRI

M. Thresholds/Weatherstripping
1. Thresholds on doors in the accessible path shall conform to accessibility codes.
2. Threshold should be based on sill detail.
3. Smoke seal shall be teardrop design bulb seal.
4. Exterior seal/thresholds shall be silicone or brush as shown in hardware sets.
5. Drip strips shall protrude 2 1/2” and be 4” wider than opening.
6. At S Label single doors provide seals on frame to comply with UL1784
7. At S Label pair of doors provide seals on frame and as meeting stile to comply with UL1784.
8. Automatic Door Bottom shall be mortised to comply with accessibility codes.
9. Supply from the following list of manufacturer’s
   Zero      ZER
   National Guard NGP
   Pemko     PEM

2.03 KEYING:

A. General: Finish Hardware Supplier shall meet in person with owner to finalize keying requirements prior to the locks and exit devices being ordered and match existing Master Key System for the City of New Braunfels project. During keying meeting all hardware functions should be reviewed with the owner to finalize lock and exit device functions. During keying meeting determine all expansion required.

B. Cylinders: Provide the correct and quantity of cylinders for all applications.

C. Keys: Provide nickel silver keys only. Furnish 2 change keys for each lock: 5 control keys: 5 master keys for each master system and 5 grandmaster keys for each grandmaster key system. Deliver all keys to Owners’ Representative.

D. Cores and keys shall be provided with identification stamping.

E. Provide construction keying / construction cores for this project with constructions keys.

F. Provide Bitting List to Owner.

2.04 KEY CONTROL:

A. Key Management: Key control shall be provided, by supplying a complete key storage and management system. Each key shall be fully cut, indexed, tagged and installed on cabinet hooks by the lock supplier and shipped with the locks. Key cabinet provided shall be wall-mounted type with capacity plus 50%.
PART 3 – EXECUTION:

3.01 EXAMINATION:

A. Examine doors, frames and related items for conditions that would prevent the proper application of any finish hardware items. Do not proceed with installation until all defects are corrected.

B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

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

3.02 INSTALLATION:

A. Follow Door and Hardware Institute Publication:
   Recommended Location for Architectural Hardware for Standard Steel Doors and Frames
   Recommended Location for Builder’s Hardware for Custom Steel Doors and Frames
   Recommended Locations for Architectural Hardware for Wood Flush Door

B. Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.


D. Review mounting locations with Architect where required.

E. Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers should not be visible in corridors, lobbies and other public spaces where possible.

F. Locate power supplies in accessible location and indicate in as-builts where located.

G. Set threshold in full bed of sealant complying with requirements specified in Division 07.

H. Pre Installation meeting required with attendees to include Architect, General Contractor, Mechanical Hardware Installer, Electrified Hardware Installer, Finish Hardware Supplier and Manufacturer’s Representative for Exit Device, Locks and Closers and Door/Frame Suppliers before installation begins.

3.03 FIELD QUALITY CONTROL:

A. After installation has been completed, obtain the services of an Architectural Hardware Consultant to check for proper installation of finish hardware, according to the finish hardware schedule and keying schedule. In addition, check all hardware for adjustments and proper operation.

3.04 ADJUST AND CLEAN:
A. Adjust, clean and inspect all hardware, to ensure proper operation and function of every opening. Replace items, which cannot be adjusted to operate freely and smoothly as intended for the application made.

3.05 PROTECTION:

A. The General 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.

3.06 TRAINING

A. After installation has been completed, provide training to the Owner on the operation of the Finish Hardware and programming of any electrified hardware.

3.07 HARDWARE SCHEDULE

A. These hardware set shown below are for use as a guideline. Provide hardware as required to meet the requirements of the openings, security, and code requirements.

**HARDWARE SET LAYOUT**

0 – Existing, No Hardware Required or Cylinders  
1 – Lockset - Office  
2 – Lockset – Storeroom  
3 – Latchset - Privacy  
4 – Latchset - Passage  
5 – Lockset - Classroom  
6 – Hospital Latch  
7 – Panic Hardware  
8 – Push/Pull  
9 – Sliding

2020929

**HARDWARE GROUP NO. 001**

FOR USE ON DOOR #(S):

1704C  1704D  1808  A107B  A108  A109B  
A110  A111A  A111B  A111C  A111D  A115  
A117A  A117B  A118  A121  A125A  A125B

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CYLINDER</td>
<td>AS REQUIRED ICX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
</tbody>
</table>

-COORDINATE HARDWARE WITH DOOR/FRAME MANUFACTURER.
HARDWARE GROUP NO. 002
FOR USE ON DOOR #(S):
1000A  1000B
PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CYLINDER</td>
<td>AS REQUIRED ICX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
</tbody>
</table>

-COORDINATE HARDWARE WITH DOOR/FRAME MANUFACTURER.

HARDWARE GROUP NO. 101AT
FOR USE ON DOOR #(S):
1904
PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE 5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ENTRANCE/OFFICE LOCK ND50HD SPA</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE 80-037</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE 8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
<td></td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 101T
FOR USE ON DOOR #(S):
A104

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE 5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE 80-037</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE 8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>GASKETING 328AA</td>
<td>AA</td>
<td>ZER</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP 39A</td>
<td>A</td>
<td>ZER</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD 655A</td>
<td>A</td>
<td>ZER</td>
<td></td>
</tr>
<tr>
<td>QTY</td>
<td>DESCRIPTION</td>
<td>CATALOG NUMBER</td>
<td>FINISH</td>
<td>MFR</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------</td>
<td>----------------</td>
<td>--------</td>
<td>-----</td>
</tr>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ENTRANCE/OFFICE LOCK</td>
<td>ND50HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>117SBK PSA</td>
<td>BK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>8150SBK PSA</td>
<td>BK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>8770NBK PSA</td>
<td>BK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR BOTTOM</td>
<td>369AA</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>655A</td>
<td>A</td>
<td>ZER</td>
</tr>
</tbody>
</table>

Locate 8770, 8150 and 117 GASKETING on frame rabbet, all three sides.

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ENTRANCE/OFFICE LOCK</td>
<td>ND50HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>OH STOP</td>
<td>90S J</td>
<td>652</td>
<td>GLY</td>
</tr>
</tbody>
</table>
HARDWARE GROUP NO. 103AT
FOR USE ON DOOR #(#(S):

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ENTRANCE/OFFICE LOCK</td>
<td>ND50HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

HARDWARE GROUP NO. 200CNRT
FOR USE ON DOOR #(#(S):

| 1509 |

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NR</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>CONST LATCHING BOLT</td>
<td>FB51P 24&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DUST PROOF STRIKE</td>
<td>DP2</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>COORDINATOR</td>
<td>COR X FL X MB X HW PREPS</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER</td>
<td>SC81A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td></td>
<td>PROVIDE MTG BRKT, SPCR &amp; PLATE AS REQ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 1&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>188S</td>
<td>BR</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>ASTRAGAL</td>
<td>322-S</td>
<td>G</td>
<td>ZER</td>
</tr>
</tbody>
</table>

PROVIDE 7/8" LIP STRIKE.
## HARDWARE GROUP NO. 200NRT
**FOR USE ON DOOR #(S):**

### 2401

**PROVIDE EACH DOOR(S) WITH THE FOLLOWING:**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SET CONST LATCHING BOLT</td>
<td>FB51P 24&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA DUST PROOF STRIKE</td>
<td>DP2</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA COORDINATOR</td>
<td>COR X FL X MB X HW PREPS</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>EA SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>2</td>
<td>EA KICK PLATE</td>
<td>8400 10&quot; X 1&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA GASKETING</td>
<td>188S</td>
<td>BR</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>SET ASTRAGAL</td>
<td>322-S</td>
<td>G</td>
<td>ZER</td>
</tr>
</tbody>
</table>

**PROVIDE 7/8" LIP STRIKE.**

## HARDWARE GROUP NO. 200NT
**FOR USE ON DOOR #(S):**

### 1215

**PROVIDE EACH DOOR(S) WITH THE FOLLOWING:**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SET CONST LATCHING BOLT</td>
<td>FB51P 24&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA DUST PROOF STRIKE</td>
<td>DP2</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA COORDINATOR</td>
<td>COR X FL X MB X HW PREPS</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>EA SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>2</td>
<td>EA KICK PLATE</td>
<td>8400 10&quot; X 1&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>EA WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA GASKETING</td>
<td>188S</td>
<td>BR</td>
<td>ZER</td>
</tr>
<tr>
<td>2</td>
<td>EA SILENCER</td>
<td>SR64</td>
<td>G</td>
<td>IVE</td>
</tr>
</tbody>
</table>

**PROVIDE 7/8" LIP STRIKE.**

## HARDWARE GROUP NO. 201ACNT
**FOR USE ON DOOR #(S):**

### 2313

**PROVIDE EACH DOOR(S) WITH THE FOLLOWING:**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>EA HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA SURFACE CLOSER</td>
<td>SC81A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
</tbody>
</table>

**PROVIDE MTG BRKT, SPCR & PLATE AS REQ**

| 1   | EA KICK PLATE                      | 8400 10" X 2" LDW B-CS | 630    | IVE |

**PROVIDE 7/8" LIP STRIKE.**

FINISH HARDWARE
HARDWARE GROUP NO. 201AT
FOR USE ON DOOR #(S):
1708
1902
PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 201CNRT
FOR USE ON DOOR #(S):
1905
1906
PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td></td>
<td>PROVIDE MTG BRKT, SPCR &amp; PLATE AS REQ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>188S</td>
<td>BR</td>
<td>ZER</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 201RT
FOR USE ON DOOR #(S):
1205B
PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>188S</td>
<td>BR</td>
<td>ZER</td>
</tr>
</tbody>
</table>
HARDWARE GROUP NO. 201T
FOR USE ON DOOR #(S):

- **4205B**
- 1510
- 2201
- A106

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC841A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 202ANT
FOR USE ON DOOR #(S):

- **2502A**

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>CONST LATCHING BOLT</td>
<td>FB61P</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DUST PROOF STRIKE</td>
<td>DP2</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ASTRAGAL</td>
<td>322-S</td>
<td>G</td>
<td>ZER</td>
</tr>
</tbody>
</table>

PROVIDE 7/8" LIP STRIKE.

HARDWARE GROUP NO. 202NT
FOR USE ON DOOR #(S):

- **1505**
- 1507
- 2316A
- 2320
- A113
- A114

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>CONST LATCHING BOLT</td>
<td>FB51P 24&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DUST PROOF STRIKE</td>
<td>DP2</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ASTRAGAL</td>
<td>322-S</td>
<td>G</td>
<td>ZER</td>
</tr>
<tr>
<td>2</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>
HARDWARE GROUP NO. 202ST
FOR USE ON DOOR #(S):
2402A      2402B
PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>EA HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SET CONST LATCHING BOLT</td>
<td>FB51P 24&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA DUST PROOF STRIKE</td>
<td>DP2</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>EA OH STOP</td>
<td>90S</td>
<td>652</td>
<td>GLY</td>
</tr>
<tr>
<td>1</td>
<td>SET ASTRAGAL</td>
<td>322-S</td>
<td>G</td>
<td>ZER</td>
</tr>
<tr>
<td>2</td>
<td>EA SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

PROVIDE 7/8" LIP STRIKE.

HARDWARE GROUP NO. 202T
FOR USE ON DOOR #(S):
1208
PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>EA HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SET CONST LATCHING BOLT</td>
<td>FB51P 24&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA DUST PROOF STRIKE</td>
<td>DP2</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>EA WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SET ASTRAGAL</td>
<td>322-S</td>
<td>G</td>
<td>ZER</td>
</tr>
<tr>
<td>2</td>
<td>EA SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 203ANT
FOR USE ON DOOR #(S):
1800AA     1800AB
PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>EA HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>
**HARDWARE GROUP NO. 203AT**

FOR USE ON DOOR #(S):

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>QTY</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1004AA</td>
<td>HINGE 5BB1 4.5 X 4.5</td>
<td>4</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1710</td>
<td>STOREROOM LOCK ND80HD</td>
<td>1</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>2102</td>
<td>SFIC EVEREST CORE 80-037</td>
<td>1</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>2505</td>
<td>WALL STOP WS406/407CCV</td>
<td>1</td>
<td>630</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>2506B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**HARDWARE GROUP NO. 203NT**

FOR USE ON DOOR #(S):

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>QTY</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>HINGE 5BB1 4.5 X 4.5</td>
<td>4</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>2317C</td>
<td>STOREROOM LOCK ND80HD</td>
<td>1</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SFIC EVEREST CORE 80-037</td>
<td>1</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WALL STOP WS406/407CCV</td>
<td>1</td>
<td>630</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SILENCER SR64</td>
<td>3</td>
<td></td>
<td>GRY</td>
<td></td>
</tr>
</tbody>
</table>

**HARDWARE GROUP NO. 203T**

FOR USE ON DOOR #(S):

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>QTY</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1605AA</td>
<td>HINGE 5BB1 4.5 X 4.5</td>
<td>4</td>
<td>652</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>1610</td>
<td>STOREROOM LOCK ND80HD</td>
<td>1</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>2014AA</td>
<td>SFIC EVEREST CORE 80-037</td>
<td>1</td>
<td>626</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>2205</td>
<td>WALL STOP WS406/407CCV</td>
<td>1</td>
<td>630</td>
<td>IVE</td>
<td></td>
</tr>
<tr>
<td>2410</td>
<td>SILENCER SR64</td>
<td>3</td>
<td></td>
<td>GRY</td>
<td></td>
</tr>
<tr>
<td>2506BA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
HARDWARE GROUP NO. 205NT
FOR USE ON DOOR #(S):

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC71A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS18L</td>
<td>BLK</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>RAIN DRIP</td>
<td>142AA</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>328AA (@JAMBS)</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>429AA (@ HEAD)</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>A</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>655A</td>
<td>A</td>
<td>ZER</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 205T
FOR USE ON DOOR #(S):

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 630 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80HD SPA 626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037 626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC71A SS 689 FAL PROVIDE MTG BRKT, SPCR &amp; PLATE AS REQ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS 630 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>RAIN DRIP</td>
<td>142AA AA ZER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>328AA (@JAMBS) AA ZER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>429AA (@ HEAD) AA ZER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>39A A ZER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>655A A ZER</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
HARDWARE GROUP NO. 214T
FOR USE ON DOOR #(S):
1205A  1618

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>CONST LATCHING BOLT</td>
<td>FB51P 24&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DUST PROOF STRIKE</td>
<td>DP2</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER</td>
<td>SC71A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
</tbody>
</table>

PROVIDE 7/8” LIP STRIKE.

HARDWARE GROUP NO. 341AT
FOR USE ON DOOR #(S):
1101A  1213  1214  1712  1713  2006
2007  2008  2016  2202  2203  2204
2301  2302

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PRIVACY LOCK</td>
<td>L9040 17A L583-363 L283-722</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10” X 2”</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 341T
FOR USE ON DOOR #(S):
A120

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PRIVACY LOCK</td>
<td>L9040 17A L583-363 L283-722</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10” X 2”</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>
HARDWARE GROUP NO. 345T
FOR USE ON DOOR #(S):
A119

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>EA HINGE 5BB1 4.5 X 4.5</td>
<td>652 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA PRIVACY LOCK L9040 17A</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA SURFACE CLOSER SC71A SS</td>
<td>689 FAL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PROVIDE MTG BRKT, SPCR & PLATE AS REQ

| 1   | EA KICK PLATE 8400 10" X 2" LDW B-CS | 630 IVE        |        |     |
| 1   | EA FLOOR STOP FS18L                | BLK IVE        |        |     |
| 1   | SET GASKETING 328AA (@JAMBS)        | AA ZER         |        |     |
| 1   | EA GASKETING 429AA (@ HEAD)         | AA ZER         |        |     |
| 1   | EA DOOR SWEEP 39A                  | A ZER          |        |     |
| 1   | EA THRESHOLD 655A                  | A ZER          |        |     |

HARDWARE GROUP NO. 403T
FOR USE ON DOOR #(S):
1617A

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>EA HINGE 5BB1 4.5 X 4.5</td>
<td>652 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA PASSAGE SET ND10S SPA</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>EA SILENCER SR64</td>
<td>GRY IVE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 503ANT
FOR USE ON DOOR #(S):
2506AA

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>EA HINGE 5BB1 4.5 X 4.5 NRP</td>
<td>652 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA CLASSROOM LOCK ND70HD SPA</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA SFIC EVEREST CORE 80-037</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>EA WALL STOP WS406/407CCV</td>
<td>630 IVE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### HARDWARE GROUP NO. 503AT
**FOR USE ON DOOR #(S):**
1702 2303 2305A

**PROVIDE EACH DOOR(S) WITH THE FOLLOWING:**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE 5BB1 4.5 X 4.5</td>
<td>652 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>CLASSROOM LOCK ND70HD SPA</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE 80-037</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP WS406/407CCV</td>
<td>630 IVE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. 503NST
**FOR USE ON DOOR #(S):**
1800B

**PROVIDE EACH DOOR(S) WITH THE FOLLOWING:**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE 5BB1 4.5 X 4.5 NRP</td>
<td>652 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>CLASSROOM LOCK ND70HD SPA</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE 80-037</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>OH STOP 90S</td>
<td>652 GLY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>GASKETING 186S</td>
<td>BR ZER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP 39A</td>
<td>A ZER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD 655A</td>
<td>A ZER</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. 700ACNRT
**FOR USE ON DOOR #(S):**
1203

**PROVIDE EACH DOOR(S) WITH THE FOLLOWING:**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>HINGE 5BB1HW 4.5 X 4.5 NRP</td>
<td>652 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>FIRE EXIT HARDWARE 9847-L-F-LBR-17 (WDC @ WD)</td>
<td>626 VON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>SFIC RIM CYLINDER 80-159</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>SFIC EVEREST CORE 80-037</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER SC81A SS</td>
<td>689 FAL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PROVIDE MTG BRKT, SPCR & PLATE AS REQ**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>KICK PLATE 8400 10&quot; X 1&quot; LDW B-CS</td>
<td>630 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ASTRAGAL 328AA (2 PCS - 1 SET)</td>
<td>AA ZER</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
HARDWARE GROUP NO. 701AHNT
FOR USE ON DOOR #(S):
1605A 1605B 1605B 1711

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1HW 4 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PANIC HARDWARE</td>
<td>98-L-17</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A HW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td></td>
<td>W/HOLD OPEN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 701ANRT
FOR USE ON DOOR #(S):
1508A 1508B 1508C

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1HW 4 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>FIRE EXIT HARDWARE</td>
<td>98-L-F-17</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td></td>
<td>W/HOLD OPEN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 701ANT
FOR USE ON DOOR #(S):
2300B

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1HW 4 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PANIC HARDWARE</td>
<td>98-L-17</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td></td>
<td>W/HOLD OPEN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>
HARDWARE GROUP NO. 711CRT
FOR USE ON DOOR #(S): 1205C

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>FIRE EXIT HARDWARE</td>
<td>98-NL-F</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
</tbody>
</table>

PROVIDE MTG BRKT, SPCR & PLATE AS REQ

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>188S</td>
<td>BR</td>
<td>ZER</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 731RT
FOR USE ON DOOR #(S): 2009 2409

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>FIRE EXIT HARDWARE</td>
<td>98-L-F-BE-17</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>188S</td>
<td>BR</td>
<td>ZER</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 781CT
FOR USE ON DOOR #(S): 4205C 2005

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PANIC HARDWARE</td>
<td>LD-98-NL</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
</tbody>
</table>

PROVIDE MTG BRKT, SPCR & PLATE AS REQ

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>
HARDWARE GROUP NO. 781T
FOR USE ON DOOR #(S):
1604  1609

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>EA HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA PANIC HARDWARE</td>
<td>LD-98-NL</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EA SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>EA KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>3</td>
<td>EA SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 784T
FOR USE ON DOOR #S:
1204  1206B  A101A

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>EA HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA PANIC HARDWARE</td>
<td>LD-9847-EO</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EA PANIC HARDWARE</td>
<td>LD-9847-NL</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EA SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>EA SURFACE CLOSER</td>
<td>SC71A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td></td>
<td>PROVIDE MTG BRKT, SPCR &amp; PLATE AS REQ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>EA KICK PLATE</td>
<td>8400 10&quot; X 1&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>EA FLOOR STOP</td>
<td>FS18L</td>
<td>BLK</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA RAIN DRIP</td>
<td>142AA</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>SET ASTRAGAL</td>
<td>328AA (2 PCS - 1 SET)</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>SET GASKETING</td>
<td>328AA (@JAMBS)</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>EA GASKETING</td>
<td>429AA (@ HEAD)</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>2</td>
<td>EA DOOR SWEEP</td>
<td>39A</td>
<td>A</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>EA THRESHOLD</td>
<td>655A</td>
<td>A</td>
<td>ZER</td>
</tr>
</tbody>
</table>
### HARDWARE GROUP NO. 801AT
**FOR USE ON DOOR #(S):**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PUSH PLATE</td>
<td>8200 4&quot; X 16&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PULL PLATE</td>
<td>8303 10&quot; 4&quot; X 16&quot; F</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. BC700AT
**FOR USE ON DOOR #(S):**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>CONTINUOUS HINGE BY DOOR/FRAME MANUFACTURER</td>
<td></td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>2</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>ELEC PANIC HARDWARE</td>
<td>LD-RX-9847-L-LBR-E996-17-FSE</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>2</td>
<td>SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER RW/PA</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>2</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 1&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

Hardware set is a guideline based on total security solutions, provide as required based on ballistic door / frame being provided.

### HARDWARE GROUP NO. BC701ACT
**FOR USE ON DOOR #(S):**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CONTINUOUS HINGE BY DOOR/FRAME MANUFACTURER</td>
<td></td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>ELEC PANIC HARDWARE</td>
<td>LD-RX-98-L-E996-17-FSE</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER RW/PA</td>
<td>SC81A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

Hardware set is a guideline based on total security solutions, provide as required based on ballistic door / frame being provided.
HARDWARE GROUP NO. BC701ART
FOR USE ON DOOR #(S): 1004A

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CONTINUOUS HINGE</td>
<td>BY DOOR/FRAME</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td></td>
<td>ELEC FIRE EXIT</td>
<td>RX-98-L-F-E996-17-FSE</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

HARDWARE SET IS A GUIDELINE BASED ON TOTAL SECURITY SOLUTIONS, PROVIDE AS REQUIRED BASED ON BALLISTIC DOOR / FRAME BEING PROVIDED.

HARDWARE GROUP NO. BC701AT
FOR USE ON DOOR #(S): 1400A

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CONTINUOUS HINGE</td>
<td>BY DOOR/FRAME</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td></td>
<td>ELEC PANIC HARDWARE</td>
<td>LD-RX-98-L-E996-17-FSE</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

HARDWARE SET IS A GUIDELINE BASED ON TOTAL SECURITY SOLUTIONS, PROVIDE AS REQUIRED BASED ON BALLISTIC DOOR / FRAME BEING PROVIDED.
HARDWARE GROUP NO. C200CNT
FOR USE ON DOOR #(S):
A124

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>CONST LATCHING BOLT</td>
<td>FB51P 24&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DUST PROOF STRIKE</td>
<td>DP2</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EU STOREROOM LOCK</td>
<td>ND80HDEU SPA RX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 1&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ASTRAGAL</td>
<td>322-S</td>
<td>G</td>
<td>ZER</td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER</td>
<td>SC81A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PROVIDE MTG BRKT, SPCR &amp; PLATE AS REQ</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PROVIDE 7/8" LIP STRIKE.

HARDWARE GROUP NO. C200T
FOR USE ON DOOR #(S):
1705B

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>CONST LATCHING BOLT</td>
<td>FB51P 24&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DUST PROOF STRIKE</td>
<td>DP2</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EU STOREROOM LOCK</td>
<td>ND80HDEU SPA RX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ASTRAGAL</td>
<td>322-S</td>
<td>G</td>
<td>ZER</td>
</tr>
<tr>
<td>2</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

PROVIDE 7/8" LIP STRIKE.
HARDWARE GROUP NO. C201ACNT
FOR USE ON DOOR #(S):
    2311
PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EU STOREROOM LOCK</td>
<td>ND80HDEU SPA RX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PROVIDE MTG BRKT, SPCR &amp; PLATE AS REQ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. C201ACT
FOR USE ON DOOR #(S):
    1800A
PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EU STOREROOM LOCK</td>
<td>ND80HDEU SPA RX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PROVIDE MTG BRKT, SPCR &amp; PLATE AS REQ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. C201ANT
FOR USE ON DOOR #(S):
    1102A  1900B  2010  2100  2200  2400
PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EU STOREROOM LOCK</td>
<td>ND80HDEU SPA RX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PROVIDE MTG BRKT, SPCR &amp; PLATE AS REQ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

FINISH HARDWARE

087100 - 29
# HARDWARE GROUP NO. C201AT
FOR USE ON DOOR #(S):

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EU STOREROOM LOCK</td>
<td>ND80HDEU SPA RX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

# HARDWARE GROUP NO. C201CGNT
FOR USE ON DOOR #(S): A123

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EU STOREROOM LOCK</td>
<td>ND80HDEU SPA RX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>328AA</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>A</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>655A</td>
<td>A</td>
<td>ZER</td>
</tr>
</tbody>
</table>

# HARDWARE GROUP NO. C201CNT
FOR USE ON DOOR #(S): A126

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EU STOREROOM LOCK</td>
<td>ND80HDEU SPA RX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>
### HARDWARE GROUP NO. C201GT
**FOR USE ON DOOR #(S):**
A122

**PROVIDE EACH DOOR(S) WITH THE FOLLOWING:**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EU STOREROOM LOCK</td>
<td>ND80HDEU SPA RX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>328AA</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>A</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>655A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. C201NT
**FOR USE ON DOOR #(S):**
1703 1704A 1705A 1707B

**PROVIDE EACH DOOR(S) WITH THE FOLLOWING:**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EU STOREROOM LOCK</td>
<td>ND80HDEU SPA RX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. C201RT
**FOR USE ON DOOR #(S):**
1602 1608A

**PROVIDE EACH DOOR(S) WITH THE FOLLOWING:**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EU STOREROOM LOCK</td>
<td>ND80HDEU SPA RX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>188S</td>
<td>BR</td>
<td>ZER</td>
</tr>
</tbody>
</table>
HARDWARE GROUP NO. C201T
FOR USE ON DOOR #(S):
1201 1504 1603A 1603B 1706 2004 2015

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EU STOREROOM LOCK</td>
<td>ND80HDEU SPA RX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. C205T
FOR USE ON DOOR #(S):
1613 1617 A101

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EU STOREROOM LOCK</td>
<td>ND80HDEU SPA RX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC71A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td></td>
<td>PROVIDE MTG BRKT, SPCR &amp;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PLATE AS REQ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS18L</td>
<td>BLK</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>RAIN DRIP</td>
<td>142AA</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>328AA (@JAMBS)</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>429AA (@ HEAD)</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>A</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>655A</td>
<td>A</td>
<td>ZER</td>
</tr>
</tbody>
</table>
### HARDWARE GROUP NO. C700ANT
FOR USE ON DOOR #(S):
1206A

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>2</td>
<td>ELEC PANIC HARDWARE</td>
<td>LD-RX-9847-L-LBR-E996-17-FSE (WDC @ WD)</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>2</td>
<td>SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>2</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 1&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>ASTRAGAL</td>
<td>328AA (2 PCS - 1 SET)</td>
<td>AA</td>
<td>ZER</td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. C701ANT
FOR USE ON DOOR #(S):
1100B 1506A

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>ELEC PANIC HARDWARE</td>
<td>LD-RX-98-L-E996-17-FSE</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. C701RT
FOR USE ON DOOR #(S):
1207A

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>ELEC FIRE EXIT HARDWARE</td>
<td>RX-98-L-F-E996-17-FSE</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>188S</td>
<td>BR</td>
<td>ZER</td>
</tr>
<tr>
<td>QTY</td>
<td>DESCRIPTION</td>
<td>CATALOG NUMBER</td>
<td>FINISH</td>
<td>MFR</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------</td>
<td>---------------------------------</td>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>ELEC FIRE EXIT</td>
<td>RX-QEL-98-NL-F</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC71A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS18L</td>
<td>BLK</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>RAIN DRIP</td>
<td>142AA</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>328AA (@JAMBS)</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>429AA (@ HEAD)</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>A</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>655A</td>
<td>A</td>
<td>ZER</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. C715T
FOR USE ON DOOR #(S):
1506B 1600 1700 A125C

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>ELEC PANIC HARDWARE</td>
<td>RX-QEL-98-NL</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SFIC RIM CYLINDER</td>
<td>80-159</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC71A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS18L</td>
<td>BLK</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>RAIN DRIP</td>
<td>142AA</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>328AA (@JAMBS)</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>429AA (@ HEAD)</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>A</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>655A</td>
<td>A</td>
<td>ZER</td>
</tr>
</tbody>
</table>
HARDWARE GROUP NO. CY731ART
FOR USE ON DOOR #(S): 1004B

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>ELEC FIRE EXIT</td>
<td>RX-98-L-BE-F-RX996-17</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td></td>
<td>HARDWARE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>SC81A RW/PA</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. G214T
FOR USE ON DOOR #(S): A100C

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>CONST LATCHING BOLT</td>
<td>FB51P 24&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DUST PROOF STRIKE</td>
<td>DP2</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80HD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER</td>
<td>SC71A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td></td>
<td>PRODUCE MTG BRKT, SPCR &amp; PLATE AS REQ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 1&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>FLOOR STOP</td>
<td>FS18L</td>
<td>BLK</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>RAIN DRIP</td>
<td>142AA</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>ASTRAGAL</td>
<td>322-S</td>
<td>G</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING (@JAMBS)</td>
<td>328AA (@JAMBS)</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING (@ HEAD)</td>
<td>429AA (@ HEAD)</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>2</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>A</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>655A</td>
<td>A</td>
<td>ZER</td>
</tr>
</tbody>
</table>

PROVIDE 7/8" LIP STRIKE. HARDWARE SET IS A GUIDELINE. GENERAL CONTRACTOR TO CONDUCT COORDINATION MEETING BETWEEN GATE/FENCE FABRICATOR AND HARDWARE SUPPLIER PRIOR TO GATE BEING FABRICATED OR HARDWARE BEING ORDERED. NOTIFY A/E OF ANY INCOMPATIBILITY.
HARDWARE GROUP NO. GC214T
FOR USE ON DOOR #(S):
A100A

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>POWER TRANSFER</td>
<td>EPT10</td>
<td>689</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>CONST LATCHING BOLT</td>
<td>FB51P 24&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DUST PROOF STRIKE</td>
<td>DP2</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EU STOREROOM LOCK</td>
<td>ND80HDEU SPA RX</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SFIC EVEREST CORE</td>
<td>80-037</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER</td>
<td>SC71A SS</td>
<td>689</td>
<td>FAL</td>
</tr>
<tr>
<td></td>
<td>PROVIDE MTG BRKT, SPCR &amp; PLATE AS REQ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 1&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>FLOOR STOP</td>
<td>FS18L</td>
<td>BLK</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>RAIN DRIP</td>
<td>142AA</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>ASTRAGAL</td>
<td>322-S</td>
<td>G</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING (@JAMBS)</td>
<td>328AA</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING (@ HEAD)</td>
<td>429AA (@ HEAD)</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>2</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>A</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>655A</td>
<td>A</td>
<td>ZER</td>
</tr>
</tbody>
</table>

PROVIDE 7/8" LIP STRIKE. HARDWARE SET IS A GUIDELINE. GENERAL CONTRACTOR TO CONDUCT COORDINATION MEETING BETWEEN GATE/FENCE FABRICATOR AND HARDWARE SUPPLIER PRIOR TO GATE BEING FABRICATED OR HARDWARE BEING ORDERED. NOTIFY A/E OF ANY INCOMPATIBILITY.

END OF SECTION
SECTION 08 71 13 - AUTOMATIC DOOR OPERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Power door operators for swinging doors.
2. Low-energy door operators for swinging doors.
3. Power-assist door operators for swinging doors.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing recessed metal frames for control mats in concrete.

1.3 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.

C. Double-Egress (Doors): A pair of doors that simultaneously swing, with the two doors moving in opposite directions with no mullion between them.

D. Double-Swing (Doors): A pair of doors that swing, with the two doors moving in opposite directions with a mullion between them; each door functioning as a single-swing door.

E. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.

F. For automatic door terminology, see BHMA A156.10 and BHMA A156.19 for definitions of terms.

1.4 COORDINATION

A. Coordinate sizes and locations of recesses in concrete floors for recessed control mats that control automatic door operators. Concrete, reinforcement, and formwork requirements are specified elsewhere.
B. Templates: Distribute for doors, frames, and other work specified to be factory prepared and reinforced for installing automatic door operators.

C. Coordinate hardware for doors with operators to ensure proper size, thickness, hand, function, and finish.

D. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to the following:
   1. Power supplies.
   2. Access-control system.
   4. Remote monitoring systems.

E. Pneumatic System Roughing-in: Coordinate layout and installation of automatic door operators and power units with compressed-air piping.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic door operators.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For automatic door operators.
   1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
   2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Indicate locations of activation and safety devices.
   4. Include diagrams for power, signal, and control wiring.
   5. Include plans, elevations, sections, and attachment details for guide rails.

C. Samples: For each exposed product and for each color and texture specified, 6”x 6”.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and Certified Inspector.

B. Product Certificates: For each type of automatic door operator. For each operator for fire-rated door assemblies, certify that operator is listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for use on types and sizes of labeled fire doors required.
AUTOMATIC DOOR OPERATORS

C. Field quality-control reports.

D. Sample Warranties: For manufacturer's special warranties.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For automatic door operators, safety devices, and control systems, to include in maintenance manuals.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project and who employs a Certified Inspector.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Certified Inspector Qualifications: Certified by AAADM.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty or sporadic operation of automatic door operator, including controls.

b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design shall be: HORTON AUTOMATICS, a division of Overhead Door Corporation. Or Equal.

B. Source Limitations: Obtain automatic door operators, including activation and safety devices, from single source from single manufacturer.
2.2 AUTOMATIC DOOR OPERATORS, GENERAL

A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and in accordance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.

1. Emergency Breakaway: Where indicated for center-pivoted doors, provide emergency breakaway feature for reverse swing of doors. Equip system to discontinue power to automatic door operator when door is in emergency breakaway position, to return door to closed position after breakaway, and to automatically reset.

2. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.

3. Wind Load: Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load of: see drawings.

B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation, including spring closing when power is off.

C. Electrohydraulic Operating System: Self-contained, low-pressure unit; with separate cylinders for power and checking, connections for power and activation- and safety-device wiring, and manual operation, including spring closing when power is off.

D. Pneumatic Operating System: Pneumatic operator, air opened and spring closed; with checking in both cycles and manual operation when power is off.

1. Power Unit: Control box and compressor unit, complete with tank, compressor, air line to operator, motor, regulator, safety valve, pressure cutoff switch, and automatic air-line filter drain.

2. Power Unit: Remote-control box powered by compressed-air system specified in Section 221513 "General-Service Compressed-Air Piping" and Section 221519 "General-Service Packaged Air Compressors and Receivers."

E. Hinges: See Section 087100 "Door Hardware" for hinge type for each door that door operator shall accommodate.

F. Housing for Overhead Concealed Operators: Fabricated from minimum 0.125-inch- thick, extruded or formed aluminum and extending full width of door opening, including door jambs, to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

G. Cover for Surface-Mounted Operators: Fabricated from 0.125-inch- thick, extruded or formed aluminum; manufacturer's standard width with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position.

H. Brackets and Reinforcements: Fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.
I. Fire-Door Package: Consisting of UL-listed latch mechanism, power-reset box, and caution signage for fire-rated doors. Latch mechanism shall allow door to swing free during automatic operation; when fire is detected, latch actuator shall cause exit hardware to latch when door closes. Provide latch actuators with fail-secure design.

J. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 POWER DOOR OPERATORS FOR SWINGING DOORS

A. Standard: BHMA A156.10.

B. Performance Requirements:

1. Opening Force:
   a. Power-Operated Doors: Not more than 50 lbf required to manually set door in motion if power fails; not more than 15 lbf required to open door to minimum required width.
   b. Power-Operated Swinging Doors: Not more than 30 lbf required to manually open door if power fails.
   c. Breakaway Device for Power-Operated Doors: Not more than 50 lbf required for breakaway door or panel to open.

2. Entrapment-Prevention Force: Not more than 40 lbf required to prevent stopped door in the last 10 degrees of opening from moving in the direction of opening; not more than 30 lbf required to prevent stopped door from moving in direction of closing.

C. Configuration: Operator to control single swinging door.

1. Traffic Pattern: One way
2. Operator Mounting: Surface

D. Operation: Power opening and power-assisted spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.10.

E. Operating System: Electromechanical

F. Microprocessor Control Unit: Solid-state controller.

G. Features:

1. Adjustable opening and closing speed.
2. Adjustable opening and closing force.
3. Adjustable backcheck.
4. Adjustable hold-open time from zero to 30 seconds.
5. Adjustable time delay.
6. Adjustable acceleration.
7. Adjustable limit switch.
8. Obstruction recycle.
9. Automatic door re-open if stopped while closing.
10. On-off/hold-open switch to control electric power to operator; key operated.

H. Controls: Activation and safety devices in accordance with BHMA standards.
   1. Activation Device: Push-plate switch on each side of door to activate door operator.
   2. Safety Device: Presence sensor mounted on door header and horizontal door muntin to detect pedestrians in presence zone and to prevent door from closing.
   3. Safety Device: One photoelectric beam mounted in guide rails to detect pedestrians in presence zone and to prevent door from closing.
   4. Safety Device: Control mat(s) installed on egress side of door to detect pedestrians in presence and safety zones and to prevent door from closing.

I. Exposed Finish: Finish matching door and frame

2.4 LOW-ENERGY DOOR OPERATORS FOR SWINGING DOORS

A. Standard: BHMA A156.19.

B. Performance Requirements:
   1. Opening Force if Power Fails: Not more than 15 lbf required to release latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
   2. Entrapment-Prevention Force: Not more than 15 lbf required to prevent stopped door from closing or opening.

C. Configuration: Operator to control single swinging door.
   1. Traffic Pattern: One way.
   2. Operator Mounting: Surface

D. Operation: Power opening and power-assisted spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.19. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.

E. Operating System: Electromechanical Retain "Microprocessor Control Unit" Paragraph below if required.

F. Microprocessor Control Unit: Solid-state controller.

G. Features:
   1. Adjustable opening and closing speed.
   2. Adjustable opening and closing force.
   3. Adjustable backcheck.
   4. Adjustable hold-open time from zero to 30 seconds.
   5. Adjustable time delay.
   6. Adjustable acceleration.
   7. Obstruction recycle.
8. On-off/hold-open switch to control electric power to operator; key operated.

H. Activation Device: Push-plate or Push-button switch on each side of door to activate door operator.

I. Exposed Finish: Finish matching door and frame

2.5 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Extrusions: ASTM B221.

B. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness, in manufacturer's standard thickness.

C. Brass Sheet: ASTM B36/B36M, Alloy UNS No. C26000 (cartridge brass, 70 percent copper), in manufacturer's standard thickness.

D. Bronze Sheet: ASTM B36/B36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper) or Alloy UNS No. C23000 (red brass, 85 percent copper), in manufacturer's standard thickness.

E. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.6 CONTROLS

A. General: Provide controls, including activation and safety devices, in accordance with BHMA standards; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.

B. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed in plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10.
   1. Provide capability for switching between bidirectional and unidirectional detection.
   2. For one-way traffic, sensor on egress side shall not be active when doors are fully closed.

C. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.

D. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.

E. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator with contrasting-colored, engraved message.
1. Configuration: Square push plate with 4-by-4-inch junction box.
   a. Mounting: Recess mounted, semiflush in wall or mullion

2. Push-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.

F. Push-Button Switch: Momentary-contact door control switch with one red-button actuator; enclosed in nominal[2-by-4-inch junction box.
   1. Provide faceplate engraved with "Press to Open" text and international symbol of accessibility in contrasting color.
   3. Faceplate Material: Stainless steel as selected by Architect from manufacturer's full range.

G. Key Switch: Recess-mounted, door control switch with key-controlled actuator; enclosed in 2-by-4-inch junction box. Provide faceplate engraved with text indicating switch functions.
   1. Faceplate Material: Stainless steel as selected by Architect from manufacturer's full range.
   2. Functions: Two-way automatic, hold open, one-way exit, and off
   3. Mounting: mounted in door jamb

H. Wireless or Remote Radio-Control Switch: Radio-control system consisting of header-mounted receiver and wall-mounted transmitter switch.
   1. Wall-Mounted Transmitter Switch: One red-button, momentary-contact actuator enclosed in 4-by-4-inch junction box. Provide blue plastic cover engraved with "Press Button to Open" in white text and with international symbol of accessibility.

I. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.7 FABRICATION

A. Factory fabricate automatic door operators to comply with indicated standards.

B. Form aluminum shapes before finishing.

C. Fabricate exterior components to drain condensation and water-passing joints within operator enclosure to the exterior.

D. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.

E. Provide metal cladding, completely covering visible surfaces before shipment to Project site. Fabricate cladding with concealed fasteners and connection devices, with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion, and with allowance for thermal expansion at exterior doors.
2.8 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary, protective covering before shipping.

B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

A. Dark Bronze Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, and other conditions affecting performance of automatic door operators.

B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic door operator installation.

C. Examine roughing-in for compressed-air piping systems to verify actual locations of piping connections before automatic door operator installation.

D. Verify that full-height finger guards are installed at each door with pivot hinges, where door has a clearance at hinge side greater than 1/4 inch and less than 3/4 inch with door in any position.

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

3.2 INSTALLATION, GENERAL

A. Install automatic door operators in accordance with manufacturer's written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building's power supply.

1. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.

2. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.
B. Controls: Install activation and safety devices in accordance with manufacturer's written instructions and cited BHMA standard for operator type and direction of pedestrian travel. Connect control wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Access-Control System: Connect operators to access-control system as specified in Section 281500 "Access Control Hardware Devices."

D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

E. Guide Rails: Install in accordance with BHMA A156.10, including Appendix A and manufacturer's written instructions unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

A. Certified Inspector: Engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and inspect each automatic door operator installation, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

C. Automatic door operators will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust automatic door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

1. Adjust operators on exterior doors for tight closure.

B. After completing installation of automatic door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.

C. Readjust automatic door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

D. Occupancy Adjustment: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of automatic door operator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Engage a Certified Inspector to perform safety inspection after each adjustment or repair and at end of maintenance period. Furnish completed inspection reports to Owner.
2. Perform maintenance, including emergency callback service, during normal working hours.
3. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic door operators.

END OF SECTION 087113
SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Storefront framing.
4. Glazed entrances.
5. Curtainwalls.
6. Interior windows and sidelights.

B. Related Sections:
1. Division 08 Section "Aluminum-Framed Entrances and Storefronts."
2. Division 08 Section “Aluminum Windows.”
3. Division 08 Section “Security Glazing.”

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

1. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.

3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.

3. Test no fewer than eight samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.

4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

C. Glazing Accessory Samples: For gaskets, sealants and colored spacers, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Qualification Data: For installers, manufacturers of insulating-glass units with sputter-coated, low-e coatings, glass testing agency and sealant testing agency.

F. Product Certificates: For glass and glazing products, from manufacturer.
G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for coated glass, insulating glass, glazing sealants and glazing gaskets.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

H. Preconstruction adhesion and compatibility test report.

I. Warranties: Sample of special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Source Limitations for Glass: Obtain coated float glass and insulating glass from single source from single manufacturer for each glass type.

F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Glazing Manual."

H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

I. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
J. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install glazing in mockups specified in Division 08 Section "Aluminum-Framed Entrances and Storefronts, Aluminum Windows and Glazed Aluminum Curtain Walls" to match glazing systems required for Project, including glazing methods.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

K. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

1.10 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge
separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For uncoated glass, comply with requirements for Condition A.

C. For coated vision glass, comply with requirements for Condition C (other coated glass).

D. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.3 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
   1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary.
   2. Spacer: Manufacturer's standard spacer material and construction.
   3. Desiccant: Molecular sieve or silica gel, or blend of both.

2.4 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from the following:
   1. Silicone complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned silicone gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
   1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.5 GLAZING SEALANTS

A. General:
   1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.

4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Corning Corporation; 790.
   b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
   d. Pecora Corporation; 890.
   e. Sika Corporation, Construction Products Division; SikaSil-C990.
   f. Tremco Incorporated; Spectrem 1.

2.6 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.8 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

SOLAR CONTROL INSULATING-GLASS TYPES

A. Glass Type GL01: Insulating glass.

2. Overall Unit Thickness: 1- inch (30 mm).
3. Thickness of Outdoor Glass Lite: 6.0 mm.
4. Thickness of Indoor Glass Lite: 6.0 mm.
5. Outdoor Lite: Tempered float glass.
6. Tint Color: Clear-Clear
7. Interspace Content: Air.
8. Indoor Lite: Tempered float glass.
12. Provide safety glazing labeling.

B. Glass Type GL02: Insulating SPANDREL glass.

1. Basis of Design: Guardian, Sunguard SNX 51/23 Clear / Medium Grey #4
2. Overall Unit Thickness: 1- inch (30 mm).
3. Thickness of Outdoor Glass Lite: 6.0 mm.
4. Thickness of Indoor Glass Lite: 6.0 mm.
5. Outdoor Lite: Tempered float glass.
6. Tint Color: Clear / Medium Grey #4
7. Interspace Content: Air.
8. Indoor Lite: Tempered float glass, painted surface on third surface.

2.10 LEVEL 3 BULLET RESISTANT GLASS TYPE (Interior Only)
   A. Glass Type GL03: See Spec Section 08 88 53 Security Glazing

2.11 UNINSULATED GLASS TYPE (Interior Only)
   A. Glass Type GL04: (1) clear glass panel
      1. Overall Unit Thickness: ¼
      2. Indoor Lites: Tempered glass
      3. Provide safety labeling

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
      1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
      2. Presence and functioning of weep systems.
      3. Minimum required face and edge clearances.
      4. Effective sealing between joints of glass-framing members.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
   A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
   B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL
   A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.8 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 80 00
SECTION 08 83 00 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:

1. Annealed monolithic glass mirrors.
2. Laminated glass mirrors qualifying as safety glazing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.
C. Samples:

1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.

1.3 INFORMATIONAL SUBMITTALS

A. Preconstruction test reports.
B. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Glazing Publications: Comply with GANA's "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."
B. Safety Glazing Products: For laminated mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.
C. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing and substrates on which mirrors are installed.
1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which mirror manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRRORS

A. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arch Aluminum & Glass Co., Inc.
b. Avalon Glass and Mirror Company.
c. Binswanger Mirror; a division of Vitro America, Inc.
d. D & W Incorporated
e. Donisi Mirror Company.
f. Gardner Glass, Inc.
g. Gilded Mirrors, Inc.
h. Guardian Industries.
i. Head West.
j. Independent Mirror Industries, Inc.
k. Lenoir Mirror Company.
l. Maran-Wurzell Glass & Mirror.
m. National Glass Industries.
n. Stroupe Mirror Co., Inc.
o. Sunshine Mirror; Westshore Glass Corp.
p. Virginia Mirror Company, Inc.
q. Walker Glass Co., Ltd.

B. Tempered Clear Glass: Mirror Glazing Quality, for blemish requirements; and comply with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.

1. Nominal Thickness: 6.0 mm.

C. Laminated Mirrors: ASTM C 1172, Kind LM.

1. Clear Glass for Outer Lite: Mirror Select Quality; ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission.
2. Nominal Thickness for Outer Lite: 3.0 mm.
3. Glass for Inner Lite: Annealed float glass; ASTM C 1036, Type I (transparent flat glass), Quality-Q3; Class 1 (clear).
4. Nominal Thickness: 3.0 mm.
5. Interlayer: Mirror manufacturer's standard 0.030-inch-thick, clear polyvinyl-butyral interlayer with a proven record of showing no tendency to delaminate from, or cause damage to, silver coating.

2.2 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
B. Edge Sealer: Approved by mirror manufacturer.
C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors.
   1. Adhesive shall have a VOC content of not more than 70 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MIRROR HARDWARE

A. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.
   1. Finish: Clear bright anodized.
B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
C. Anchors and Inserts: Provide devices as required for mirror hardware installation.

2.4 FABRICATION

A. Cutouts: Fabricate cutouts before tempering for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.
B. Mirror Edge Treatment: Flat polished. Seal edges of mirrors with edge sealer.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
   1. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.
   2. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

B. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

C. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

D. Wall-Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.

E. Protect mirrors from breakage and contaminating substances resulting from construction operations.

F. Do not permit edges of mirrors to be exposed to standing water.

G. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

H. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 08 83 00
SECTION 08 88 53 – SECURITY GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes glazing for the following products and applications and of the following types:

1. Products and applications specified in other Sections where glazing requirements are specified by reference to this Section:
   a. Security Steel windows.

2. Security Glazing Types:
   a. Laminated polycarbonate.

B. Related Sections:

1. Division 08 Section "Glazing" for nonsecurity glazing in the form of monolithic glass, laminated glass, and insulating glass.

1.3 DEFINITIONS

A. Glazing Manufacturers: Firms that produce primary glass, monolithic plastic glazing, or fabricated security glazing, as defined in referenced glazing publications.

1.4 PERFORMANCE REQUIREMENTS

A. General:

1. Installed security glazing shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing; or other defects in construction.

2. Installed security glazing shall withstand security-related loads and forces without damage to the glazing beyond that allowed by referenced standards.

B. Delegated Design: Design security glazing, including comprehensive engineering analysis by a qualified professional engineer.

1. Design Procedure for Glass: Design according to ASTM E 1300.
2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.

3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glazing framing members and glazing components.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each security glazing type, tape sealant, gasket, glazing accessory, and glazing-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to security glazing, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Security Glazing Samples: For each type of security glazing; 12 inches square.
C. Glazing Accessory Samples: For gaskets, sealants and colored spacers, in 12-inch lengths.
D. Security Glazing Schedule: List security glazing types and thicknesses for each size opening and location. Use same designations indicated on Drawings. Indicate coordinated dimensions of security glazing and construction that receives security glazing, including clearances and glazing channel dimensions.
E. Delegated-Design Submittal: For security glazing indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
F. Qualification Data: For installers, glazing testing agency and sealant testing agency.
G. Product Certificates: For each type of product indicated, from manufacturer.
H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of security glazing, glazing sealant and glazing gasket.
   1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

I. Preconstruction adhesion and compatibility test reports.

J. Warranties: Sample of special warranties.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glazing installers for this Project who are certified under the National Glass Association Glazier Certification Program.

B. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

C. Source Limitations for Security Glazing: Obtain security glazing from single source from single manufacturer using the same type of lites, plies, interlayers, and spacers for each security glazing type indicated.
   1. Source Limitations for Tinted Glass: Obtain tinted glass from single source from single primary glass manufacturer for each tint color indicated.

D. Source Limitations for Glazing Sealants and Gaskets: Obtain from single source from single manufacturer for each product and installation method.

E. Glazing Publications: Comply with published recommendations of security glazing and glazing material manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

F. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glazing, thickness, and safety glazing standard with which glazing complies.

G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Install security glazing in mockups specified in Division 08 Section "Security Windows" and "Detention Windows" to match glazing systems required for Project, including glazing methods.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

H. Preinstallation Conference: Conduct conference at Project site.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for security glazing during and after installation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect security glazing and glazing materials according to manufacturer's written instructions. Prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating security glazing and with air-gap security glazing manufacturers' written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

   1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.10 COORDINATION

A. Coordinate dimensions, including thickness, of security glazing with dimensions of construction that receives security glazing.

1.11 WARRANTY

A. Manufacturer's Special Warranty for Laminated Polycarbonate: Manufacturer's standard form in which laminated polycarbonate manufacturer agrees to replace laminated polycarbonate that deteriorates within specified warranty period. Deterioration is defined as defects developed from normal use that are not attributed to maintaining and cleaning laminated polycarbonate contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced standard, yellowing, and loss of light transmission.

   1. Warranty Period: Five years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 SECURITY GLAZING, GENERAL

A. Thickness: Where thickness is indicated, it is a minimum. Provide security glazing in thicknesses as needed to comply with requirements indicated.

B. Fire-Test-Response Characteristics of Plastic Sheets: As determined by testing plastic sheets identical to those used in security glazing products by a qualified testing agency acceptable to authorities having jurisdiction.

1. Self-ignition temperature of 650 deg F or more when tested per ASTM D 1929 on plastic sheets in thicknesses indicated for the Work.
2. Smoke-developed index of 450 or less when tested according to ASTM E 84, or smoke density of 75 or less when tested per ASTM D 2843 on plastic sheets in thicknesses indicated for the Work.
3. Burning extent of 1 inch or less when tested per ASTM D 635 at a nominal thickness of 0.060 inch or thickness indicated for the Work.

C. Thermal and Optical Performance Properties: Provide security glazing with performance properties specified, as indicated in manufacturer's published test data, based on products of construction indicated and on procedures indicated below:

1. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 POLYCARBONATE SECURITY GLAZING

A. Laminated Polycarbonate: Polycarbonate sheets laminated with clear urethane interlayer that complies with ASTM C 1349, Appendix X2, and has a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation. Provide laminated units that comply with requirements of ASTM C 1349 for maximum allowable laminating process blemishes and haze.

2.3 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

2.4 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including security glazing, seals of insulating security
glazing and air-gap security glazing, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and security glazing manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.

4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Corning Corporation; 790.
   b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
   d. Pecora Corporation; 890.
   e. Sika Corporation, Construction Products Division; SikaSil-C990.
   f. Tremco Incorporated; Spectrem 1.

2.5 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and security glazing manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of security glazing and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by security glazing manufacturer to maintain security glazing lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit security glazing lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 FABRICATION OF SECURITY GLAZING

A. Fabricate security glazing in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.8 LAMINATED-POLYCARBONATE SECURITY GLAZING TYPES

A. Security Glazing: Laminated polycarbonate.

1. Detention Security Grade: Grade 3 per ASTM F 1915 cold-temperature impact test.
2. Forced-Entry Resistance: Class III per ASTM F 1233.
3. Forced-Entry Resistance: Level III per HPW-TP-0500.03.
4. Number of Plies: Three.
5. Outer and Inner Plies: 0.236-inch polycarbonate.
6. Interlayer Thicknesses: 0.025 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing for security glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Clean glazing channels and other framing members receiving security glazing immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of security glazing, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect edges of security glazing from damage during handling and installation. Remove damaged security glazing from Project site and legally dispose of off Project site. Damaged security glazing includes units with edge or face damage or other imperfections that, when installed, could weaken security glazing, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glazing unit manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by security glazing manufacturers for installing lites.

F. Provide spacers for security glazing lites where the length plus width is larger than 50 inches.
   1. Locate spacers directly opposite each other on both inside and outside faces of security glazing. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glazing lites and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent security glazing from moving sideways in glazing channel, as recommended in writing by security glazing manufacturer and according to requirements in referenced glazing publications.

H. Set security glazing in each series with uniform pattern, draw, bow, and similar characteristics.

I. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

J. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by security glazing, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center security glazing in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket securely in place between glazing unit and frame or fixed stop, with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center security glazing in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center security glazing in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.
3.6  SEALANT GLAZING (WET)

   A.  Install continuous spacers, or spacers combined with cylindrical sealant backing, between security glazing and glazing stops to maintain face clearances and to prevent sealant from extruding into glazing channel and blocking weep systems.  Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

   B.  Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to security glazing and channel surfaces.

   C.  Tool exposed surfaces of sealants to provide a substantial wash away from security glazing.

3.7  PROTECTION AND CLEANING

   A.  Protect exterior security glazing from damage immediately after installation by attaching crossed streamers to framing held away from glazing unit.  Do not apply markers to security glazing surfaces.  Remove nonpermanent labels, and clean surfaces.

   B.  Protect security glazing from contact with contaminating substances resulting from construction operations, including weld splatter.  If, despite such protection, contaminating substances do come into contact with security glazing, remove substances immediately as recommended in writing by security glazing manufacturer.

   C.  Examine security glazing surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by security glazing manufacturer.

   D.  Remove and replace security glazing that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, or vandalism during construction period.

   E.  Wash security glazing on exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.  Wash security glazing as recommended in writing by security glazing manufacturer.

   END OF SECTION 08 88 53
SECTION 08 90 00 – LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.

C. Vertical Louver: Louver with vertical blades; i.e., the axes of the blades are vertical.

D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

E. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on a uniform pressure of 30 lb/sq. ft., acting inward or outward.
C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.5 SUBMITTALS

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

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.


D. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
2. For color-finished louvers, use fasteners with heads that match color of louvers.

E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide subsills made of same material as louvers for recessed louvers.
F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Drainable Louver:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide model ELF30V as manufactured by Ruskin Company or comparable product by one of the following:
      a. Air Balance Inc.; a Mestek company.
      b. Air Flow Company, Inc.
      c. Airolite Company, LLC (The).
      d. All-Lite Architectural Products.
      e. American Warming and Ventilating, Inc.; a Mestek company.
      f. Arrow United Industries; a division of Mestek, Inc.
      g. Construction Specialties, Inc.
      h. Greenheck Fan Corporation.
      i. Industrial Louvers, Inc.
      j. NCA Manufacturing, Inc.
      k. Nystrom Building Products.
      l. Reliable Products, Inc.
      m. United Enertech Corp.

   2. Louver Depth: 3 inches.
   3. Frame and Blade Nominal Thickness: Not less than 0.080 inch for blades and 0.080 inch for frames.
   4. Louver Performance Ratings:
      a. Free Area: Not less than 5.0 sq. ft. for 48-inch-wide by 48-inch-high louver.
      b. Air Performance: Not more than 0.10-inch wg static pressure drop at 600-fpm free-area intake velocity.
      c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 300 fpm.

   5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.
   1. Screen Location for Fixed Louvers: Interior face.
   2. Screening Type: Insect screening.

B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
   1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
   2. Finish: Same finish as louver frames to which louver screens are attached.
   3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:
   1. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

2.5 FINISHES, GENERAL
   A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.6 ALUMINUM FINISHES
   A. Finish louvers after assembly.
   B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
   A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION
   A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
   B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
   C. Form closely fitted joints with exposed connections accurately located and secured.
D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 90 00
PART 1.0 – GENERAL

1.1 SUMMARY

A. This section includes the WaveBlok™ SW Sound, Air and Moisture Barrier.

B. Related Sections:
   a. Division 7 Section: Basic Thermal and Moisture Protection Materials and Methods (07050)

1.2 REFERENCES

A. Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. American Society for Testing and Materials (ASTM):

   2. ASTM E989-89 Standard Classification for Determination of Impact Insulation Class (IIC).
   3. ASTM E413-87 Classification for Rating Sound Insulation.

C. Leadership in Energy and Environmental Design – LEED®

   1. International Organization for Standardization® document, ISO 14021 - Provides guidance on the terminology, symbols, testing and verification methodologies that an organization should use for self-declaration of the environmental aspects of its products and services.

1.3 SYSTEM DESCRIPTION
A. Performance Requirements: Provide WaveBlok™ SW Sound, Air and Moisture Barrier, which has been manufactured and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.4 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract.

B. LEED: Provide documentation of how the requirements for credit will be met.

C. Product Data: Submit manufacturer’s product specification sheet.

D. Samples: Submit 12”x12” verification samples of the supplied product.

E. Quality Assurance Submittals: Submit the following:

1. Test Reports: Provide test reports showing compliance with specified performance characteristics and physical properties.

2. Certificates: Product certificates signed by manufacturer or Product Data sheets certifying materials comply with specified requirements.

3. Manufacturer’s Instructions: Manufacturer’s installation instructions.

F. Closeout Submittals: Submit the following:

1. Warranty: Manufacturer’s warranty documents specified herein.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.

2. Manufacturer’s Qualifications: Manufacturer capable of manufacturing suitable products and approving application method.

1.6 DELIVERY, STORAGE & HANDLING

A. Ordering: Comply with manufacturer’s ordering instructions and lead time requirements to avoid construction delays.

B. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.
C. Receiving: Verify quantity, condition and dimensions comply with specifications ordered.

D. Storage and Protection: Store materials at temperature and humidity conditions recommended by manufacturer and protect from exposure to harmful weather conditions.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer. Do not install products under environmental conditions outside manufacturer’s recommendations.

1.8 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

1. United Plastic Corporations liability and responsibility in the event of damages are limited to the extent defined in our General Terms and Conditions of Sale.

PART 2.0 – MANUFACTURER / PRODUCTS


2.2 PRODUCT(S)

A. Basis of Design: WaveBlok™ SW Sound, Air and Moisture Barrier.
   1. Alternate products allowable if specifications met.

B. Material: Made with recycled Acoustical Grade Polymer.

C. Sheet Dimensions: 4’ by 8’ sheet size 4’ by 10’ sheet size Other sizes available

D. Sheet Weight: 1.0 lb/ft² nominal (4.89 Kg M²) @ 0.100” thickness

E. Standard Tolerances:
   width: + 0.5” - 0”
   length: +1% - 0”
   thickness: ±0.010”

G. Product Performance:
   1. Minimum STC 25 per ASTM E 90-02 or SAE j1400
   2. Flammability rating of class 1 per ASTM E 84 Rev. A, behind minimum 3/8” drywall
3. No fungal or algal growth and no visible disfigurement per ASTM D3273 and ASTM G 21.

4. Thermal Resistance minimum of 0.3 per ASTM C 518 5. Per ASTM E 119 – 08 must meet 1 hr. fire resistance wall rating.

2.3 Installation Accessories

A. Fasteners: Staples, nails, or screws should be of sufficient size and length to hold materials in place until wall board can be installed.

B. Adhesives: When necessary use premium urethane adhesives and acoustical sealants. Please be environmentally conscious when selecting these products choosing “Green” products when available.

2.4 PRODUCT SUBSTITUTIONS

1. A. Substitutions: Alternate products allowable if specifications met.

PART 3.0 - EXECUTION

3.1 MANUFACTURER’S INSTRUCTIONS

A. Compliance: Comply with manufacturer’s product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

3.2 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions are acceptable for product installation in accordance with manufacturer’s instructions.

3.3 PREPARATION

A. Surface Preparation: Surfaces to receive WaveBlok™ SW Sound, Air and Moisture Barrier shall be clean and reasonably dry at time of installation.

3.4 INSTALLATION/APPLICATION

A. Install in accordance with manufacturers recommendations.

B. Installers shall utilize acoustical sealant, tape, sound rated putty and sound isolation materials as necessary to preserve the wall assembly’s acoustical integrity. This includes all electrical openings, boxes, switches, plumbing, and HVAC components.

C. On floor / Ceiling assemblies, WaveBlok SW can be installed either on top of floor joists, on top of sub-floor, or attached to joists from below.

1. Do not use WaveBlok SW to surround any light fixture due to possible high temperatures and air flow requirements.
2. A T-bar or drywall jack may be needed to support WaveBlok SW during overhead installation.

D. Installation should not begin until all other trades are finished in the area.

E. It is recommended that areas to receive the WaveBlok™ SW Sound, Air and Moisture Barrier should be weather tight and maintained at a minimum average temperature of 65°F (18°C) for 48 hours before, during and after the installation.

3.5 FINISHING

A. Once WaveBlok™ SW Sound, Air and Moisture Barrier is in place, install wall, floor or ceiling as designed in accordance with industry standards.

3.6 PROTECTION

A. Protection: Protect installed product and finish surfaces from damage during construction.

END OF SECTION
SECTION 09 21 16 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes gypsum board shaft-wall assemblies for the following:
   1. Shaft-wall enclosures.
   2. Chase enclosures.
B. Related Sections include the following:
   1. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall assemblies that incorporate gypsum board shaft-wall assemblies.

1.3 SUBMITTALS
A. Product Data: For each gypsum board shaft-wall assembly indicated.

1.4 QUALITY ASSURANCE
A. Fire-Resistance Ratings: Provide materials and construction identical to those of assemblies with fire-resistance ratings determined according to ASTM E 119 by a testing and inspecting agency.
B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.
C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures for installing gypsum board shaft-wall assemblies including, but not limited to, the following:
   1. Fasteners proposed for anchoring nonstructural steel framing to building structure.
   2. Sprayed fire-resistive materials applied to structural steel framing.
   3. Elevator equipment, including hoistway doors, elevator call buttons, and elevator floor indicators.
   4. Wiring devices in shaft-wall assemblies.
   5. Doors and other items penetrating shaft-wall assemblies.
   6. Items supported by shaft-wall-assembly framing.
7. Mechanical work enclosed within shaft-wall assemblies.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, and bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

C. Stack panels flat on leveled supports off floor or slab to prevent sagging.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. BPB America Inc.
4. Lafarge North America Inc.
6. PABCO Gypsum.
8. USG Corporation.

2.2 GYPSUM BOARD SHAFT-WALL ASSEMBLIES, GENERAL

A. Provide materials and components complying with requirements of fire-resistance-rated assemblies indicated.
1. Provide panels in maximum lengths available to eliminate or minimize end-to-end butt joints.

2. Provide auxiliary materials complying with gypsum board shaft-wall assembly manufacturer's written recommendations.

### 2.3 PANEL PRODUCTS

**A. Recycled Content:** Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 3 percent by weight.

**B. Gypsum Liner Panels:** Comply with ASTM C 442/C 442M.

1. **Type X:** Manufacturer's proprietary liner panels with moisture-resistant paper faces.
   
   a. Core: 1 inch thick.
   b. Long Edges: Double bevel.

2. **Moisture- and Mold-Resistant Type X:** Manufacturer's proprietary liner panels with moisture- and mold-resistant core and surfaces; comply with ASTM D 3273.

   a. Core: 1 inch thick.
   b. Long Edges: Double bevel.

**C. Gypsum Board:** As specified in Division 09 Section "Gypsum Board."

**D. Water-Resistant Gypsum Backing Board:** As specified in Division 09 Section "Gypsum Board."

**E. Cementitious Backer Units:** As specified in Division 09 Section "Tiling."

### 2.4 NON-LOAD-BEARING STEEL FRAMING

**A. Framing Members:** Comply with ASTM C 754 for conditions indicated.

**B. Steel Sheet Components:** Comply with ASTM C 645 requirements for metal, unless otherwise indicated.

1. **Recycled Content:** Provide steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

2. **Protective Coating:** ASTM A 653/A 653M, G40, hot-dip galvanized, unless otherwise indicated.

### 2.5 AUXILIARY MATERIALS

**A. General:** Provide auxiliary materials that comply with referenced product standards and manufacturer's written recommendations.
B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes specified in Division 09 Section "Gypsum Board" that comply with gypsum board shaft-wall assembly manufacturer's written recommendations for application indicated.

C. Gypsum Board Joint-Treatment Materials: As specified in Division 09 Section "Gypsum Board."

D. Laminating Adhesive: Adhesive or joint compound recommended by manufacturer for directly adhering gypsum face-layer panels and gypsum-base face-layer panels to backing-layer panels in multilayer construction.
   1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
   1. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

F. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft-wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
   1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
   2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

G. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."
   1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 GYPSUM BOARD SHAFT-WALL ASSEMBLIES

A. Basis-of-Design Product: As indicated on Drawings by design designation of a qualified testing agency.

B. Fire-Resistance Rating: As indicated.

C. STC Rating: As indicated.

D. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
   1. Depth: As indicated.
   2. Minimum Base-Metal Thickness: 0.0179 inch.
E. Runner Tracks: Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches long and in depth matching studs.

1. Minimum Base-Metal Thickness: Matching steel studs.

F. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dietrich Metal Framing; The System by Metal-Lite, Inc.
   b. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.

G. Jamb Struts: Manufacturer's standard J-profile strut with long-leg length of 3 inches, in depth matching studs, and not less than 0.0329 inch thick.

H. Room-Side Finish: As indicated.

I. Shaft-Side Finish: As indicated by fire-resistance-rated assembly design designation.

J. Insulation: Sound attenuation blankets.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board shaft-wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

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

3.2 PREPARATION

A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft-wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft-wall assemblies to comply with requirements specified in Division 07 Section "Applied Fireproofing."

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runner tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft-wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

A. General: Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and the following:

1. ASTM C 754 for installing steel framing except comply with framing spacing indicated.
2. Division 09 Section "Gypsum Board" for applying and finishing panels.
3. Division 09 Section "Tiling" for cementitious backer units.

B. Do not bridge architectural or building expansion joints with shaft-wall assemblies; frame both sides of expansion joints with furring and other support.

C. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing.

1. At elevator hoistway entrance door frames, provide jamb struts on each side of door frame.
2. Where handrails directly attach to gypsum board shaft-wall assemblies, provide galvanized steel reinforcing strip with 0.0312-inch minimum thickness of base (uncoated) metal, accurately positioned and secured behind at least 1 gypsum board face-layer panel.

D. Integrate stair hanger rods with gypsum board shaft-wall assemblies by locating cavity of assemblies where required to enclose rods.

E. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

F. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.

G. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

H. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect, while maintaining fire-resistance rating of gypsum board shaft-wall assemblies.

I. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain
an airtight and smoke-tight seal; and comply with ASTM C 919 requirements or with manufacturer's written instructions, whichever are more stringent.

J. In elevator shafts where gypsum board shaft-wall assemblies cannot be positioned within 4 inches of the shaft face of structural beams, floor edges, and similar projections into shaft, install 1/2- or 5/8-inch-thick, gypsum board cants covering tops of projections. No recesses allowed (at steel beams especially).

1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft-wall framing.

2. Where steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft-wall framing.

K. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 21 16
SECTION 09 22 16 – NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes non-load-bearing steel framing members for the following applications:
   1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
   2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

B. Related Sections include the following:
   1. Division 05 Section "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.
   2. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall joint systems installed with non-load-bearing steel framing.
   3. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for non-load-bearing metal shaft-wall framing, gypsum panels, and other components of shaft-wall assemblies.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.

2.2 SUSPENSION SYSTEM COMPONENTS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.

C. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
   1. Depth: 1-1/2 inches.

E. Furring Channels (Furring Members):
   1. Cold-Rolled Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
   2. Steel Studs: ASTM C 645.
      a. Minimum Base-Metal Thickness: 0.0179 inch.
      b. Depth: As indicated on Drawings.
      a. Minimum Base Metal Thickness: 0.0179 inch.
   4. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.

F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
   1. Products: Subject to compliance with requirements, provide one of the following:
2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.
   1. Minimum Base-Metal Thickness: 0.0179 inch.
   2. Depth: As indicated on Drawings.

B. Slip-Type Head Joints: Where indicated, provide one of the following:
   1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) Steel Network Inc. (The).
         2) Superior Metal Trim.

C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
      b. Metal-Lite, Inc.; The System.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
   1. Minimum Base-Metal Thickness: 0.0179 inch.

E. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch wide flanges.
   1. Depth: 1-1/2 inches.
   2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
   1. Minimum Base Metal Thickness: 0.0179 inch.
   2. Depth: 7/8 inch.

G. Resilient Furring Channels: 1/2-inch deep, steel sheet members designed to reduce sound transmission.
H. Cold-Rolled Furring Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges.
   1. Depth: 3/4 inch.
   2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch.
   3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.

I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
   1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:
   1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
   2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
   1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:
1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.

2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.

4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

5. Do not attach hangers to steel roof deck.

6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.

7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.

8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

1. Space studs as follows:

   a. Single-Layer Application: 16 inches o.c., unless otherwise indicated.
   b. Multilayer Application: 16 inches o.c., unless otherwise indicated.
   c. Tile backing panels: 16 inches o.c., unless otherwise indicated.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

   a. Install two studs at each jamb, unless otherwise indicated.
b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.

c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

D. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. Z-Furring Members:

1. Erect insulation (specified in Division 07 Section "Thermal Insulation") vertically and hold in place with Z-furring members spaced 24 inches o.c.

2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 09 22 16
SECTION 09 29 00 – GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Interior gypsum board.
   2. Tile backing panels.

B. Related Sections include the following:
   1. Division 05 Section "Cold-Formed Metal Framing" for load-bearing steel framing that supports gypsum board.
   2. Division 06 Section "Sheathing" for gypsum sheathing.
   3. Division 07 Section "Thermal Insulation" for insulation installed in assemblies that incorporate gypsum board.
   4. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall assemblies that incorporate gypsum board.
   5. Division 09 Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board.
   6. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
   7. Division 09 Section "Tiling" for cementitious backer units installed as substrates for ceramic tile.
   8. Division 09 painting Sections for primers applied to gypsum board surfaces.

1.3 SUBMITTALS

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

B. Samples: For the following products:
   1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:
   a. Each level of gypsum board finish indicated for use in exposed locations.
   b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

A. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 5 percent by weight.
B. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Gypsum Co.
      b. BPB America Inc.
      c. G-P Gypsum.
      d. Lafarge North America Inc.
      e. National Gypsum Company.
      f. PABCO Gypsum.
      g. Temple.
      h. USG Corporation.

B. Regular Type:
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered.

C. Type X:
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered.

D. Flexible Type: Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
   1. Thickness: 1/4 inch.
   2. Long Edges: Tapered.

E. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.
   1. Thickness: 1/2 inch.
   2. Long Edges: Tapered.

F. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
   1. Basis of Design: Subject to compliance with the requirements, provide DensArmor as manufactured by Georgia Pacific or a comparable product.
   2. Core: 5/8 inch, Type X.
   4. Location: In Instructional Fitness Pool at high wall.
2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
   2. Shapes:
      a. Cornerbead.
      b. LC-Bead: J-shaped; exposed long flange receives joint compound.
      c. L-Bead: L-shaped; exposed long flange receives joint compound.
      d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
      e. Expansion (control) joint.
      f. Curved-Edge Cornerbead: With notched or flexible flanges.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   1. Interior Gypsum Wallboard: Paper.
   2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Prefilling: At open joints, rounded or beveled panel edges and damaged surface areas, use setting-type taping compound.
   2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
      a. Use setting-type compound for installing paper-faced metal trim accessories.
   3. Fill Coat: For second coat, use drying-type, all-purpose compound.
   4. Finish Coat: For third coat, use drying-type, all-purpose compound.
   5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

D. Joint Compound for Tile Backing Panels:
   1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
   2. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Regular Type: As indicated on Drawings.
2. Type X: Where required for fire-resistance-rated assembly and at vertical surfaces, unless otherwise indicated.
3. Flexible Type: Apply in double layer at curved assemblies.
4. Impact-Resistant Type: As indicated on Drawings
5. Moisture- and Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
   a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
   b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.
3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
   a. Primer and its application to surfaces are specified in other Division 09 Sections.
4. Level 5: Where indicated on Drawings.
   a. Primer and its application to surfaces are specified in other Division 09 Sections.

A. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.6 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00
SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes Interior Applications:
   1. Ceramic tile.
   2. Crack isolation membrane.
   3. Tile backing panels.

B. Related Sections:
   1. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.


C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028 to comply with Texas Department of Licensing and Regulations requirements.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required.
   2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
   3. Full-size units of each type of base, trim and accessory for each color and finish required.

D. Qualification Data: For qualified Installer.

E. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

F. Product Certificates: For each type of product, signed by product manufacturer.

G. Material Test Reports: For each tile-setting and -grouting product and special purpose tile.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
   1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
   1. Crack isolation membrane.
   2. Joint sealants.
   3. Cementitious backer units.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup of each type of wall tile installation.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site.
   1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

A. Tile Types: See Finish Schedule for Selection info for each tile type.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Basis of Design tile listed on finish schedule or comparable product by one of the following:
      a. American Olean; Division of Dal-Tile International Inc.
      b. Crossville, Inc.
      c. Daltile.
      d. Deutsche Steinzeug America, Inc.
      e. Interceramic.
      f. Lone Star Ceramics Company.
      g. Grupo Porcelanite.
      h. Portobello America, Inc.
      i. Seneca Tiles, Inc.

2. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, in maximum lengths available to minimize end-to-end butt joints.
   1. Products: Subject to compliance with requirements, provide the following:
      a. C-Cure; C-Cure Board 990.
      b. Custom Building Products; Wonderboard.
      c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
      d. USG Corporation; DUROCK Cement Board.
   2. Thickness: 5/8 inch.

2.4 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
B. PVC Sheet: PVC heat-fused on both sides to facings of nonwoven polyester.

1. **The Noble Company**
   a. Nominal Thickness: 0.040 inch.

2. **Compotite Corporation**
   a. Nominal Thickness: 0.040 inch.

2.5 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.


1. Products: Subject to compliance with requirements, provide one of the following:
   a. Boiardi Products; a QEP company; Elastiment 344 Reinforced Waterproofing and Anti-Fracture/Crack Suppression Membrane.
   b. Bonsal American; an Oldcastle company; B 6000 Waterproof Membrane with Glass Fabric.
   c. Bostik, Inc.; Hydroment Blacktop 90210.
   d. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
   e. Laticrete International, Inc.; Laticrete Blue 92 Anti-Fracture Membrane.
   f. MAPEI Corporation; Mapelastic L (PRP M19).
   g. Mer-Kote Products, Inc.; Hydro-Guard 2000.
   h. Summitville Tiles, Inc.; S-9000.

C. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. C-Cure; CureLastic 949.
   c. Custom Building Products; Redgard Waterproofing and Crack Prevention Membrane.
   d. Jamo Inc.; Waterproof.
   e. Mer-Kote Products, Inc.; Fracture-Guard 5000.
   f. Southern Grouts & Mortars, Inc.; Southcrete 1100 Crack Suppression and Waterproofing.
   g. TEC; a subsidiary of H. B. Fuller Company; HydraFlex - Waterproofing Crack Isolation Membrane.

D. Latex-Portland Cement: Flexible mortar consisting of cement-based mix and latex additive.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. C-Cure; UltraCure 971.
b. MAPEI Corporation; Mapelastic (PRP 315).
c. TEC; a subsidiary of H. B. Fuller Company; Triple Flex Waterproofing, Crack Isolation Membrane & Mortar.

2.6 SETTING MATERIALS


1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Boiardi Products; a QEP company.
   b. Bonsal American; an Oldcastle company.
   c. Bostik, Inc.
   d. C-Cure.
   e. Custom Building Products.
   f. Jamo Inc.
   g. Laticrete International, Inc.
   h. MAPEI Corporation.
   i. Southern Grouts & Mortars, Inc.
   j. Summitville Tiles, Inc.
   k. TEC; a subsidiary of H. B. Fuller Company.

2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.

2.7 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Boiardi Products; a QEP company.
   c. Bonsal American; an Oldcastle company.
   d. Bostik, Inc.
   e. C-Cure.
   f. Custom Building Products.
   g. Jamo Inc.
   h. Laticrete International, Inc.
   i. MAPEI Corporation.
   j. Mer-Kote Products, Inc.
   k. Southern Grouts & Mortars, Inc.
   l. Summitville Tiles, Inc.
   m. TEC; a subsidiary of H. B. Fuller Company.
2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F and 212 deg F, respectively, and certified by manufacturer for intended use.

2.8 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants."

1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. DAP Inc.; Titanium Enriched Kitchen and Bath Sealant.
   b. Dow Corning Corporation; Dow Corning 786.
   c. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
   e. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
   f. Tremco Incorporated; Tremsil 600 White.

2.9 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F per ASTM D 87.
2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
D. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Bonsal American; an Oldcastle company; Grout Sealer.
   b. Bostik, Inc.; CeramaSeal Grout & Tile Sealer.
   c. C-Cure; Penetrating Sealer 978.
   d. Custom Building Products; Surfaceguard Sealer.
   e. Jamo Inc.; Matte Finish Sealer.
   f. MAPEI Corporation; KER 003, Silicone Spray Sealer for Cementitious Tile Grout.
   g. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
   i. TEC; a subsidiary of H. B. Fuller Company; TA-256 Penetrating Silicone Grout Sealer.

2.10 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

   a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
   b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.

4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 TILE INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:

   a. Exterior tile floors.
   b. Tile floors in wet areas.
   c. Tile floors composed of tiles 8 by 8 inches or larger.
   d. Tile floors composed of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Ceramic Tile: 1/16 inch.

F. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

H. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 TILE BACKING PANEL INSTALLATION

A. Install cementitious backer units and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.6 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
1. Remove latex-portland cement grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 09 30 00
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Provide suspended ceiling acoustical ceiling panels including but not limited to:
   1. Linear Metal Ceiling System.

B. Related Sections:
   1. Section 01 81 19, Indoor Air Quality Requirements
   2. Section 23 50 00, Central Heating Equipment.
   3. Section 26 50 00, Lighting.

1.3 REFERENCES

A. Abbreviations and Acronyms:
   1. ASTM: American Society for Testing and Materials
   2. CISCA: Ceilings & Interior Systems Construction Association; www.cisca.org
   3. IBC: International Building Code
   4. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
   6. International Well Building Standard
   7. Mindful Materials
   8. Living Building Challenge

B. Reference Standards:
   1. ASTM A1008 - Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
2. ASTM A641 - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
3. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
4. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
6. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
9. ASTM E580 - Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
12. ASTM E1264 - Classification for Acoustical Ceiling Products

C. Alternates
1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been approved by Addenda, the specified products shall be provided without additional compensation.
2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meetings: Conduct meeting at Project site. Agenda includes Project conditions, coordination with work of other trades and layout of items which penetrate ceilings.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer’s Product data, including suspension system and maintenance data.

B. Samples: Submit samples of specified ceiling panels.

C. Show Drawings: Necessary technical drawings and documents that pertain to the layout of the acoustical metal ceiling.
D. Certifications: Acoustical metal ceiling product’s certifications that confirm compliance with applicable tests and standards. Acoustical metal ceiling products must also contain information pertaining to certification for NRC.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Supply additional material (full-size ceiling panels) equal to 5% of ceiling area. Additional material should match Products installed and have the appropriate labels and identification.

B. Supply extra materials that match Products installed and are packaged with protective covering for storage and identified with labels describing contents.

1.7 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

B. Fire Performance Details: Suspension ceiling components will feature markings of applicable testing and inspecting organization.

C. Coordination of Work: Coordination between installers and other related professions in reference to acoustical ceiling work can include electrical fixtures and systems, fire safety systems, gypsum and building construction.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect system components from excessive moisture in shipment, storage, and handling. Deliver in unopened bundles and store in a dry place with adequate air circulation.

1.9 WARRANTY

A. Manufacturer Warranty: Submit a written warranty executed by manufacturer for a period of 1 year from date for metal ceilings, of Substantial Completion, agreeing to repair or replace suspension system components that fail or are compromised within the specified warranty period. Failed or compromised parts can include, but are not limited to:

1. Rusting or defects directly made by the manufacturer.
2. Sagging or warping directly made by the manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Metal Ceiling Systems:
   1. Rockfon, 4849 South Austin Avenue, Chicago, IL 60638. 1-800-323-7164;
B. Suspension Systems:
1. Rockfon, 4849 South Austin Avenue, Chicago, IL 60638. 1-800-323-7164; www.rockfon.com.

C. Aluminum Perimeter Trim:
1. Rockfon, 4849 South Austin Avenue, Chicago, IL 60638. 1-800-323-7164; www.rockfon.com.

2.2 MATERIALS

A. Acoustical Metal Panels: Linear Metal Ceiling System, “PLANARMACRO® MACROPLUS™” LINEAR CEILINGS” by Rockfon with following characteristics:

1. Surface: Smooth
2. Composition: Metal
3. Material: 0.032” Aluminum
4. Edges: SQ
5. Color: See Drawings
6. Perforation Option: Yes
7. Filler: Recessed
8. NRC:
9. Fire Class: Class A.
10. Light Reflectance:
11. Recycled Content: up to 85%

B. Accessories:
1. Planar Filler Strips (Recessed): Manufactured from aluminum 3/4 inch wide by 144 inches long coated to match panel with linear metal panels.
2. Panel Splices: Manufactured from 0.025 inch thick aluminum 83/4 inches long coated with finish identical to linear metal panels, with profile compatible with linear panels.
3. End Plugs: Manufactured from 0.025 inch thick aluminum with square edges. Coated identical to linear metal panels.
4. Access Doors: Manufactured from galvanized steel with square edges. Coated identical to linear metal panels.
5. Perimeter Trim
   a. Rockfon Infinity: extruded aluminum perimeter trim
   b. Planar Macro Wall Channel: Manufactured from 0.025 inch thick aluminum 113/16 inch I.D. by 17/8 inch top flange by 1 inch bottom flange by 120 inches long. Coated identical to linear metal panels.
   c. Wall Angle: Manufactured from 0.025 inch thick aluminum 15/16 inch wide by 3/4 inch high by 144 inches long with hemmed edges.

C. Suspension System
1. Symmetrical Carrier:
   a. Manufactured to an inverted "U" shape from 0.040 inch aluminum 144 inches long. Coated with black polyester enamel. Architect Note: Double grip carrier required on
2. Slotted at appropriate intervals to receive stabilizing components as described below.

2. Stabilizer Bars: Manufactured from 0.025 inch thick aluminum (4913/16) (3513/16) (2313/16) inch long. Coated with black polyester enamel.

3. Radius Carrier: Manufactured to an inverted "U" shape from 0.040” thick aluminum 144” inches long with integral carrier tabs, painted black.

D. Acoustical Material

1. Blanket type black vinyl faced one side 1 1/2 inches thick by 1 1/2 pounds per cubic foot density with 0.90 NRC

E. Air Diffusion

1. Air Units: As specified on Drawings.
   a. Manufactured by others from 0.024 inch thick steel with gasketed lower flanges and factory applied acoustical insulation adhered to internal surfaces.
   b. "L" shaped directional vanes painted black.
   c. Optional remote control damper assembly with control cable extending through air distribution slot.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine suspension assemblies, with installer present, for compliance with requirements specified in this and other Sections affecting ceiling panel installation and with requirements for installation tolerances and other conditions affecting performance of acoustic ceiling assemblies.

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

3.2 INSTALLATION

A. Install ceiling panels to comply with ASTM C636/C636M, ASTM E580, and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. General:

1. For interior applications in non-seismic areas install in accordance with ASTM C636 (see 1.03, A 2.).
2. For interior applications in seismic areas install in accordance with IBC Section 1621.

C. Suspension System

1. Symmetrical Carriers: Installed 50 inches on center by direct suspension from existing structure with not less than 12 gauge hanger wires wrapped tightly 3 full turns, spaced 48 inches on center.
2. Stabilizer Bars: Installed perpendicular to symmetrical carrier 24 inches on center.

D. Linear Metal Panels:

1. Attach to main carrier tabs and connect with Panel Splices with joints staggered in
adjacent rows.
2. Slip-on Moldings: Install on exposed ends of panels.
3. End Plugs: Installed exposed ends of panels.
4. Wall Angles: Installed on vertical surfaces intersecting system by appropriate method in accordance with industry accepted practice.
5. Filler Strips: Installed into open reveal between panels.

E. Integrated Accessories
1. Insulation trimmed to fit and installed in plenum between carriers.

3.3 REPAIR

A. Remove damaged or compromised components; replace with undamaged components.

3.4 CLEANING

A. Clean exposed surfaces in accordance with manufacturer’s written instructions.

END OF SECTION
SECTION 09 51 13 – ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes acoustical panels and exposed suspension systems for ceilings.
B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 DEFINITIONS
A. AC: Articulation Class.
B. CAC: Ceiling Attenuation Class.
C. LR: Light Reflectance coefficient.
D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Ceiling suspension system members.
   2. Method of attaching hangers to building structure.
      a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
   3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
1. Acoustical Panel: Set of 6-inch-square samples of each type, color, pattern, and texture.
2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch-long samples of each type, finish, and color.

D. Qualification Data: For testing agency.
E. Field quality-control test reports.
F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
G. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.
H. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE
A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
B. Source Limitations:
   1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
   2. Suspension System: Obtain each type through one source from a single manufacturer.
C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
   1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
      a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
      b. Identify materials with appropriate markings of applicable testing and inspecting agency.
   2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
      a. Smoke-Developed Index: 450 or less.
E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.8 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

A. Recycled Content: Provide acoustical panels with recycled content such that total recycled content constitutes a minimum of 70 percent by weight.

B. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

C. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

D. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

E. Antimicrobial Fungicide Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING AC01

A. Basis-of-Design Product: Subject to compliance with requirements, provide Alaska #10200 as manufactured by Rockfon or a comparable product by one of the following:

1. Armstrong World Industries, Inc.
2. BPB USA.
3. Chicago Metallic Corporation.
4. Ecophon CertainTeed, Inc.
5. Tectum Inc.
6. USG Interiors, Inc.

B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with membrane-faced overlay; Form 2, water felted.
2. Pattern: CE.

C. Color: White.

D. LR: Not less than 0.85.

E. NRC: Not less than 0.55.

F. CAC: Not less than 33.
G. Edge/Joint Detail: Square.

H. Thickness: 5/8 inch.

I. Modular Size: 24 by 24 inches.

J. Grid: Chicago Metallic Integrity 4200 9/16”

2.3 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING AC02

A. Basis-of-Design Product: Subject to compliance with requirements, provide Alaska #10201 as manufactured by Rockfon or a comparable product by one of the following:

1. Armstrong World Industries, Inc.
2. BPB USA.
3. Chicago Metallic Corporation.
4. Ecophon CertainTec, Inc.
5. Tectum Inc.
6. USG Interiors, Inc.

B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type XII, Form 2.

C. Color: White.

D. LR: Not less than 0.83.

E. NRC: Not less than 0.90.

F. Edge/Joint Detail: Square Lay-in

G. Thickness: 3/4 inch.

H. Modular Size: 24 by 48 inches.

I. Grid: Chicago Metallic Integrity 4200 9/16”

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
C. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

D. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
   a. Type: Postinstalled expansion anchors.
   b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
   c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
4. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.

F. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

G. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

2.5 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Basis-of-Design Product: Subject to compliance with requirements, provide Integrity as manufactured by Rockfon, or a comparable product by one of the following:

1. Armstrong World Industries, Inc.
2. BPB USA.
3. Chicago Metallic Corporation.
4. Ecophon CertainTeed, Inc.
5. US Gypsum, Inc.

B. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished 9/16-inch- wide metal caps on flanges.

2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
6. Cap Width: 15/16”.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.7 ACOUSTICAL SEALANT

A. Products: Subject to compliance with requirements, provide one of the following:

1. Acoustical Sealant for Exposed and Concealed Joints:
   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
   b. USG Corporation; SHEETROCK Acoustical Sealant.

B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

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

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

9. Do not attach hangers to steel deck tabs.

10. Do not attach hangers to steel roof deck. Attach hangers to structural members.

11. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.

3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:

   a. As indicated on reflected ceiling plans.
   b. Install panels with pattern running in one direction parallel to long axis of space.
   c. Install panels in a basket-weave pattern.

2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.

3. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.

4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:

1. Suspended ceiling system.
2. Hangers, anchors and fasteners.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Tests and Inspections: Testing and inspecting of completed installations of acoustical panel ceiling hangers and anchors and fasteners shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.

1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.

   a. Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every 2 postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
   b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Remove and replace acoustical panel ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13
SECTION 09 65 13 – RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Resilient base.
B. Related Sections:
   1. Division 09 Section "Resilient Tile Flooring" for resilient floor tile.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Samples for Initial Selection: For each type of product indicated.
C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.
D. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE
A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
B. Mockups: Provide resilient products with mockups specified in other Sections.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.
1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE - RB1

A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allstate Rubber Corp.; Stoler Industries.
   b. Armstrong World Industries, Inc.
   c. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
   d. Endura Rubber Flooring; Division of Burke Industries, Inc.
   e. Estrie Products International; American Biltrite (Canada) Ltd.
   f. Flexco, Inc.
   g. Johnsonite.
   h. Mondo Rubber International, Inc.
   i. Musson, R. C. Rubber Co.
   j. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
   k. PRF USA, Inc.
   l. Roppe Corporation, USA.
   m. VPI, LLC; Floor Products Division.


1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous) or Group II (layered).
3. Style: Straight (flat or toeless).

C. Minimum Thickness: 0.125 inch.

D. Height: 4 inches.
E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job-formed.

G. Inside Corners: Job-formed.

H. Finish: Matte.

I. Colors and Patterns: Burnt Umber as manufactured by Johnsonite.

2.2 RESILIENT BASE – RB2

A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allstate Rubber Corp.; Stoler Industries.
   b. Armstrong World Industries, Inc.
   c. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
   d. Endura Rubber Flooring; Division of Burke Industries, Inc.
   e. Estrie Products International; American Biltrite (Canada) Ltd.
   f. Flexco, Inc.
   g. Johnsonite.
   h. Mondo Rubber International, Inc.
   i. Musson, R. C. Rubber Co.
   j. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
   k. PRF USA, Inc.
   l. Roppe Corporation, USA.
   m. VPI, LLC; Floor Products Division.


1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous) or Group II (layered).
3. Style: Straight (flat or toeless).

C. Minimum Thickness: 0.125 inch.

D. Height: 4 inches.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job-formed.

G. Inside Corners: Job-formed.

H. Finish: Matte.

I. Colors and Patterns: To be determined.
2.3 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   a. Cove Base Adhesives: Not more than 50 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

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

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. Job-Formed Corners:
   1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
   2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 09 65 13
PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: This section includes labor, materials and other services necessary to complete resilient sheet flooring and accessories work. Conform with requirements of all Sections of Division 1, General Requirements, as it applies to the work of this Section.

B. Related Sections:
   1. Section 03300 - Cast-in-Place Concrete: Concrete finishing.
   2. Section 06100 - Rough Carpentry: Plywood floor sheathing.
   3. Division 7 - Thermal and Moisture Protection.
   4. Division 15 - Mechanical.

1.02 REFERENCES

D. ASTM F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
I. (RFCI) Resilient Floor Covering Institute
   1. RFCI Standard Slab Moisture Test Method (Calcium Chloride Method)

1.03 SUBMITTALS

A. Product Data: Submit manufacturer’s current printed product literature, specifications, installation instructions, and field reports in accordance with Section 013300 - Submittal Procedures.

B. Shop Drawings: Submit shop drawings to indicate materials, details, and accessories in accordance with Section 013300 - Submittal Procedures including but limited to the following:
   1. Submit a cut diagram indicating seam locations and roll direction. Use mitered seam layouts for corners when changing directions 180 degrees (e.g. when running material down corridors which bisect at a right angle), unless approved otherwise.

C. Samples: Submit duplicate 12" x 12" (300 mm x 300 mm) sample pieces of sheet material, 12" (300 mm) long gulley edge, cap strip, joint cover strip, cove former in accordance with Section 013300 - Submittal Procedures.
D. Closeout Submittals: Submit the following:
   1. Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals Section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
   1. Training: Installer who has attended an Altro flooring installation training clinic.

B. Regulatory Requirements: Provide sheet vinyl flooring in compliance with the following:
   2. Occupational Safety & Health Administration (OSHA).

C. Mock-ups: Install at project site a job mock-up using acceptable products and manufacturer approved installation methods, including concrete substrate testing.
   1. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
   2. Incorporation: Mock-up may be incorporated into final construction upon Owner’s approval.

D. Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer’s installation instructions, manufacturer’s warranty requirements, and installer qualifications.

1.05 SITE CONDITIONS

A. Temperature Requirements: If storage temperature is below 65F (18C) or the floor temperature is below 50F (18C), the Altro safety flooring product must be moved to a warmer place and allowed to reach this temperature before unrolling or installation. For further information, refer to current Altro Installation Practices and Quick Facts.

B. Maintain air temperature and structural base temperature at flooring installation area between 68F (20C) and 80F (26C) for 48 hours before, during and 24 hours after installation.

1.06 WARRANTY

A. Warranty period for Altro Symphonia shall be 10 years commencing on date of substantial completion. Refer to conditions of the contract for project warranty provisions.

1.07 BACKING

A. Altro Symphonia uses non-woven polyester/cellulose, glass fiber reinforcement.

PART 2  PRODUCTS

2.01 FLOORING

A. Sheet Vinyl Manufacturer: Symphonia by Altro or Similar.

B. Acceptable material: Altro Symphonia (measurements and product weights given below are approximate): Slip Resistance ASTM 2047 >.6 dry >.7 wet. Alternates acceptable if specifications met.
COLOR
1. Tern-AQ12008: Thickness: 0.08” (2 mm); Roll Width: 6’ 7” (2 m); Roll Length: 66’ (20 m); Roll Weight: 225 lb (102 kg);

2.02 ACCESSORIES

A. Vinyl welding rod: Acceptable material:
   1. Altro weld rod
B. Cove former: Acceptable material, sized to suit application:
   1. Altro Cove former 20R - 24 mm (1”) radius
C. Gulley edge: Acceptable material, vinyl, sized to suit application:
   1. Altro Gulley Edge GA 35/25
D. Cap strip: Acceptable material, sized to suit application, stainless steel:
   1. Altro Cap Strip [C4] [C7] [C8] [C11].
E. Subfloor Filler and Leveler: Use only gray Portland cement-based “moisture tolerant”
   underlayments, and patching compounds. Use for filling cracks, holes or leveling. White gypsum
   materials are not acceptable.
F. Metal edge strips:
   1. Aluminum extruded, smooth, [mill finish] stainless steel with lip to extend over flooring.
G. Adhesives
   1. Altrofix 30- 2 part polyurethane for areas prone to moisture

PART 3 EXECUTION

3.01 EXAMINATION

A. Compliance: Comply with manufacturer’s product data, including product technical bulletins, product catalog, installation instructions.

B. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer’s instructions.

3.02 PREPARATION

A. Flooring shall be installed over subfloors conforming to ASTM F710 for concrete and other monolithic floors or ASTM F1482 for wood subfloors.

B. Always conduct moisture tests per ASTM F-2170 on all concrete slabs regardless of age or grade level. ASTM F-2170 Relative Humidity (IRH) test results must not exceed 90%.

C. Do not proceed with work until results of moisture condition tests are acceptable.

D. When patching, a moisture tolerant patching compound must always be used.
3.03 INSTALLATION

A. Symphonia Installation: Install Altro flooring in accordance with the current posted Altro Installation Practices and Quick Facts Guide. All Seams shall be heat welded with Altro Weldrod™ only. Failure to install Altro flooring in accordance with recommended procedures will void the Altro Limited Product Warranty.

B. Coved Installation: Where Altro flooring is coved up wall surfaces and other abutments, installation shall be in accordance with Altro flooring Installation Practices using the following accessories:
   1. At standard wall finishes: Use Altro C7 vinyl cap strip to accommodate sheet vinyl to a height as indicated.
   2. At ceramic tile, Altro Whiterock semi-rigid wall cladding or FRP paneling: Use Altro C8 Vinyl Captile Strip or C4 cap, respectively.
   3. At 0.75" (19.1 mm) radius coving at juncture of vertical and horizontal surfaces: Use Altro Vinyl Cove Former 20R.
   4. At 1.5" (38 mm) radius coving at juncture of vertical and horizontal surfaces: Use Altro Vinyl Cove Former 38R.
   5. Top set cove base: Install in accordance with manufacturer’s instructions.

3.04 CLEANING

Specifier Note: Altro flooring is unaffected by surface water and most chemicals which do not have a solvent action on vinyl. Certain organic solvents and chemicals, including asphalt, can cause staining. Acids and dyes may affect the color, which should be selected accordingly. Contact Altro for information about the effect of chemicals on Altro flooring.

A. Cleaning: Remove temporary coverings and protection of adjacent work areas.
   1. Repair or replace damaged installed products.
   2. Clean installed products in accordance with manufacturer’s instructions prior to Owner’s acceptance.

B. Protection:
   1. Sweep or vacuum all construction debris and dust first, then clean the flooring with Altro Clean 44 using an auto scrubber.

3.05 PROTECTION

A. Cover and protect finished installation from damage from other trades using a non-staining, temporary floor protection system, such as a reusable textured plastic sheeting. Symphonia should be covered and protected from all other trades during construction with a suitable non-staining protective covering without taping to the surface of the flooring.
SECTION 09 65 66 – RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Rubber floor tile.

B. Related Sections:
   1. Division 09 Section "Resilient Base and Accessories" for wall base and accessories installed with flooring.

1.3 SUBMITTALS

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

B. Shop Drawings: Show installation details and locations of the following:
   1. Border tiles.
   2. Floor patterns.
   3. Locations of floor inserts for athletic equipment installed through flooring.
   4. Seam locations for sheet flooring.

C. Samples for Initial Selection: For each type of flooring indicated.

D. Samples for Verification: For each type, color, and pattern of flooring indicated, 6-inch- square Samples of same thickness and material indicated for the Work.
   1. Seam Samples: For each sheet flooring color and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.

E. Qualification Data: For qualified sheet flooring Installer.

F. Maintenance Data: For flooring to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Rubber Flooring Installer Qualifications: An experienced Installer who has completed sheet rubber flooring installations using seaming methods indicated for this Project and similar in
material, design, and extent to that indicated for this Project; who is acceptable to manufacturer; and whose work has resulted in installations with a record of successful in-service performance.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.

B. Store materials to prevent deterioration. Store tiles on a flat surface.

1.6 FIELD CONDITIONS

A. Adhesively Applied Products:

1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.

2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F or more than 95 deg F.

3. Close spaces to traffic during flooring installation.

4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.

B. Install flooring after other finishing operations, including painting, have been completed.

1.7 COORDINATION

A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

PART 2 - PRODUCTS

2.1 RUBBER FLOOR TILE– RAF1

A. Basis-of-Design Product: Subject to compliance with requirements, provide 8mm And/Or Rubber Cork flooring as manufactured by Capri Cork. or comparable product by one of the following:

1. Aacer Flooring, LLC.
2. Action Floor Systems, LLC.
3. Amarco Products.
4. American Floor Products Company, Inc.
5. ECORE International.
6. Flexco.
8. Johnsonite; a Tarkett company.
12. Sport Court; Subsidiary of Connor Sport Court International.
13. Surface America Incorporated.

A. Description: Athletic flooring consisting of modular rubber tiles with smooth edges for adhered application.
B. Material: 34.9% pre-consumer recycled content, blend EPDM and Cork
C. Traffic-Surface Texture: Smooth
D. Tile Size: 24” x 24” tile
E. Thickness: 8 mm.
F. Color and Pattern: as noted on finish schedule

2.2 ACCESSORIES
B. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.
   1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.
   1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of flooring.
B. Concrete Substrates: Prepare according to ASTM F 710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Alkalinity Testing: Perform pH testing according to ASTM F 710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.

3. Moisture Testing:
   
a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

   1) Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than two tests in each installation area and with test areas evenly spaced in installation areas.

b. Perform relative humidity test using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.

   1. Do not install flooring until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust.

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

3.3 FLOORING INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.
3.4 FLOOR TILE INSTALLATION

A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated.

B. Discard broken, cracked, chipped, or deformed tiles.

C. Tile Matching: Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged if so numbered.

1. Lay tiles in pattern of colors and sizes indicated.

D. Adhered Floor Tile: Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.5 Free-Lay Tile: Place flooring at locations indicated with units securely interconnected and fully seated on substrate to form a smooth, level surface

3.6 CLEANING AND PROTECTING

A. Perform the following operations immediately after completing flooring installation:

1. Remove adhesive and other blemishes from flooring surfaces.
2. Sweep and vacuum flooring thoroughly.
3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.

B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 09 65 66
SECTION 09 68 13 – TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes modular, tufted carpet tile.

1.2 PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: Show the following:
      1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
      2. Type of subfloor.
      3. Type of installation.
      4. Pattern of installation.
      5. Pattern type, location, and direction.
      6. Pile direction.
   C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS
   A. Product test reports.
   B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS
   A. Maintenance data.

1.6 QUALITY ASSURANCE
   A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.8 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

1.9 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber and delamination.
3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE PRODUCTS

A. Tile Types: See Finish Schedule for Selection info for each tile type.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Basis of Design tile listed on finish schedule or comparable product by one of the following:
   a. Interface, LLC
   b. J&J Invision
   c. Mannington Mills, Inc
   d. Milliken & Company
   e. Mohawk Group
   f. Patcraft
   g. Shaw Contract Group

2. Composition: See Finish Schedule
3. Module Size: See Finish Schedule
4. Thickness: As scheduled.
5. Face: Plain with cushion edges.
6. Surface: As scheduled.
7. Tile Color and Pattern: See Finish Schedule and Finish Floor Plans
8. Epoxy Grout Color: As selected by Architect from manufacturer's full range.

B. Applied Soil-Resistance Treatment: Manufacturer's standard material.

C. Antimicrobial Treatment: Manufacturer's standard material.

D. Performance Characteristics: As follows:
   1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D 7330.
   2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
   3. Dry Breaking Strength: Not less than 100 lbf according to ASTM D 2646.
   4. Tuft Bind: Not less than 3 lbf according to ASTM D 1335.
   5. Delamination: Not less than 3.5 lbf/in. according to ASTM D 3936.
   6. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
   7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
   9. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
   10. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC 16, Option E.
   11. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
   12. Electrostatic Propensity: Less than 3.5kV according to AATCC 134.
   13. Emissions: Provide carpet tile that complies with testing and product requirements of CRI's "Green Label Plus" program.

2.2 CARPET TILE

A. Basis-of-Design Product: Subject to compliance with requirements, provide TBD as scheduled.

B. Color: TBD

C. Pattern: TBD

D. Fiber Content:

E. Pile Characteristic:

F. Primary Backing/Backcoating: Manufacturer's standard composite materials.

G. Secondary Backing: Manufacturer's standard material.

H. Size: TBD

I. Applied Soil-Resistance Treatment: Manufacturer's standard material.

J. Antimicrobial Treatment: Manufacturer's standard material.
K. Performance Characteristics: As follows:

1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D 7330.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
3. Dry Breaking Strength: Not less than 100 lbf according to ASTM D 2646.
4. Tuft Bind: Not less than 3 lbf according to ASTM D 1335.
5. Delamination: Not less than 3.5 lbf/in. according to ASTM D 3936.
6. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
9. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
10. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC 16, Option E.
11. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
12. Electrostatic Propensity: Less than 3.5kV according to AATCC 134.
13. Emissions: Provide carpet tile that complies with testing and product requirements of CRI's "Green Label Plus" program.

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
D. Preparation: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

E. Installation: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

F. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

G. Maintain dye lot integrity. Do not mix dye lots in same area.

H. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

I. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

J. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

K. Install pattern parallel to walls and borders.

L. Perform the following operations immediately after installing carpet tile:
   1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
   2. Remove yarns that protrude from carpet tile surface.

M. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

END OF SECTION 09 68 13
SECTION 09 84 33 – SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes shop-fabricated, fabric-wrapped, sound-absorbing wall panel units tested for acoustical performance.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: For sound-absorbing wall units. Include mounting devices and details.
   C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS
   A. Product certificates.

1.4 CLOSEOUT SUBMITTALS
   A. Maintenance data.

1.5 QUALITY ASSURANCE
   A. Fire-Test-Response Characteristics: Provide sound-absorbing wall units meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
      1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
         a. Flame-Spread Index: 25 or less.
         b. Smoke-Developed Index: 450 or less.
      2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265.
   B. Preinstallation Conference: Conduct conference at Project site.
PART 2 - PRODUCTS

2.1 SOUND-ABSORBING WALL UNITS

A. **Basis-of-Design Product**: Subject to compliance with requirements, provide FilzFelt products or comparable product by one of the following:

2. Acoustical Solutions, Inc.
3. Armstrong World Industries.
4. AVL Systems, Inc.
5. Benton Brothers Solutions, Inc.
6. Conwed Designscape; an Owens Corning company.
7. Decoustics Limited; a CertainTeed Ceilings company.
8. Essi Acoustical Products.
10. Kinetics Noise Control, Inc.
11. Lamvin, Inc.
12. MBI Products Company, Inc.
13. Panel Solutions, Inc.
15. Pinta Acoustic, Inc.
17. Sound Concepts Canada, Inc.
18. Sound Management Group LLC.
19. Tectum Inc.
20. Wall Technology, Inc.; an Owens Corning company.
21. Working Walls, Inc.

B. Sound-Absorbing Wall Panel: 100% Wool design Felt plus Akustika 10 substrate.

1. Mounting: Zee Clips
2. Panel thickness with Zee Clips: ¾”
3. Standard sizes: 6 ft. min, 3’-11” x 9’-10” max.
4. Edge Construction: Wrapped at exposed edges
5. Acoustical Performance: Sound absorption NRC of 0.75
6. Nominal Overall Panel Thickness: 1 inch.

2.2 FABRICATION

A. General: Use manufacturer's standard construction except as otherwise indicated.

B. Install product cut to size as shown on architectural drawings.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install sound-absorbing wall units in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with sound-absorbing wall unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

C. Align and level fabric pattern and grain among adjacent units.

D. Clip loose threads; remove pills and extraneous materials.

E. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 09 84 33
SECTION 09 91 13 – EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
   1. Concrete masonry units (CMU).
   2. Steel.
   4. Aluminum (not anodized or otherwise coated).

B. Related Sections include the following:
   1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
   2. Division 09 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3 SUBMITTALS

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

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.

   1. Submit Samples on rigid backing, 8 inches square.
   2. Step coats on Samples to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

   1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
   2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
   a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
   b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on benchmark samples.
   a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
4. BLP Mobile Paint Manufacturing.
7. Cloverdale Paint.
10. Coronado Paint.
11. Davis Paint Company.
15. Durant Paints Inc.
16. Duron, Inc.
17. Envirocoat Technologies Inc.
18. Farrell-Calhoun.
20. Frazee Paint.
21. General Paint.
22. Griggs Paint.
23. Hallman Lindsay Quality Paints.
24. Hirshfield's, Inc.
25. ICI Devoe (Canada).
26. ICI Paints.
27. ICI Paints (Canada).
28. Insl-x.
29. Iowa Paint Manufacturing Company, Inc.
32. Kwal-Howells Paint.
34. McCormick Paints.
35. Miller Paint.
36. Mills Paint.
37. NCP Coatings.
38. Northern Paint.
39. PARA Paints.
41. Porter Paints.
42. PPG Architectural Finishes, Inc.
43. Rodda Paint Co.
44. Sherwin-Williams Company (The).
45. Sico, Inc.
46. Sigma Coatings.
47. Smiland Paint Company.
48. Spectra-Tone.
49. Tamms Industries, Inc.
50. Tower Paint.
51. Vista Paint.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As selected by Architect from manufacturer's full range.

2.3 BLOCK FILLERS


1. VOC Content: E Range of E2.

2.4 PRIMERS/SEALERS

A. Alkali-Resistant Primer: MPI #3.

1. VOC Content: E Range of E1.

2.5 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.

1. VOC Content: E Range of E1.

B. Quick-Drying Alkyd Metal Primer: MPI #76.

1. VOC Content: E Range of E1.

C. Waterborne Galvanized-Metal Primer: MPI #134.

1. VOC Content: E Range of E1.
2. Environmental Performance Rating: EPR 1.
D. Quick-Drying Primer for Aluminum: MPI #95.
   1. VOC Content: E Range of E1.

2.6 EXTERIOR LATEX PAINTS
A. Exterior Latex (Semigloss): MPI #11 (Gloss Level 5).
   1. VOC Content: E Range of E1.

2.7 EXTERIOR ALKYD PAINTS
A. Exterior Alkyd Enamel (Semigloss): MPI #94 (Gloss Level 5).
   1. VOC Content: E Range of E1.

2.8 QUICK-DRYING ENAMELS
A. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).
   1. VOC Content: E Range of E1.

2.9 ALUMINUM PAINT
A. Aluminum Paint: MPI #1.
   1. VOC Content: E Range of E1.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent.
   3. Wood: 15 percent.
   4. Plaster: 12 percent.
   5. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
   1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
   2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Aluminum Substrates: Remove surface oxidation.

I. Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.
   1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:

1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will perform tests for compliance of paint materials with product requirements.

3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:
1. Latex System: MPI EXT 3.1A.
   c. Topcoat: Exterior latex (semigloss).

B. CMU Substrates:

1. Latex System: MPI EXT 4.2A.
   c. Topcoat: Exterior latex (semigloss).

C. Steel Substrates:

1. Alkyd System: MPI EXT 5.1D.
   c. Topcoat: Exterior alkyd enamel (semigloss).

D. Galvanized-Metal Substrates:

1. Alkyd System: MPI EXT 5.3B.
   c. Topcoat: Exterior alkyd enamel (semigloss).

E. Aluminum Substrates:

1. Alkyd System: MPI EXT 5.4F.
   c. Topcoat: Exterior alkyd enamel (semigloss).

END OF SECTION 09 91 13
SECTION 09 91 23 – INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Steel.
4. Aluminum (not anodized or otherwise coated).
5. Gypsum board.

B. Related Sections include the following:

1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 09 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
3. Division 09 Section "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

1.3 SUBMITTALS

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

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

A. MPI Standards:
   1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
      a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft..
      b. Other Items: Architect will designate items or areas required.
   2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
   3. Final approval of color selections will be based on benchmark samples.
      a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
4. BLP Mobile Paint Manufacturing.
7. Cloverdale Paint.
10. Coronado Paint.
11. Davis Paint Company.
14. Durant Paints Inc.
15. Duron, Inc.
16. Envirocoat Technologies Inc.
17. Farrell-Calhoun.
18. Flex Bon Paints.
19. Frazee Paint.
20. General Paint.
22. Hallman Lindsay Quality Paints.
23. Hirshfield's, Inc.
24. ICI Devoe (Canada).
25. ICI Paints.
26. ICI Paints (Canada).
27. Insl-x.
32. M.A.B. Paints.
33. McCormick Paints.
2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Floor Coatings: VOC not more than 100 g/L.
5. Shellacs, Clear: VOC not more than 730 g/L.
6. Shellacs, Pigmented: VOC not more than 550 g/L.
7. Flat Topcoat Paints: VOC content of not more than 50 g/L.
8. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
9. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
10. Floor Coatings: VOC not more than 100 g/L.
11. Shellacs, Clear: VOC not more than 730 g/L.
12. Shellacs, Pigmented: VOC not more than 550 g/L.
13. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
14. Dry-Fog Coatings: VOC content of not more than 400 g/L.
15. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
16. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.

C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:
   
   a. Acrolein.
   b. Acrylonitrile.
   c. Antimony.
   d. Benzene.
   e. Butyl benzyl phthalate.
   f. Cadmium.
   g. Di(2-ethylhexyl) phthalate.
   h. Di-n-butyl phthalate.
   i. Di-n-octyl phthalate.
   j. 1,2-dichlorobenzene.
   k. Diethyl phthalate.
   l. Dimethyl phthalate.
   m. Ethylbenzene.
   n. Formaldehyde.
   o. Hexavalent chromium.
   p. Isophorone.
   q. Lead.
   r. Mercury.
   s. Methyl ethyl ketone.
   t. Methyl isobutyl ketone.
   u. Methylene chloride.
   v. Naphthalene.
   w. Toluene (methylbenzene).
   x. 1,1,1-trichloroethane.
   y. Vinyl chloride.

D. Colors: As selected by Architect from manufacturer's full range.

2.3 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.
   
   1. VOC Content: E Range of E1.
   2. Environmental Performance Rating: EPR 1.

B. Interior Alkyd Primer/Sealer: MPI #45.
   
   1. VOC Content: E Range of E1.
2.4 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.
   1. VOC Content: E Range of E1.

B. Quick-Drying Alkyd Metal Primer: MPI #76.
   1. VOC Content: E Range of E1.

C. Rust-Inhibitive Primer (Water Based): MPI #107.
   1. VOC Content: E Range of E1.
   2. Environmental Performance Rating: EPR 1.

D. Waterborne Galvanized-Metal Primer: MPI #134.
   1. VOC Content: E Range of E1.
   2. Environmental Performance Rating: EPR 1.

E. Quick-Drying Primer for Aluminum: MPI #95.
   1. VOC Content: E Range of E1.

2.5 LATEX PAINTS

A. Interior Latex (Low Sheen): MPI #44 (Gloss Level 2).
   1. VOC Content: E Range of E1.
   2. Environmental Performance Rating: EPR 1.

B. Interior Latex (Eggshell): MPI #52 (Gloss Level 3).
   1. VOC Content: E Range of E1.
   2. Environmental Performance Rating: EPR 1.

C. Interior Latex (Satin): MPI #43 (Gloss Level 4).
   1. VOC Content: E Range of E1.
   2. Environmental Performance Rating: EPR 1.5.

D. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).
   1. VOC Content: E Range of E1.
   2. Environmental Performance Rating: EPR 2.

2.6 ALKYD PAINTS

A. Interior Alkyd (Eggshell): MPI #51 (Gloss Level 3).
1. VOC Content: E Range of E1.

B. Interior Alkyd (Semigloss): MPI #47 (Gloss Level 5).
   1. VOC Content: E Range of E1.
   2. Environmental Performance Rating: EPR 1.

2.7 QUICK-DRYING ENAMELS
A. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).
   1. VOC Content: E Range of E1.

2.8 ALUMINUM PAINT
A. Aluminum Paint: MPI #1.
   1. VOC Content: E Range of E1.

2.9 FLOOR COATINGS
A. Interior Concrete Floor Stain: MPI #58.
   1. VOC Content: E Range of E1.
   2. Environmental Performance Rating: EPR 2.
B. Interior/Exterior Clear Concrete Floor Sealer (Water Based): MPI #99.
   1. VOC Content: E Range of E1.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent.
   2. Gypsum Board: 12 percent.
   3. Plaster: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Aluminum Substrates: Remove surface oxidation.

I. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.
1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:

1. Mechanical Work:
   a. Uninsulated metal piping.
   b. Uninsulated plastic piping.
   c. Pipe hangers and supports.
   d. Tanks that do not have factory-applied final finishes.
   e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
   f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

2. Electrical Work:
   a. Switchgear.
   b. Panelboards.
   c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:

1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System: MPI INT 3.1E.
   c. Topcoat: Interior latex (eggshell).

B. Concrete Substrates, Traffic Surfaces:

1. Concrete Stain System: MPI INT 3.2E.

2. Clear Sealer System: MPI INT 3.2F.

C. Steel Substrates:

1. Quick-Drying Enamel System: MPI INT 5.1A.
c. Topcoat: Quick-drying enamel (semigloss).

2. Latex Over Alkyd Primer System: MPI INT 5.1Q.
   c. Topcoat: Interior latex (eggshell).

3. Alkyd System: MPI INT 5.1E.
   c. Topcoat: Interior alkyd (eggshell).

4. Aluminum Paint System: MPI INT 5.1M.
   c. Topcoat: Aluminum paint.

5. Institutional Low-Odor/VOC Latex System: MPI INT 5.1S.
   a. Prime Coat: Rust-inhibitive primer (water based).

D. Galvanized-Metal Substrates:
1. Alkyd System: MPI INT 5.3C.
   c. Topcoat: Interior alkyd (eggshell).

2. Aluminum Paint System: MPI INT 5.3G.
   c. Topcoat: Aluminum paint.

3. Institutional Low-Odor/VOC Latex System: MPI INT 5.3N.

E. Aluminum (Not Anodized or Otherwise Coated) Substrates:
1. Latex System: MPI INT 5.4H.
c. Topcoat: Interior latex (eggshell).

2. Aluminum Paint System: MPI INT 5.4D.
   a. Prime Coat: Vinyl wash primer.
   c. Topcoat: Aluminum paint.

3. Institutional Low-Odor/VOC Latex System: MPI INT 5.4G.

F. Gypsum Board Substrates:

1. Latex System: MPI INT 9.2A.
   c. Topcoat: Interior latex (eggshell).

   c. Topcoat: Interior alkyd (eggshell).

3. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.

END OF SECTION 09 91 23
SECTION 09 93 00 – STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes surface preparation and application of wood finishes.

B. Related Requirements:
   1. Division 09 Section "Exterior Painting" for standard paint systems on exterior substrates.
   2. Division 09 Section "Interior Painting" for stains and transparent finishes on concrete floors.

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

D. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

E. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification: For each type of finish system and in each color and gloss of finish indicated.
   1. Submit Samples on representative samples of actual wood substrates, 8 inches square.
   2. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:
1. Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules.

2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the product proposed for use highlighted.

3. VOC content.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
   a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
   b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.
   a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply finishes when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Benjamin Moore & Co.
5. BLP Mobile Paint Manufacturing.
7. Cloverdale Paint.
11. Coronado Paint.
12. Davis Paint Company.
15. Durant Paints Inc.
16. Duron, Inc.
17. Euclid Chemical Company.
18. Farrell-Calhoun.
19. Frazee Paint.
20. General Paint.
22. Hirshfield's, Inc.
23. ICI Paints.
24. ICI Paints (Canada).
25. Insl-x.
27. Kwal Paint.
28. Life Paint Corp.
31. Miller Paint.
32. Mills Paint.
33. PARA Paints.
34. Parex LaHabra Inc.
36. PPG Architectural Finishes, Inc.
37. Pratt & Lambert.
38. Rodda Paint Co.
40. Sherwin-Williams Company (The).
41. Sico, Inc.
42. Target Coatings.
43. Vista Paint.
44. Zinsser.

2.2 MATERIALS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
B. Material Compatibility:
   1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior stains and finishes applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   1. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
   2. Shellacs, Clear: VOC not more than 730 g/L.
   3. Stains: VOC not more than 250 g/L.
   4. Primers, Sealers, and Undercoaters: 200 g/L.

D. Low-Emitting Materials: Interior stains and finishes shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Stain Colors: As selected by Architect from manufacturer's full range.

2.3 WOOD FILLERS
   A. Wood Filler Paste: MPI #91.

2.4 PRIMERS AND SEALERS
   A. Alkyd, Sanding Sealer, Clear: MPI #102.

2.5 STAINS
   A. Stain, Semi-Transparent, for Interior Wood: MPI #90.

2.6 WATER-BASED VARNISHES
   A. Varnish, Water Based, Clear, Satin (Gloss Level 4): MPI #128.

2.7 POLYURETHANE VARNISHES
   A. Varnish, Interior, Polyurethane, Oil-Modified, Satin (Gloss Level 4): MPI #57.
2.8 SOURCE QUALITY CONTROL

A. Testing of Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample wood finishing materials. Contractor will be notified in advance and may be present when samples are taken. If materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying wood finishes if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and refinish surfaces finished with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces before refinish with complying materials if the two finishes are incompatible or produce results that, in the opinion of the Architect, are aesthetically unacceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.
C. Maximum Moisture Content of Interior Wood Substrates: 15 percent, when measured with an electronic moisture meter.
D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
E. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

D. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
3. Sand surfaces that will be exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for finish and substrate indicated.
2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.
3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood substrates, nontraffic surfaces, including doors and paneling.

1. Semitransparent Stain System:
   b. Topcoat: Stain, semi-transparent, for interior wood, MPI #90.

2. Polyurethane Varnish over Stain System:
   a. Stain Coat: Stain, semi-transparent, for interior wood, MPI #90.
   b. Topcoat: Varnish, interior, polyurethane, oil-modified, satin (Gloss Level 4), MPI #57.

3. Clear, Two-Component Polyurethane System:
   c. Topcoat: Varnish, aliphatic polyurethane, two-component (Gloss Level 6 or Gloss Level 7), MPI #78.

END OF SECTION 09 93 00
SECTION 099656 - EPOXY FLOOR COATINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Provide a complete epoxy floor system for concrete surfaces that meet the requirements for specific use indicated in the contract documents. Include all applicable substrate testing, surface preparation, and detail work.

1.02 RELATED SECTIONS

A. Section 033000 – Cast-In-Place Concrete
B. Section 090000 - Finishes

1.03 SUBMITTALS

A. Submit under provisions of Section 013300.
B. Product Data: Submit manufacturer’s product data sheets on each product and system to be used including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements.
   3. Installation methods.
   4. Maintenance requirements.
C. Selection Samples: For each system specified, provide two sets of samples and color charts, representing manufacturer’s full range of colors and patterns.

1.04 QUALITY ASSURANCE

A. All materials used in the epoxy floor system shall be manufactured and provided by a single manufacturer to ensure compatibility and proper bonding.
B. Use adequate numbers of skilled workmen thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the work of this section.
C. Contractor shall have a minimum of 3 years experience installing epoxy floor coatings similar to that which is required for this project and who is acceptable to the manufacturer.
   1. Applicator shall designate a single individual as project foreman who shall be on site at all times during installation.
   2. Contractor must show and have QCA Qualified Contractor/Applicator paperwork from the manufacturer of the coating system, as required to obtain a long-term jobsite specific warranty.
D. Convene a pre-application meeting before the start of application of coating system. Require attendance of parties directly affecting work of this section, including: Architect, contractor, applicator, and authorized representative of the coating system manufacturer and interfacing trades. Review the following:
   1. Drawings and specifications affecting work of this section.
   2. Protection of adjacent surfaces.
   3. Surface preparation and substrate conditions.
   4. Application.
   5. Field quality control.
6. Protection of coating system.
7. Repair of coating system.
8. Coordination with other work.

1.05 DELIVERY, STORAGE & HANDLING

A. Delivery: Materials shall be delivered to the job site in sealed, undamaged containers. Each container shall be clearly marked with manufacturer’s label showing type of material, color, and lot number.
B. Storage: Store all materials in a clean, dry place with a temperature range in accordance with manufacturer’s instructions.
C. Handling: Handle products carefully to avoid damage to the containers. Read all labels and Material Safety Data Sheets prior to use.

1.06 PROJECT SITE CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within the limits recommended by the manufacturer.
B. All concrete should be tested for moisture before applying a seamless coating. If moisture emissions exceed 5 lbs/1000 square feet (ASTM F1869) or if the relative humidity (RH) exceeds 75% (ASTM F2170), see EC-15 Moisture Vapor Barrior product specification.
C. Concrete must be at least 2500 psi.
D. Concrete must be cured for a minimum of 28 days before coating is applied.
E. Schedule coating work to avoid excessive dust and airborne contaminates. Protect work areas from excessive dust and airborne contaminates during coating application.
F. Before any work is started, the applicator shall examine all surfaces for any deficiencies. Should any deficiencies exist, the architect, owner or general contractor shall be notified in writing and any corrections necessary shall be made.

1.07 WARRANTY

A. Upon completion of the work in this section provide a written warranty from the manufacturer against defects of materials for a period of 1 (one) year. To obtain project specific warranty the coating system applicator must be a Westcoat Qualified Contractor/ Applicator and apply for warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS


2.02 MATERIALS

A. As basis of design Westcoat Epoxy Slurry: Multi-component 100% solids epoxy floor coating, blended with slurry powder or graded silica. Subject to compliance with requirements, provide products by one of the following:
   a. BASF Corporation.
   b. CornerStone Flooring & Linings.
   c. Duraflex, Inc.
   d. FLEXMAR Coatings, Inc.
2.03 MATERIALS

A. Epoxy Slurry System: 100% Solids High Build Epoxy Slurry.
1. Primer: EC-12 Epoxy Primer 250-300 square feet per gallon.
2. Slurry Coat: 1 ½ gallons EC-34 Epoxy Topcoat mixed with 1 ½ gallons TC-71 Slurry Filler. Apply at a rate of 25-100 square feet per mix.
3. Top Coat: EC-34 Epoxy Topcoat pigmented with EC-40 Antimicrobial 250-300 feet per gallon
4. Patching materials shall be EC-72 Epoxy Patch Gel.
5. Concrete repairs can be made with TC-23 Mortar Mix as needed.
6. Cove base shall be EC-76 Epoxy Cove Gel.
7. Aggregate shall be CA-30 Small Safe Grip, CA-31 Large Safe Grip or TC-70 Silica Sand designed to meet the owners skid resistance requirements.
8. EC-102 Polyaspartic may be used OVER the EC-34 when tire staining is a concern. Provides a quick drying, UV resistant, high gloss, high build, mar and chemical resistant finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions.
1. Inspect all surfaces to receive epoxy flooring. The surface must be structurally sound, clean, dry and free of grease, paint, oil, dust, curing agents, laitance or any foreign material that will prevent proper adhesion.
2. Conduct calcium chloride testing according to ASTM F1869.
3. Before starting work, report in writing to the authority having jurisdiction any unsatisfactory conditions.

3.02 SURFACE PREPARATION

A. Prepare surfaces using methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
B. Shot blast or mechanically abrade the surface to achieve a surface profile equal to CSP of 3-5 as specified by ICRI.
C. Clean Surfaces thoroughly prior to installation.
D. Rout and clean moving cracks and joints: fill with manufacturer’s recommended flexible epoxy filler material.
E. Repair any non-moving surface deviations with manufacturer’s recommended patching material.
3.03 INSTALLATION

A. Install coatings in accordance with manufacturer’s instructions.
B. Mix multi-component materials in accordance with manufacturer’s instructions.
C. Use application equipment, tools, and techniques in accordance with manufacturer’s instructions.
D. Uniformly apply coatings at spread rates and in number of coats to achieve specified mil thickness recommended by the manufacturer.
   1. Install integral cove base where indicated on the contract drawings and according to manufacturer’s instructions.
   2. Key in all drains, edges, and transition points according to manufacturer’s instructions.
E. Broadcast aggregates in accordance with the specified system and manufacturer’s instructions.
F. Adhere to all limitations, instructions, and cautions for epoxy coating as stated in the manufacturer’s published literature.

3.04 FIELD QUALITY CONTROL

A. Verify coatings and other materials are as specified.
B. Verify coverages of the system as work progresses. Areas found not to meet the required thickness shall receive additional material until specified thickness is attained.
C. Manufacturer’s representative shall provide technical assistance and guidance for surface preparation and application of coating systems.

3.05 PROTECTION AND CLEAN-UP

A. Prohibit traffic on floor for 48 hours after installation. Avoid heavy abrasion and chemical exposure for 5 days. Allow 72 hours minimum for vehicular traffic.
B. Protect finished surfaces of coating system from damage during construction.
C. Touch-up, repair or replace damaged flooring system after substantial completion.
D. Clean area and remove all debris upon completion of work. Dispose of empty containers properly according to current Local, State and Federal regulations.

3.06 MAINTENANCE

A. Contractor shall provide to owner, maintenance and cleaning instructions for the floor system upon completion of work. Owner is required to clean and maintain the surfaces to maintain manufacturer’s warranty.

END OF SECTION
SECTION 10 12 00 – DISPLAY CASES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Nonilluminated bulletin boards.
   2. Nonilluminated display cases.

B. Related Sections:
   1. Division 09 Section "Fabric-Wrapped Panels" for tackable, fabric-covered wall panels.

1.3 DEFINITIONS

A. Bulletin Board: Tackable visual display surface or tackboard enclosed in a display case.

B. Display Case: Glazed cabinet with adjustable shelves and visual display surface background and adjustable shelves.

1.4 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for display cases.

B. Shop Drawings: For display cases. Include plans, elevations, sections, details, and attachments to other work.

   1. Show location of seams and joints in visual display surfaces.
   2. Include sections of typical trim members.
C. Samples for Initial Selection: For units with factory-applied color finishes, and as follows:
   1. Actual sections of visual display surfaces.
   2. Section of header panel for color selection.

D. Samples for Verification: For each type of product indicated.
   1. Visual Display Surface: Not less than 8-1/2 by 11 inches, mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
   2. Trim: 6-inch- long sections of each trim profile including corner section.

E. Delegated-Design Submittal: For display cases indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Qualification Data: For qualified professional engineer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.

H. Maintenance Data: For visual display surfaces, operating hardware to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain display cases from single source from single manufacturer.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 50 or less.

C. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install display cases until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of openings for display cases by field measurements before fabrication.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Hardboard: ANSI A135.4, tempered.

B. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.

C. Fiberboard: ASTM C 208.

D. Hardwood Plywood: HPVA HP-1, made with adhesive containing no urea formaldehyde.

E. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering, and 6 mm thick unless otherwise indicated.

F. Fasteners: Provide screws, bolts, and other fastening devices made from same material as items being fastened, except provide hot-dip galvanized, stainless-steel, or aluminum fasteners for exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.

2.2 BULLETIN BOARD DISPLAY CASE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. AARCO Products, Inc.
3. ADP Lemco, Inc.
4. Best-Rite Manufacturing.
5. Claridge Products and Equipment, Inc.
11. Tablet & Ticket Co. (The).

B. Recessed Cabinet: Factory-fabricated cabinet; with tackboard assembly on back inside surface, operable glazed doors at front, and trim on face to cover edge of recessed opening.

1. Cabinet Box: Veneer plywood.
2. Cabinet Frame and Trim: For paint to match adjacent walls.

C. Tack Surface: Natural-cork tackboard assembly.

2.3 DISPLAY CASE
A. Shelves: 6-mm-thick tempered glass; supported on adjustable shelf standards and supports.
   1. Shelf Width: as indicated on drawings.
   2. Number of Shelves: As indicated on Drawings.

B. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112; recess mounted in rear surface. Provide standards full height of display case.

2.4 FABRICATION

A. Fabricate bulletin boards and display cases to requirements indicated for dimensions, design, and thickness and finish of materials.

B. Use metals and shapes of thickness and reinforcing to produce flat surfaces, free of oil-canning, and to impart strength for size, design, and application indicated.

C. Fabricate cabinets and door frames with reinforced corners, mitered to a hairline fit, with no exposed fasteners.

D. Fabricate exterior units with vents to permit evaporation of moisture trapped inside.

E. Fabricate shelf standards plumb and at heights to align shelf brackets for level shelves.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine walls and partitions for proper backing for bulletin boards and display cases.

C. Examine walls and partitions for suitable framing depth if recessed units will be installed.

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

3.2 PREPARATION

A. Prepare recesses for display cases as required by type and size of unit.

3.3 INSTALLATION

A. General: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
B. Recessed Display Cases: Attach units to wall framing with fasteners at not more than 16 inches o.c. Attach aluminum trim over edges of recessed display cases and conceal grounds and clips. Attach trim with fasteners at not more than 24 inches o.c.

C. Install display case shelving level and straight.

3.4 ADJUSTING AND CLEANING

A. Adjust doors to operate smoothly without warp or bind and so contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION 10 12 00
SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
1. Dimensional characters.
2. Panel signs.
3. Handicapped parking sign.
4. Plaques.

B. Related Sections include the following:
1. Division 14 Section "Hydraulic Elevators" for code-required elevator signage.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for labels, tags, and nameplates for plumbing systems and equipment.
3. Division 23 Section "Identification for HVAC Piping and Equipment" for labels, tags, and nameplates for HVAC systems and equipment.
4. Division 26 Sections for electrical service and connections for illuminated signs.
5. Division 26 Section "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.
6. Division 26 Section "Interior Lighting" for illuminated Exit signs.

1.3 DEFINITIONS


1.4 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details for signs.
1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following:

1. Aluminum.

D. Samples for Verification: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:

1. Dimensional Characters: Full-size Samples of each type of dimensional character (letter, number, and graphic element).
2. Aluminum: For each form, finish, and color, on 6-inch-long sections of extrusions and squares of sheet at least 4 by 4 inches.
3. Panel Signs: Not less than 12 inches square.

E. Sign Schedule: Use same designations indicated on Drawings.

F. Qualification Data: For fabricator.

G. Maintenance Data: For signs to include in maintenance manuals.

H. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

C. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.


E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.
1.7 COORDINATION

A. Coordinate placement of anchorage devices with templates for installing signs.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Deterioration of metal and polymer finishes beyond normal weathering.
   b. Deterioration of embedded graphic image colors and sign lamination.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.

B. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.

C. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 6063-T5.

D. Steel:

1. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 coating, either commercial or forming steel.
2. Steel Sheet: Uncoated, cold-rolled, ASTM A 1008/A 1008M, commercial steel, Type B, exposed or electrolytic zinc-coated, ASTM A 591/A 591M, with steel sheet substrate complying with ASTM A 1008/A 1008M, commercial steel, exposed.
3. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness.
4. Steel Members Fabricated from Plate or Bar Stock: ASTM A 529/A 529M or ASTM A 572/A 572M, 42,000-psi minimum yield strength.
5. For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness.
2.2 DIMENSIONAL CHARACTERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Series LF as manufactured by ASI Modulex, Inc. or a comparable product by one of the following:

1. ACE Sign Systems, Inc.
2. Advance Corporation; Braille-Tac Division.
5. Charleston Industries, Inc.
7. Grimco, Inc.
8. Innerface Sign Systems, Inc.
13. Signature Signs, Incorporated.

B. Fabricated Channel Characters: Form exposed faces and sides of characters to produce surfaces free from warp and distortion. Include internal bracing for stability and attachment of mounting accessories. Comply with the following requirements:

1. Aluminum Sheet: Not less than 0.050 inch thick for face and 0.031 inch thick for returns.


2. Provide manufacturer's hardware for projection mounting channel characters at one inch distance from wall surface.

C. Dimensional Character Sign Schedule:

1. Sign Type:

   a. Sign Size: As indicated.
   b. Character Size: As indicated.
   c. Text/Message: As indicated.
   d. Location: As indicated.

2.3 PANEL SIGNS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Reflection System manufactured by ASI Signage Inc. or a comparable product by one of the following:

1. ACE Sign Systems, Inc.
2. Advance Corporation; Braille-Tac Division.
3. Allen Industries Architectural Signage
4. Allenite Signs; Allen Marking Products, Inc.
5. APCO Graphics, Inc.
6. Best Sign Systems Inc.
8. Fossil Industries, Inc.
10. Grimco, Inc.
11. Innerface Sign Systems, Inc.
12. InPro Corporation
13. Matthews International Corporation; Bronze Division.
17. Seton Identification Products.
18. Signature Signs, Incorporated.
19. Supersine Company (The)

B. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following requirements:

1. Aluminum Sheet: 0.050 inch thick.
2. Laminated, Polycarbonate-Faced Sheet: 0.060-inch-thick, polycarbonate face sheet laminated to each side of 0.197-inch-thick phenolic backing.
   a. Wall mounted with concealed anchors.
   b. Manufacturer's standard anchors for substrates encountered.
4. Custom Paint Colors: Match Pantone color matching system.
5. Color: As selected by Architect from manufacturer's full range.
6. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch above surface with contrasting colors.

C. Brackets: Fabricate brackets and fittings for bracket-mounted signs from extruded aluminum to suit panel sign construction and mounting conditions indicated. Factory paint brackets in color matching background color of panel sign.

D. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.
   1. Raised-Copy Thickness: Not less than 1/32 inch.

E. Subsurface Engraved Acrylic Sheet: Reverse-engrave back face of clear acrylic sheet. Fill resulting copy with enamel. Apply opaque background color coating over enamel-filled copy.

F. Panel Sign Schedule:

1. Sign Type:
   a. Sign Size: As indicated.
   b. Message Panel Material: As indicated.
   c. Character Size: As indicated.
d. Text/Message: As indicated.

e. Location: As indicated.

2.4 ACCESSORIES

A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.5 FABRICATION

A. General: Provide manufacturer's standard signs of configurations indicated.

   1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.

   2. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.

   3. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.

   4. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
1. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mils, medium gloss.

2.8 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

B. Factory Priming for Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment.

1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, universal primer, selected for resistance to normal atmospheric corrosion, for compatibility with substrate and field-applied finish paint system indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

C. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: Manufacturer's standard Class 1 clear anodic coating, 0.018 mm or thicker, over a satin (directionally textured) mechanical finish, complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Verify that items, including anchor inserts, and electrical power are sized and located to accommodate signs.

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

3.2 INSTALLATION

A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.

1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
   1. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.

C. Bracket-Mounted Signs: Provide manufacturer's standard brackets, fittings, and hardware for mounting signs that project at right angles from walls and ceilings. Attach brackets and fittings securely to walls and ceilings with concealed fasteners and anchoring devices to comply with manufacturer's written instructions.

D. Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
   1. Projected Mounting: Mount characters at projection distance from wall surface indicated.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 10 14 00
SECTION 10 21 13 – TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Phenolic-core toilet compartments configured as toilet enclosures.

B. Related Sections:
   1. Division 05 Section "Metal Fabrications" for supports that attach ceiling-hung compartments to overhead structural system.
   2. Division 06 Section "Rough Carpentry" for blocking.
   3. Division 10 Section "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
   1. Show locations of cutouts for compartment-mounted toilet accessories.
   2. Show locations of reinforcements for compartment-mounted grab bars.
   3. Show locations of centerlines of toilet fixtures.
   4. Show ceiling grid and overhead support or bracing locations.

C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
   1. Each type of material, color, and finish required for units, prepared on 6-inch- square Samples of same thickness and material indicated for Work.
   2. Each type of hardware and accessory.

E. Product Certificates: For each type of toilet compartment, from manufacturer.
F. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.4 QUALITY ASSURANCE


B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" for toilet compartments designated as accessible.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

B. Stainless-Steel Castings: ASTM A 743/A 743M.

2.2 PHENOLIC-CORE UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide DURALINE CGL SERIES 2081G.67PDS as manufactured by Bobrick Washroom Equipment, Inc. or comparable product by one of the following:

1. Accurate Partitions Corporation.
3. Ampco, Inc.
4. Bradley Corporation; Mills Partitions.
5. Flush Metal Partition Corp.
7. Global Steel Products Corp.
9. Metpar Corp.
12. Sanymetal; a Crane Plumbing company.
14. Tex-Lam Manufacturing, Inc.
15. Weis-Robart Partitions, Inc.
16. Young Group Ltd. (The); Fabricated Products Division; DesignRite Partitions.

B. Toilet-Enclosure Style: Floor Mounted.

C. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 3/4-inch- thick doors and pilasters and minimum 1/2-inch- thick panels. 72” door and panel height, gapless..

D. Pilaster: Pilaster shall be attached to the floor by means of an 11-guage stainless steel footer, with provisions for leveling, attached to two (2) 3/8-inch diameter stainless steel studs set into expansion shields.
   1. Pilaster Shoes: The floor connections are to be covered by a four (4) inch high stainless steel shoe, #4 finish.

E. Brackets (Fittings):
   1. Stirrup Type: Ear or U-brackets, stainless steel.

F. Phenolic-Panel Finish:
   1. Facing Sheet Finish: One color and pattern in each room.
   2. Color and Pattern: As selected by Architect from manufacturer's full range, with manufacturer's standard color core matching face sheet.

2.3 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
   2. Hinges: Manufacturer's standard stainless steel welded barrel hinges shall be attached to door and stile by theft resistant, pin-in-head Torx stainless steel machine screws into factory installed, threaded brass inserts. Fasteners secured directly into the core are not acceptable. Paired with self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
   3. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Provide Occupancy Indicator - part number 1002612.
   4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
   5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

7. Door Stops: Heavy duty rubber tipped stainless steel bumper mounted on top and bottom of all doors. Mount with inserts of through bolts.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.4 FABRICATION

A. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

B. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, in-swinging doors for standard toilet compartments and 36-inch- wide, out-swinging doors with a minimum 32-inch- wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:
   a. Pilasters and Panels: 1/2 inch.
   b. Panels and Walls: 1 inch.

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel.
   a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

B. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.
3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10 21 13
SECTION 102213 - WIRE MESH PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Heavy-duty wire mesh partitions.

1.3 DEFINITIONS

A. Lock Crimp: Deep crimps at points of the intersection that lock wires securely in place.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Indicate clearances required for operation of doors.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: 12-by-12-inch panel constructed of specified frame members and wire mesh. Show method of finishing members at intersections.

E. Delegated-Design Submittal: For wire mesh partitions indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.
1.6 CLOSEOUT SUBMITTALS
   A. Maintenance Data: For wire mesh partition hardware to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS
   A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      1. Door Locks: Furnish 5 percent of quantity installed for each type indicated, but no fewer than 2 locks.

1.8 QUALITY ASSURANCE
   A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
   B. Welding Qualifications: Qualify procedures and personnel according to the following:
      1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.9 DELIVERY, STORAGE, AND HANDLING
   A. Deliver wire mesh items with cardboard protectors on perimeters of panels and doors and with posts wrapped to provide protection during transit and Project-site storage. Use vented plastic.
   B. Inventory wire mesh partition door hardware on receipt, and provide secure lockup for wire mesh partition door hardware delivered to Project site.
      1. Tag each item or package separately with identification, and include basic installation instructions with each item or package.

1.10 FIELD CONDITIONS
   A. Field Measurements: Verify actual dimensions of construction contiguous with wire mesh units by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      2. Folding Guard Corporation.
      3. G-S Company (The).
5. Kenco Wire & Iron Products Inc.
6. King Wire Partitions, Inc.
7. Miller Wire Works, Inc.
8. Newark Wire Works Inc.
9. R. J. Donaldson, Inc.
10. SpaceGuard Products.
12. WireCrafters, LLC.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wire mesh units.

B. Structural Performance: Wire mesh units shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft. at any location on a panel.
2. Total load of 200 lbf applied uniformly over each panel.
3. Concentrated load and total load need not be assumed to act concurrently.

2.3 MATERIALS

A. Steel Wire: ASTM A510.

B. Steel Plates, Channels, Angles, and Bars: ASTM A36/A36M.

C. Steel Sheet: Cold-rolled steel sheet, ASTM A1008/A1008M, Commercial Steel (CS), Type B.

D. Steel Pipe: ASTM A53/A53M, Schedule 40, unless another weight is indicated or required by structural loads.

E. Steel Tubing: ASTM A500/A500M, cold-formed structural-steel tubing or ASTM A513, Type 5, mandrel-drawn mechanical tubing.

F. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with G60 zinc (galvanized) or A60 zinc-iron-alloy (galvannealed) coating designation.

G. Panel-to-Panel Fasteners: Manufacturer's standard steel bolts, nuts, and washers.

H. Post-Installed Anchors: Capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components are zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

I. Power-Driven Fasteners: ICC-ES AC70.

J. Zinc-Rich Primer: Compatible with topcoat, complying with SSPC-Paint 20 or SSPC-Paint 29.

2.4 HEAVY-DUTY WIRE MESH PARTITIONS

A. Mesh: 0.192-inch- diameter steel wire, resistance welded into 1-1/2-by-2-1/2-inch rectangular mesh.

B. Vertical and Horizontal Panel Framing: 1-1/2-by-3/4-by-1/8-inch cold-rolled steel channels; with holes for 3/8-inch- diameter bolts not more than 12 inches o.c.

C. Horizontal Panel Stiffeners: Two cold-rolled steel channels, 1 by 1/2 by 1/8 inch, bolted or riveted toe to toe through mesh.

D. Top Capping Bars: 3-by-1-inch steel channels.

E. Posts for 90-Degree Corners: 1-1/2-by-1-1/2-by-1/8-inch steel angles or tubes or 2-by-2-by-0.075-inch cold-rolled steel angles or tubes, with holes for 3/8-inch- diameter bolts aligning with bolt holes in vertical framing; with 1/4-inch steel base plates.

F. Posts for Other-Than-90-Degree Corners: 2-inch- OD by 1/8-inch steel pipe or round tube, with holes for 3/8-inch- diameter bolts aligning with bolt holes in vertical framing; with 1/4-inch steel base plates.

G. Adjustable Corner Posts: Two 1-1/2-by-3/4-by-1/8-inch cold-rolled, steel channels or 2-by-2-by-0.075-inch steel tubes connected by steel hinges at 36 inches o.c. attached to posts; with 1/4-inch- diameter bolt holes aligning with bolt holes in vertical framing; with 1/4-inch steel base plates.

H. Line Posts: 3-inch-by-4.1-lb or 3-1/2-by-1-1/4-by-1/8-inch steel channels; with 1/4-inch steel base plates.

I. Three- and Four-Way Intersection Posts: 2-by-2-by-0.075-inch steel tubes, with holes for 3/8-inch- diameter bolts aligned for bolting to adjacent panels; with 1/4-inch steel base plates.

J. Floor Shoes: Metal, not less than 2 inches high; sized to suit vertical framing, drilled for attachment to floor, and with set screws for leveling adjustment.

K. Swinging Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/2-by-3/4-by-1/8-inch steel channels, banded with 1-1/2-by-1/8-inch flat steel bar cover plates on four sides, and with 1/8-inch- thick angle strike bar and cover on strike jamb.

1. Hinges: Full-surface type, 3-1/2-by-3-1/2-inch steel, three per door; bolted, riveted, or welded to door and jamb framing.

2. Padlock Lug: Mortised into door framing and enclosed with steel cover.
3. Cylinder Lock: Mortise type with [manufacturer's standard cylinder] [cylinder specified in Section 087100 "Door Hardware"] [cylinder specified in Section 087111 "Door Hardware (Descriptive Specification)"]; operated by key outside and [recessed turn knob] [knob] [lever] inside; mounted in lower section of door.

4. Inactive Leaf Hardware: Cane bolt at bottom and chain bolt at top.

2.5 FABRICATION

A. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.

1. Fabricate wire mesh items to be readily disassembled.
2. Welding: Weld corner joints of framing and grind smooth, leaving no evidence of joint

B. Heavy-Duty Wire Mesh Partitions: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.

1. Mesh: Weld mesh to framing.
2. Framing: Fabricate framing with mortise and tenon corner construction.
   a. Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height and as recommended by wire mesh partition manufacturer. Weld horizontal stiffeners to vertical framing.
   b. Fabricate three- and four-way intersections using intersection posts
   c. Fabricate partition and door framing with slotted holes for connecting adjacent panels.
3. Fabricate wire mesh partitions with bottom horizontal framing flush with finished floor.
4. Doors: Align bottom of door with bottom of adjacent panels.
   a. For doors that do not extend full height of partition, provide transom over door, fabricated from same mesh and framing as partition panels.
5. Hardware Preparation: Mortise, reinforce, drill, and tap doors and framing as required to install hardware.

2.6 STEEL AND IRON FINISHES

A. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on powder-coat finish, suitable for use indicated, with a minimum dry film thickness of 2 mils.

B. Color and Gloss: As selected by Architect from manufacturer's full range
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine floors for suitable conditions where wire mesh items will be installed.

C. Examine walls to which wire mesh items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.

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

3.2 WIRE MESH PARTITIONS ERECTION

A. Anchor wire mesh partitions to floor with 3/8-inch-diameter postinstalled expansion anchors at 12 inches o.c. through floor shoes located at each post and corner. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.

1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.

B. Anchor wire mesh partitions to walls at 12 inches o.c. through back corner panel framing and as follows:

1. For concrete and solid masonry anchorage, use expansion anchors.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed gypsum board assemblies, use lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.

C. Secure top capping bars to top framing channels with 1/4-inch-diameter "U" bolts spaced not more than 28 inches o.c.

D. Provide line posts at locations indicated or, if not indicated, as follows:

1. On each side of sliding-door openings.
2. For partitions that are 7 to 9 feet high, spaced at 15 to 20 feet o.c.
3. For partitions that are 10 to 12 feet high, located between every other panel.
4. For partitions that are more than 12 feet high, located between each panel.

E. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.
F. Where standard-width wire mesh partition panels do not fill entire length of run, provide adjustable filler panels to fill openings.

G. Install doors complete with door hardware.

H. Install service windows complete with window hardware.

I. Bolt accessories to wire mesh partition framing.

3.3 ADJUSTING AND CLEANING

A. Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Remove and replace defective work, including doors and framing that are warped, bowed, or otherwise unacceptable.

C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

END OF SECTION 102213
SECTION 10 26 00 – WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wall guards.
   2. Corner guards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: For each impact-resistant wall protection unit. Include sections, details, and attachments to other work.
   1. 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.
C. Samples: For each exposed product and for each color and texture specified, 12 inches long.

1.3 INFORMATIONAL SUBMITTALS

A. Material certificates.
B. Material test reports.
C. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
B. Surface-Burning Characteristics: As determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

D. Preinstallation Conference: Conduct conference at Project site.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures.
   b. Deterioration of plastic and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. PVC Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout.

1. Impact Resistance: Minimum 25.4 ft-lbf/in. of notch when tested according to ASTM D 256, Test Method A.

2. Nominal .040” thickness.

3. Sheet Size: 4’ x 8’.

4. Chemical and Stain Resistance: Tested according to ASTM D 543.

5. Self-extinguishing when tested according to ASTM D 635.

6. Flame-Spread Index: 25 or less.

7. Smoke-Developed Index: 450 or less.

B. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than strength and durability properties specified in ASTM B 221 for Alloy 6063-T5.

C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

D. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and with a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2.2 WALL PROTECTION

A. High Impact Wall Covering: Heavy-duty assembly consisting of continuous adhered plastic cover installed over wall substrate.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Acrovyn 4000 as manufactured by Construction Specialties, Inc. or comparable product by one of the following:
   a. American Floor Products Co., Inc.
   b. Arden Architectural Specialties, Inc.
   c. Balco, Inc.
   d. Construction Specialties, Inc.
   e. IPC Door and Wall Protection Systems; Division of InPro Corporation.
   f. Korogard Wall Protection Systems; a division of RJF International Corporation.
   g. Musson Rubber Company.
   h. Pawling Corporation.
   i. Tepromark International, Inc.
   j. WallGuard.com.

2. Covering: Extruded rigid plastic, minimum 0.040-inch thickness; in dimensions and profiles indicated on Drawings.
   a. Surface: Uniform.
   b. Color and Texture: As selected by Architect from manufacturer's full range.

3. Continuous Retainer: Minimum 0.080-inch thick, one-piece, extruded aluminum.
5. End Caps and Corners: Prefabricated, injection-molded plastic; matching color cover; field adjustable for close alignment with snap-on cover.
6. Accessories: Concealed splices and mounting hardware.
7. Mounting: Surface mounted directly to wall.

2.3 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards: Fabricated from one-piece, formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Floor Products Co., Inc.
   b. Arden Architectural Specialties, Inc.
   c. Balco, Inc.
   d. Boston Retail Products.
   e. Construction Specialties, Inc.
   f. IPC Door and Wall Protection Systems; Division of InPro Corporation.
   g. Korogard Wall Protection Systems; a division of RJF International Corporation.
   h. Pawling Corporation.
   i. Tepromark International, Inc.
j. WallGuard.com.

2. Material: Stainless steel, Type 304.
   a. Thickness: Minimum 0.0500 inch.
   b. Finish: Directional satin, No. 4.
3. Wing Size: Nominal 2-1/2 by 2-1/2 inches.
5. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings.
2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
   a. Provide anchoring devices to withstand imposed loads.
   b. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches.

B. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

C. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 26 00
SECTION: 10 26 41  BULLET RESISTANT PANELS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes bullet resistant fiberglass panels.

1.2 REFERENCES

A. American Society for Testing and Materials:
   1. ASTM E119-98 Standard Test for One-Hour Fire-Rating of Building Construction and Materials
B. International Organization for Standardization:
   1. ISO 9001:2015 Quality Management System
C. National Institute of Justice Ballistic Standards:
   1. NIJ Standard 0108.01 – Type III-A
D. Small Business Administration:
   1. SBA Small Business Size Standard
E. Underwriters Laboratories:
F. The United States Department of State:
   1. The International Traffic in Arms Regulations (ITAR)

1.3 SUBMITTALS

A. Submittals for Review: Submit for approval prior to fabrication.
   1. Product Data: Include specifications, brochures, and samples.
   2. Recommendations for installation of Bullet Resistant Fiberglass Panels available in print document and video link.
B. Certificates: Submit printed data to indicate compliance with following requirements.
   1. UL LISTING Verification and UL752 Current Test Results as provided by Underwriters Laboratories.
   5. Manufacturer’s U.S. Dept. of State ITAR Statement of Registration.
   6. Manufacturer’s SBA Profile verifying small business status by the SBA.

1.4 DELIVERY, HANDLING, AND STORAGE

A. Deliver materials to project with manufacturer’s UL LISTED Labels intact and legible.
B. Handle material with care to prevent damage. Store materials inside under cover, stack flat and off the floor.

1.5 WARRANTY

A. Warrant all materials and workmanship against defects for a period of ten (10) years from the date of Substantial Completion.
PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Design Basis: Contract Documents are based on ArmorCore by Waco Composites, (Waco, TX 76710, phone: 254-752-3622, toll free: 866-688-3088, email: sales@armorcore.com, web: www.armorcore.com) Equivalent products acceptable if specifications met.

2.2 PERFORMANCE CRITERIA

A. Bullet Resistant Fiberglass Panels shall be “non ricochet type” to permit the encapture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration.
B. Panel Rating: UL752 Level 3.
C. Bullet resistance of joints: equal to that of the panel.

2.3 MATERIALS

A. Panels fabricated of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets.
B. Thickness: 7/16” nominal thickness
C. Nominal Weight: 4.8 lbs. per sq. ft.
D. Available Panel Sizes: [3’ x 8’] [3’ x 9’] [3’ x 10’] [4’ x 8’] [4’ x 9’] [4’ x 10’] [5’ x 8’] [5’ x 9’] [5’ x 10’]
E. Panels manufactured in the United States of America with raw materials sourced from the U.S.A. for quality assurance purposes and to comply with any applicable “Buy American” provisions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to starting installation, verify work of related trades required in contract documents and architectural drawings is complete to the point where work of this Section may properly commence.

3.2 JOINTS

A. Reinforce joints with a back-up layer of bullet resistive material. Minimum width of reinforcing layer at joint shall be 4-inches, centered on panel joints.

3.3 APPLICATION

A. Install armor in accordance with manufacturer’s printed recommendations and as required by contract documents.
B. Secure armor panels using screws, bolts, or an industrial adhesive.
   1. Method of application shall install panels minimizing vulnerabilities by fitting tightly to adjacent surfaces including concrete floor slab, concrete roof slab, bullet resistive door frames, bullet resistive window frames, and the like.

END OF SECTION 10 26 41
SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Public-use washroom accessories.
2. Private-use shower room accessories.
3. Underlavatory guards.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated on Drawings.
2. Identify products using designations indicated on Drawings.

D. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.
1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Brass: ASTM B 19 flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.

D. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.


F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Basis-of-Design Product: The design for accessories is based on products indicated in the DRAWINGS (SEE ACCESSORIES SCHEDULE IN DRAWINGS). Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
5. General Accessory Manufacturing Co. (GAMCO).

B. SEE DRAWINGS FOR SELECTIONS OF BASIS OF DESIGN ACCESSORIES PRODUCTS

2.3 UNDERLAVATORY GUARDS

A. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. TCI Products.
2. Truebro, Inc.

B. Underlavatory Guard:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Plumberex Specialty Products, Inc. Handy Shield or a comparable product by one of the manufacturers listed above.
2. Description: Insulating pipe covering for supply and drain piping assemblies, that prevent direct contact with and burns from piping, and allow service access without removing coverings.

2.4 CUSTODIAL ACCESSORIES

A. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
5. General Accessory Manufacturing Co. (GAMCO).

B. Mop and Broom Holder (TA-38): PROVIDE ONE IN EACH JANITOR CLOSET
1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Model B-223 or a comparable product by one of the manufacturers listed above.

2. Description: **Unit with three mop and broom holders.**

3. Length: **36 inches**


5. Material and Finish: Stainless steel, No. 4 finish (satin).

2.5 **FABRICATION**

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 **INSTALLATION**

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.


3.2 **ADJUSTING AND CLEANING**

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800
SECTION 104413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Semi-recessed fire protection cabinets for the following:
      a. Portable fire extinguishers.

B. Related Sections:
   1. Division 10 Section "Fire Extinguishers."

1.3 SUBMITTALS
A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
   1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
   2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
   1. Size: 6 by 6 inches square.

D. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

E. Maintenance Data: For fire protection cabinets to include in maintenance manuals.
1.4 QUALITY ASSURANCE

A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

B. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to fire protection cabinets including, but not limited to, the following:
      a. Schedules and coordination requirements.

1.5 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Stainless-Steel Sheet: ASTM A 666, Type 304.

2.2 FIRE PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Clear Vu Series Model FX1527G25 as manufactured by JL Industries. or a comparable product by one of the following:
      a. Fire End & Croker Corporation.
      b. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
      c. Larsen's Manufacturing Company.
      d. Modern Metal Products, Division of Technico Inc.
      e. Moon-American.
      f. Potter Roemer LLC.
      g. Watrous Division, American Specialties, Inc.

B. Cabinet Material: Steel sheet.
   1. Shelf: Same metal and finish as cabinet.
C. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.

   1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.

D. Door Material: Steel sheet.

E. Door Style: Full bubble with frame.

F. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

   1. Provide manufacturer's standard concealed handle.
   2. Provide continuous hinge, of same material and finish as door permitting door to open 180 degrees.

G. Accessories:

   1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
   2. Alarm: Manufacturer's standard alarm that actuates when fire protection cabinet door is opened and that is powered by batteries.

H. Finishes:

   1. Manufacturer's standard baked-enamel paint for the following:
      a. Interior of cabinet.
      b. Exterior of cabinet.

2.3 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

   1. Weld joints and grind smooth.
   2. Provide factory-drilled mounting holes.
   3. Prepare doors and frames to receive locks.
   4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

   1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
   2. Fabricate door frames of one-piece construction with edges flanged.
   3. Miter and weld perimeter door frames.
C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling".

B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.6 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:

1. Fire Protection Cabinets: 54 inches above finished floor to top of cabinet.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
2. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413
SECTION 10 44 16 – FIRE EXTINGUISHERS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes portable, hand-carried fire extinguishers.
   B. Related Sections:
      1. Division 10 Section "Fire Extinguisher Cabinets."

1.3 SUBMITTALS
   A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.
   B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.
   C. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.
   D. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE
   A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
   B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
      1. Provide fire extinguishers approved, listed, and labeled by FMG.
   C. Preinstallation Conference: Conduct conference at Project site.
      1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:
1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Failure of hydrostatic test according to NFPA 10.
   b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet indicated.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Cosmic 6E as manufactured by J.L. Industries, Inc. or comparable product by one of the following:
      a. Amerex Corporation.
      b. Ansul Incorporated; Tyco International Ltd.
      c. Badger Fire Protection; a Kidde company.
      d. Buckeye Fire Equipment Company.
      e. Fire End & Croker Corporation.
      f. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
      g. Larsen's Manufacturing Company.
      h. Moon-American.
      i. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
      j. Potter Roemer LLC.
      k. Pyro-Chem; Tyco Safety Products.

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 3-A:40-B:C, 6-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

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

3.2 INSTALLATION

A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION 10 44 16
10 65 00 Operable Partition

Part 1 - General

1.01 DESCRIPTION
   A. General
      1. Furnish and install operable partitions and suspension system. Provide all labor,
         materials, tools, equipment, and services for operable walls in accordance with
         provisions of contract documents.

1.02 RELATED WORK BY OTHERS
   A. Preparation of opening will be by General Contractor. Any deviation of site conditions
      contrary to approved shop drawings must be called to the attention of the architect.
   B. All header, blocking, support structures, jambs, track enclosures, surrounding insulation,
      and sound baffles as required in 1.04 Quality Assurance.
   C. Pre-punching of support structure in accordance with approved shop drawings.
   D. Paint or otherwise finishing all trim and other materials adjoining head and jamb of
      operable partitions.

1.03 SUBMITTALS
   A. Complete shop drawings are to be provided prior to fabrication indicating construction
      and installation details. Shop drawings must be submitted within 60 days after receipt of
      signed contract.

1.04 QUALITY ASSURANCE
   A. Preparation of the opening shall conform to the criteria set forth per ASTM E557
      Standard Practice for Architectural Application and Installation of Operable Partitions.
   B. The partition STC (Sound Transmission Classification) shall be achieved per the standard
      test method ASTM E90-99 and E413-87. Test run under ASTM procedures prior to E90-
      99 shall not be permitted. All tests must be from an independent, currently operating, NIST-accredited Laboratory available to verify results.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING
   A. Proper storage of partitions before installation, and continued protection during and after
      installation will be the responsibility of the General Contractor.

1.06 WARRANTY
   A. Partition Panels shall be guaranteed for a period of two years with all mechanical parts
      including track and carriers guaranteed for a period of five years. This guarantee is against
      defects in material or workmanship of manufacturer’s product.

Part 2 - Products

2.01 MANUFACTURERS
   A. Basis-of-Design Manufacturers: Subject to compliance with requirements, provide
      products or equal by the following:
      1. Moderco Inc.

2.02 MATERIALS
   A. Product to be top supported Signature 842 paired panels as manufactured by Moderco
      Inc.
      1. Panels shall be nominally 4” [102mm] thick, in manufacturer’s standard widths up
         to 48” [1230mm], and hinged in pairs.
      2. Panel faces shall be of gypsum laminated to appropriate substrates to meet the STC
         requirement. or
Panel faces shall be removable and replaceable on site to accommodate future décor / finish changes.
3. Frames shall be a composite of steel and aluminum alloys, formed to protect the edges of the face material.
4. Interlocking vertical seals between the panels shall consist of tongue and groove aluminum and vinyl astragals creating a shock-absorbing, deep nesting, impact resistant acoustical interlock between panels. Each pair of panels shall be equipped with a concealed panel locking device, such that, when engaged will result in a uniform & interlocked unit without the use of top guide rails.
5. Horizontal top seals shall be continuous contact multi-fingered vinyl.
6. Horizontal bottom seals shall be automatically setting and retracting, providing 2” [50mm] nominal clearance, and exert downward force when extended.
7. The panel hinges used on the panels shall be of steel and project no more than 1/4” [6mm] beyond panel faces. Panels shall be connected with a minimum of three hinges.

B. Weight of the panels shall be between 6 to 9.5 lbs./sq. ft. [29 to 46 kg/sq.m] (based on STC value selected) plus or minus 1 lb. based on options selected.

C. Suspension system:
1. Track shall be tempered aluminum with integrated soffit trims providing a transition to the ceiling. Track shall include support brackets and rods, spaced to manufacturer’s standards. Track model selection based on weight of panels.
   a. Each panel shall be supported by one 4-wheeled carrier. Wheels to be of hardened steel ball bearings. Carrier design shall ensure that all wheels remain in contact with the track during normal movement of the panels. Trolley model to be adapted to selected track.

D. Finishes:
1. Face finish shall be (select as required):
   a. Factory applied reinforced vinyl wall-covering with woven backing, weighing 21 oz. or more per lineal yard [545 g/m]. Color shall be selected from manufacturer’s standard color selector. or
2. Frame color shall be (select as required):
   a. Clear Anodized Aluminum (standard) or
3. Track finish:
   a. Aluminum track shall be clear anodized. or

E. Accessories/Options (select as required)
1. ADA-compliant pass door of the same thickness, acoustical construction and finish as the basic panels. Locate where shown on the plans.
   a. Concealed Automatic Door Closer.
   b. Inset Panic Bar (lockable on lever side if required).
   c. Inset Self-Illuminated Exit Sign (above door).
2. Inset chalk/dry marker boards. Location and height as indicated on drawings.
3. Inset tack boards. Location and height as indicated on drawings.
4. Acoustical Pocket doors of same construction as panels. or

2.03 OPERATION
A. Panels shall be manually operated, top supported, moved in pairs from the storage area, positioned in the opening, and seals set.
B. Retractable Bottom Seals
1. Bottom seals shall automatically activate as panels are deployed / positioned without the use of any handle or action by the operator and shall automatically retract when panels are moved to be stored.

C. Final partition closure to be by:
   1. Telescopic closure panel incorporating an expanding jamb member operated from either side of the panel with a removable handle. Panel shall be capable of compensating for minor out-of-plumb wall conditions and provide a positive vertical seal between partition and building structure. or

2.04 ACOUSTICAL PERFORMANCE
   A. Acoustical performance shall have been tested at an NIST-accredited, independent laboratory in accordance with ASTM E90-99 or more recent Test Standards. Standard panel construction shall have obtained an STC rating of (select one) 49.
   1. Copies of the written test report are to be made available upon request. Tests must have been conducted at a laboratory available for verification of results.

Part 3 - Execution
   A. Installation.
      1. The complete installation of the operable wall system shall be by an authorized factory-trained installer and be in strict accordance with the approved shop drawings and manufacturer’s standard printed specifications, instructions, and recommendations.
   B. Cleaning
      1. All track and panel surfaces shall be wiped clean and free of handprints, grease, and soil.
      2. Packing and other installation debris shall be removed from the job site.
   C. Training
      1. Installer shall demonstrate proper operation and maintenance procedures to owner’s representative.
      2. Operating handle and owner’s manuals shall be provided to owner’s representative.

END OF SECTION
SECTION 10 73 15 – EXTRUDED ALUMINUM CANOPIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fixed extruded aluminum entrance and parking canopies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, fabrication details, dimensions of individual components and profiles, hardware, fittings, mounting accessories, features, and finishes for extruded aluminum canopies.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, mounting heights, and attachment details.

2. Detail fabrication and assembly of extruded aluminum canopies.

3. Show locations for blocking, reinforcement, and supplementary structural support.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For the following:

1. Seam, Edge, and Corner Condition: Not less than 12-inch- long section showing seam, edge, and corner treatment.

2. Frame Finish: Not less than 6-inch lengths.

3. Frame Corner and Frame Intersections: Not less than 12-inch sections showing finished joint construction.

4. Exposed Hardware Finishes: Manufacturer's standard-size unit, not less than 3 inches square.

F. Delegated-Design Submittal: For extruded aluminum canopies.
1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator and professional engineer.

B. Welding certificates.

C. Product Certificates: For each type of awning fabric.

D. Evaluation Reports: For anchors and fasteners, from ICC-ES.

E. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
   1. Fabricator's responsibilities include fabricating and installing extruded aluminum canopies and providing professional engineering services needed to assume engineering responsibility.

B. Installer Qualifications: Fabricator of products.

C. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects, to set quality standards for materials and execution, and to set quality standards for fabrication and installation.

1.6 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of extruded aluminum canopies in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Where awning installation is indicated to fit to other work, verify dimensions of other work by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for fenestration operation throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 WARRANTY

A. Special Warranty: Manufacturer and fabricator agree to repair or replace components of extruded aluminum canopies that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
   a. Structural failures including framework.
   b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Canopy Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Basis-of-Design Product: Subject to compliance with requirements, provide canopies as manufactured by Avadek or approved equal.
   B. Source Limitations: Obtain extruded aluminum canopies from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS
   A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design extruded aluminum canopies.
   B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
      1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.3 CARPORT COMPONENTS
   A. All components shall be 6061-T6 or 6005-T5 Alloy extruded aluminum.
   B. Deck: 2 ¾”, Anodized Aluminum
   C. Trim: 10”.
   D. Beams: 6” x 10” or appropriate size to withstand 130 mph wind design requirement.
   E. Columns: 6 x 12 or as design by canopy mfr.
   F. Finishes: Kynar
   G. Color: Dark bronze
   H. Fasteners: Concealed stainless steel.
2.4 ENTRANCE CANOPY COMPONENTS

A. All components shall be 6061-T6 or 6005-T5 Alloy extruded aluminum.

B. Deck: 2 ¾” X 6” Self-mating deck, clear anodized aluminum finish

C. Trim: As required

D. Beams: 4” x 8” or appropriate size to withstand 130 mph wind design requirement.

E. Finishes: Kynar,

F. Color: Dark Bronze

G. Fasteners: Concealed stainless steel.

2.5 CANOPY FRAMES

A. Aluminum Frames: Alloy and temper recommended by awning manufacturer for type of use and finish indicated and with not less than the strength and durability properties of alloy and temper required by structural loads.

1. Aluminum Plate and Sheet: ASTM B 209.
3. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, standard weight (Schedule 40) unless another weight is indicated or required by structural loads.

B. Anchors, Fasteners, Fittings, Hardware, and Installation Accessories: Complying with performance requirements indicated and suitable for exposure conditions, supporting structure, anchoring substrates, and installation methods indicated. Corrosion-resistant or noncorrodible units; weather-resistant, compatible, nonstaining materials. Provide as required for awning assembly, mounting, and secure attachment. Number as needed to comply with performance requirements and to maintain uniform appearance; evenly spaced. Where exposed to view, provide finish and color as selected by Architect from manufacturer’s full range.

2. Lag Bolts: ASME B18.2.1.
3. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
4. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing according to ASTM E 488 conducted by a qualified independent testing and inspecting agency.

   a. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.
5. Adhesive-Bonded Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing according to ASTM E 1512 conducted by a qualified independent testing and inspecting agency.

   a. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.


D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

PART 3 - EXECUTION

3.1 EXAMINATION

   A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for supporting members, blocking, inserts, installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

   A. General: Install extruded aluminum canopies at locations and in position indicated, securely connected to supports, free of rack, and in proper relation to adjacent construction. Install extruded aluminum canopies after other finishing operations, including joint sealing and painting, have been completed.

   B. Weld frame connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

   1. Field Welding: Comply with the following requirements:

      a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
      b. Obtain fusion without undercut or overlap.
      c. Remove welding flux immediately.
      d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

   C. Anchoring to In-Place Construction: Use anchors, fasteners, fittings, hardware, and installation accessories where necessary for securing extruded aluminum canopies to structural support and for properly transferring load to in-place construction.
D. Corrosion Protection: Coat concealed surfaces of aluminum that come in contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

E. Coordinate canopy installation with flashing and joint-sealant installation so these materials are installed in sequence and in a manner that prevents exterior moisture from passing through completed exterior wall and roof assemblies.

3.3 CLEANING AND PROTECTION

A. Touchup Painting: Immediately after erection, clean field welds, connections, and abraded areas. Paint uncoated and abraded areas with same or compatible material as used for shop-applied finish painting.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 10 73 15
SECTION 11 31 00 – RESIDENTIAL APPLIANCES

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   2. Refrigeration appliances.
B. Related Sections:
   1. Division 22 Section "Plumbing Fixtures" for kitchen sinks, waste disposers, and instant hot-water dispensers.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, dimensions, furnished accessories, and finishes for each appliance.
B. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.
C. Product Schedule: For appliances. Use same designations indicated on Drawings.
D. Qualification Data: For qualified manufacturer.
E. Product Certificates: For each type of appliance, from manufacturer.
F. Field quality-control reports.
G. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.
H. Warranties: Sample of special warranties.
1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintains, within 50 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

B. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.

C. Source Limitations: Obtain residential appliances from single source.

D. Regulatory Requirements: Comply with the following:

   1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

F. Preinstallation Conference: Conduct conference at Project site.

1.5 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.

   1. Warranty Period: Two years from date of Substantial Completion.

B. Microwave Oven: Full warranty including parts and labor.

   1. Warranty Period: Two years from date of Substantial Completion.

C. Refrigerator/Freezer, Sealed System: Full warranty including parts and labor for on-site service on the product.

   1. Warranty Period for Sealed Refrigeration System: Two years from date of Substantial Completion.
   2. Warranty Period for Other Components: Two years from date of Substantial Completion.

D. Dishwasher: Full warranty including parts and labor for on-site service on the product.

   1. Warranty Period for Deterioration of Tub and Metal Door Liner: Three years from date of Substantial Completion.
   2. Warranty Period for Other Components: Two years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 MICROWAVE OVENS, DISHWASHERS ELECTRIC RANGES, REFRIGERATOR/FREEZER, UNDERCOUNTER REFRIGERATOR, VENT HOODS

A. Basis-of-Design Products: See Drawings for Equipment Schedule with Manufacturer, model, finish and ADA requirements. Equivalent equipment from alternate manufacturer subject to compliance with all requirements,

1. Amana; a division of Whirlpool Corporation.
2. BOSCH Home Appliances.
3. BSH Home Appliances Corporation (Gaggenau).
4. BSH Home Appliances Corporation (Thermador).
5. Dacor, Inc.
7. Electrolux Home Products (Frigidaire).
10. KitchenAid; a division of Whirlpool Corporation.
11. LG Appliances.
12. Maytag; a division of Whirlpool Corporation.
15. Viking Range Corporation.
17. Wolf Appliance, Inc.
19. Sears Brands LLC (Kenmore).
20. Sharp Electronics Corp.
22. Whirlpool Corporation.
23. Wolf Appliance, Inc.

2.2 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Utilities: See Divisions 22 and 26 for plumbing and electrical requirements.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.

2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After installation, start units to confirm proper operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

C. An appliance will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 11 31 00
SECTION 115313 - LABORATORY FUME HOODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Bench-top laboratory fume hoods.
   2. Fume hood base cabinets.
   3. Work tops within fume hoods.
   4. Piping and wiring within fume hoods for service fittings, light fixtures, fan switches, and other electrical devices included with fume hoods.

B. Related Sections:
   1. Division 06 Section "Rough Carpentry" for wood blocking for anchoring fume hoods.
   2. Division 09 Section "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring fume hoods.
   3. Division 09 Section "Resilient Base and Accessories" for resilient base applied to fume hood base cabinets.
   4. Division 23 Sections for fume hood duct connections, including ducts and exhaust fans.
   5. Division 23 and 26 Sections for installing service fittings in fume hoods, including piping and wiring within fume hoods, and for other wiring in fume hoods, including connecting light fixtures, fan switches, and other electrical devices included with fume hoods.
   6. Division 23 and 26 Sections for connecting service utilities at back of fume hoods. Piping and wiring within fume hoods are specified in this Section.
   7. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for field quality-control testing of fume hoods.

1.3 PERFORMANCE REQUIREMENTS

A. Containment: Provide fume hoods that comply with the following when tested according to ASHRAE 110 as modified below at a release rate of 4.0 L/min.:

   1. Average Face Velocity: 100 fpm plus or minus 10 percent with sashes fully open.
   2. Face-Velocity Variation: Not more than 10 percent of average face velocity.

      a. Test hoods with horizontal sashes with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.
b. Test hoods with combination sashes fully raised, with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.

4. As-Manufactured (AM) Rating: AM 0.05 (0.05 ppm).
5. As-Installed (AI) Rating: AI 0.10 (0.10 ppm).
6. Test Setup Modifications: Conduct tests with a minimum of three and a maximum of five people in the test room and with two 1-gal. round paint cans, one 12-by-12-by-12-inch cardboard box, and three 6-by-6-by-12-inch cardboard boxes in the fume hood during the test. Position items from 6 to 10 inches behind the sash, randomly distributed, and supported off the work surface by 2-by-2-inch blocks.
7. Walk-by Test: At the conclusion of containment test, execute three rapid walk-bys at 30-second intervals, 12 inches behind the mannequin. Test-gas concentration during each walk-by shall not exceed 0.1 ppm and shall return to specified containment value within 15 seconds.

B. Static-Pressure Loss: Not more than 1/4-inch wg at 100-fpm face velocity when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.

C. Structural Performance: Provide fume hood components capable of withstanding the following loads without permanent deformation, excessive deflection, or binding of cabinet drawers and doors:

1. Radioisotope Fume Hood Work Tops: 200 lb/ft..
2. Base Cabinets of Radioisotope Fume Hoods: 75 lb/ft. within cabinets, 50-lb/ft. work top, 200 lb/ft. on work top, plus weight of hood.
3. Fume Hood Base Stands for Radioisotope Hoods: 50-lb/ft. work top, 200 lb/ft. on work top, plus weight of hood.

D. Delegated Design: Design fume hoods, including comprehensive engineering analysis by a qualified professional engineer, using seismic performance requirements and design criteria indicated.

E. Seismic Performance: Fume hoods, including attachments to other work, shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
1. Component Importance Factor is 1.5.

1.4 SUBMITTALS

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

B. Shop Drawings: For laboratory fume hoods. Include plans, elevations, sections, details, and attachments to other work.

1. Indicate details for anchoring fume hoods to permanent building construction including locations of blocking and other supports. Include calculations demonstrating that anchorages comply with seismic performance requirements.
2. Indicate locations and types of service fittings together with associated service supply connection required.
3. Indicate duct connections, electrical connections, and locations of access panels.
4. Include roughing-in information for mechanical, plumbing, and electrical connections.
5. Show adjacent walls, doors, windows, other building components, laboratory casework, and other laboratory equipment. Indicate clearances from above items.
6. Include layout of fume hoods in relation to lighting fixtures and air-conditioning registers and grilles.
7. Include coordinated dimensions for laboratory equipment specified in other Sections.

C. Samples for Initial Selection: For fume hood exterior finishes.

D. Samples for Verification: For fume hood exterior finishes, interior lining and work top material, in manufacturer's standard sizes.

E. Delegated-Design Submittal: For fume hoods indicated to comply with seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Product Test Reports: Showing compliance with specified performance requirements for as-manufactured containment and static pressure loss based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency.

G. Source quality-control reports.

H. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Source Limitations for Laboratory Fume Hoods: Obtain fume hoods from single manufacturer.

1. Obtain from same source from same manufacturer as laboratory casework specified in Division 12 Section "Laboratory Casework."

B. Product Designations: Drawings indicate sizes, types, and configurations of fume hoods by referencing designated manufacturer's catalog numbers. Other manufacturers' hoods of similar sizes, types, and configurations, and complying with the Specifications, may be considered. See Division 01 Section "Product Requirements."

C. Product Standards: Comply with SEFA 1, "Laboratory Fume Hoods - Recommended Practices." Provide fume hoods UL listed and labeled for compliance with UL 1805.

D. Safety Glass: Products complying with testing requirements in 16 CFR 1201 for Category II materials.

1. Permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Preinstallation Conference: Conduct conference at Project site.
1.6 DELIVERY, STORAGE, AND HANDLING
   A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.7 PROJECT CONDITIONS
   A. Environmental Limitations: Do not deliver or install fume hoods until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.8 COORDINATION
   A. Coordinate layout and installation of framing and reinforcements for lateral support of fume hoods.
   B. Coordinate installation of fume hoods with laboratory casework, fume hood exhaust ducts, and plumbing and electrical work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Basis-of-Design Product: Subject to compliance with requirements, provide products as specified on Supplemental Cut Sheets or comparable product by one of the following
   B. See equipment schedule for make and model information for all Forensic Suite Equipment.

   1. Air Master Systems Corporation.
   2. Bedcolab Ltd.
   3. BMC Manufacturing.
   4. Fisher Hamilton L.L.C.
   5. Hanson Lab Furniture, Inc.
   9. Lab Crafters, Inc.
   10. Lab Fabricators.
   11. Laboratory Design & Supply.
   12. Laboratory Equipment Manufacturers, LLC.
   14. Mott Manufacturing Ltd.
   15. Sheldon Laboratory Systems.
   16. HEMCO Corporation.
   17. Baker Company (The).

2.2 MATERIALS

A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness.

1. For perchloric acid fume hoods, use Type 316L instead of Type 304.

C. Glass-Fiber-Reinforced Polyester: Polyester laminate with a chemical-resistant gel coat on the exposed face, and having a flame-spread index of 25 or less per ASTM E 84.

D. Epoxy: Factory molded, modified epoxy-resin formulation with smooth, nonspecular finish.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Durcon Company (The).
   b. Epoxyn Products.
   c. Laboratory Tops, Inc.
   d. Prime industries, inc.

2. Physical Properties:
   a. Flexural Strength: Not less than 10,000 psi.
   b. Modulus of Elasticity: Not less than 2,000,000 psi.
   c. Hardness (Rockwell M): Not less than 100.
   d. Water Absorption (24 Hours): Not more than 0.02 percent.
   e. Heat Distortion Point: Not less than 260 deg F.
   f. Flame-Spread Index: 25 or less per ASTM E 84.

3. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
   a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.
   b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).


E. Glass-Fiber Cement Board: ASTM C 1186.

F. Glass: Clear, laminated tempered glass complying with ASTM C 1172, Kind LT, Condition A, Type I, Class I, Quality-Q3; with two lites not less than 3.0 mm thick and with clear, polyvinyl butyral interlayer.
G. Fasteners: Provide stainless-steel fasteners where exposed to fumes.

2.3 FUME HOOD VENTILATION

A. Bypass Fume Hoods: Provide bypass fume hoods. Compensating bypass above sash opens as sash is closed. Provide sufficient bypass capacity so that face velocity with sash opening of 6 inches does not exceed three times the face velocity with sash fully open.

B. Variable-Air-Volume Control: Equip fume hoods with an electronic control unit with a sensing device that monitors face velocity, and a motorized damper on the exhaust connection that maintains a constant face velocity by controlling air volume in response to control unit. Equip units with manual override switch that opens motorized damper to provide maximum exhaust capacity regardless of sash position.

1. Provide output transmitter on electronic control unit that produces 0- to 10-V dc signal proportional to fume hood exhaust volume for interface with building's HVAC control system.
2. Provide electronic control unit that also monitors sash position and anticipates changes in face velocity caused by abrupt changes in sash position.

C. Auxiliary Air: Equip fume hoods with auxiliary-air outlet for connection to a system that supplies air from an external source equal to 70 percent of the exhausted air volume. Auxiliary-air system introduces air directly above and immediately in front of hood face. Capture efficiency of hoods shall be 90 percent minimum.

2.4 FABRICATION

A. General: Assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations. Fume hoods shall be capable of being partly disassembled as necessary to permit movement through a 35-by-79-inch door opening.

B. Steel Exterior: Fabricate from steel sheet, not less than 0.0478 inch thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings. Apply chemical-resistant finish to interior and exterior surfaces of component parts before assembly.

C. Fiberglass Exterior: Fabricate from glass-fiber-reinforced polyester components not less than 1/4 inch thick, bonded together to maximum extent practical. Trim edges of panels with PVC extrusion. Limit removable parts to access panels, front fascia, and airfoil.

D. Product Option: Provide either steel or fiberglass exterior as specified above.

E. Ends: Fabricate with double-wall end panels without projecting corner posts or other obstructions to interfere with smooth, even airflow. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.

F. Splay top and sides of face opening to provide an aerodynamic shape to ensure smooth, even flow of air into fume hood.
G. Interior Lining: Provide the following unless otherwise indicated:
   1. Epoxy, not less than 1/4 inch thick.

H. Lining Assembly: Unless otherwise indicated, assemble with stainless-steel fasteners or epoxy adhesive, concealed where possible. Seal joints by filling with chemical-resistant sealant during assembly.
   1. Fasten lining components together with stainless-steel cleats or angles to form a rigid assembly to which exterior panels are attached.
   2. Fasten lining components to a rigid frame assembly fabricated from stainless steel and to which exterior panels are attached.
   3. Punch fume hood lining side panels to receive service fittings and remote controls. Provide removable plug buttons for holes not used for indicated fittings.

I. Rear Baffle: Unless otherwise indicated, provide baffle, of same material as fume hood lining, at rear of hood with openings at top and bottom for airflow through hood. Secure baffle to cleats at rear of hood with stainless-steel screws. Fabricate baffle for easy removal for cleaning behind baffle.
   1. Provide preset baffles unless otherwise indicated.
   2. Provide epoxy-coated, stainless-steel screen at bottom baffle opening to prevent paper from being drawn into the exhaust plenum behind baffles.

J. Exhaust Plenum: Full width of fume hood and with adequate volume to provide uniform airflow from hood, of same material as hood lining, and with duct stub for exhaust connection.

K. Bypass Grilles: Provide grilles at bypass openings of bypass and restricted bypass fume hoods.

L. Sashes: Provide operable sashes of type indicated.
   1. Fabricate from 0.050-inch- nominal thickness stainless steel. Form into four-sided frame with bottom corners welded and finished smooth. Make top member removable for glazing replacement. Set glazing in chemical-resistant, U-shaped gaskets.
   2. Glaze with laminated safety glass.
   3. Counterbalance vertical-sliding sash with sash weight and stainless-steel cable system to hold sash in place regardless of position. Provide ball-bearing sheaves, plastic glides in stainless-steel guides, and stainless-steel lift handles. Provide rubber bumpers at top and bottom of each sash unit.
   4. Fabricate horizontal-sliding sashes hung from adjustable nylon-tired, ball-bearing sheaves supported on an overhead stainless-steel track. Provide a lower track for guiding sashes only. Sashes shall bypass and be removable. Provide flush finger pulls and rubber bumpers at both stiles of each sash.

M. Airfoil: Unless otherwise indicated, provide airfoil at bottom of fume hood face opening with 1-inch space between airfoil and work top. Sash closes on top of airfoil, leaving 1-inch opening for air intake. Airfoil directs airflow across work top to remove heavier-than-air gases and to prevent reverse airflow.
   1. Fabricate airfoil from stainless steel coated with PTFE or PVDF.
N. Light Fixtures: Provide vaporproof, two-tube, rapid-start, fluorescent light fixtures, of longest practicable length; complete with tubes at each fume hood. Shield tubes from hood interior with 1/4-inch-thick laminated glass or 3-mm-thick tempered glass, sealed into hood with chemical-resistant rubber gaskets. Provide units with fluorescent tubes easily replaceable from outside of fume hood.

1. Provide vaporproof, acid-resistant, incandescent light fixtures complete with 100-W, Type A, long-life bulbs instead of fluorescent fixtures at perchloric acid and radioisotope fume hoods. Provide two fixtures for hoods up to 60 inches long and one fixture for each 24 inches of length for longer hoods.

O. Base Cabinets: Provide base cabinet that in complimentary product line with fume hood 48 inch wide designed to hold acid products. Finish to match the fume hood. Unit shall be ADA compliant.

P. Work Top:

1. Work Tops, General: Provide units with smooth surfaces free of defects. Make exposed edges and corners straight and uniformly beveled. Where acid storage cabinets are indicated beneath fume hoods, provide holes in work tops as need to accommodate cabinet vents.

2. Resin Work Tops: Provide front overhang of 1 inch, with continuous drip groove on underside 1/2 inch from edge.
   b. Work Top Configuration: Raised (marine) edge, 1 inch thick at raised edge, with beveled edge and corners.

Q. Ceiling Extensions: Provide filler panels matching fume hood exterior to enclose space above fume hoods at front and sides of fume hoods and extending from tops of fume hoods to ceiling.

R. Finished Back Panels: Where rear surfaces of fume hoods are exposed to view, provide finished back panels matching rest of fume hood enclosure.

S. Comply with requirements in Divisions 23 and 26 Sections for installing water and laboratory gas service fittings, piping, electrical devices, and wiring. Install according to Shop Drawings. Securely anchor fittings, piping, and conduit to fume hoods unless otherwise indicated.

2.5 CHEMICAL-RESISTANT FINISH

A. General: Prepare, treat, and finish welded assemblies after welding. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.

B. Preparation: Clean steel surfaces, other than stainless steel, of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply fume hood manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat
and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.
2. Colors for Fume Hood Finish: As selected by Architect from manufacturer's full range.

2.6 ACCESSORIES

A. Service Fittings: Comply with requirements in Division 12 Section "Laboratory Casework."
   1. Provide service fittings with exposed surfaces, including fittings, escutcheons, and trim, finished with acid- and solvent-resistant powder coating complying with requirements in SEFA 7 for corrosion-resistant finishes.
   2. Provide service fittings with exposed surfaces in laboratory casework manufacturer's standard metallic brown, aluminum, white, or other color as approved by Architect.

B. Airflow Indicator: Provide each fume hood with airflow indicator of one of the following type(s):
   1. Indicator Type: Direct-reading aneroid (Magnehelic-type) gage that measures fume hood exhaust duct static pressure as an indication of airflow.

C. Airflow Alarm: Provide fume hoods with audible and visual alarm that activates when airflow sensor reading is outside of preset range.
   1. Provide with thermal-anemometer airflow sensor.
   2. Provide with reset and test switches.
   3. Provide with switch that silences audible alarm and automatically resets when airflow returns to within preset range.

D. Sash Alarm: Provide fume hoods with audible and visual alarm that activates when sash is opened beyond preset position.
   1. Provide with silence and test switches.

E. Sash Stops: Provide fume hoods with sash stops to limit hood opening to 50 percent of sash height. Sash stops can be manually released to open sash fully for cleaning fume hood and for placing large apparatus within fume hood.

F. Bypass Grille Blank-off Panel: Provide fume hoods with blank-off panel on bypass grille designed for use with sash stops to reduce exhaust air volume and provide design face velocity with sash at 50 percent open position.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fume hoods.

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

3.2 INSTALLATION

A. General: Install fume hoods according to Shop Drawings and manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels, but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

B. Comply with requirements in Division 12 Section "Laboratory Casework" for installing fume hood base cabinets, work tops, and sinks.

C. Comply with requirements in Divisions 22 and 26 Sections for installing water and laboratory gas service fittings and electrical devices.

1. Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink and work top-mounted fittings in sealant recommended by manufacturer of sink or work top material. Securely anchor fittings to fume hoods unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

A. Field test installed fume hoods according to "Flow Visualization and Velocity Procedure" requirements in ASHRAE 110.

1. Test one installed fume hood, selected by Architect, for each type of hood installed, according to ASHRAE 110 as modified in "Performance Requirements" Article.

B. Field test installed fume hoods according to ASHRAE 110 as modified in "Performance Requirements" Article to verify compliance with performance requirements.

1. Adjust fume hoods, hood exhaust fans, and building's HVAC system, or replace hoods and make other corrections until tested hoods perform as specified.

2. After making corrections, retest fume hoods that failed to perform as specified.

3.4 ADJUSTING AND CLEANING

A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.
B. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION 115313
SECTION 12 21 13 – HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Horizontal louver blinds with aluminum slats.

B. Related Sections include the following:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting horizontal louver blinds and accessories.

1.3 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details for horizontal louver blinds.

C. Samples for Initial Selection: For each type and color of horizontal louver blind indicated.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For each type and color of horizontal louver blind indicated.

1. Slat: Not less than 12 inches long.
2. Tapes: Full width, not less than 6 inches long.
3. Horizontal Louver Blind: Full-size unit, not less than 16 inches wide by 24 inches long.
4. Valance: Full-size unit, not less than 12 inches wide.
5. Cornice: Full-size unit, not less than 12 inches wide.

E. Product Certificates: For each type of horizontal louver blind, signed by product manufacturer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for each type of horizontal louver blind.

G. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.
1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain horizontal louver blinds through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide horizontal louver blinds with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.


C. Product Standard: Provide horizontal louver blinds complying with WCSC A 100.1.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver horizontal louver blinds in factory packages, marked with manufacturer and product name, fire-test-response characteristics, lead-free designation and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and dirty finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Mark 1 as manufactured by Levolor or a comparable product by one of the following:

2. Springs Window Fashions Division, Inc.

B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radiused corners.
   1. Width: 1 inch.
      a. Spacing: Not less than every 0.71 inch.
   2. Thickness: Manufacturer's standard.
   3. Finish: One color.
      a. Ionized Coating: Antistatic, dust-repellent, baked polyester finish.
      b. Reflective Coating: Manufacturer's special coating enhancing the reflection of solar energy on the outside-facing slat surface.

C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and end plugs and the following:
   1. Capacity: One blind per headrail.
   2. Integrated Headrail/Valance: Curved face.
   3. Light-blocking lower back lip.
   4. Tilt limiter with preselected degree settings.

D. Bottom Rail: Formed-steel or extruded-aluminum tube, with plastic or metal capped ends top contoured to match crowned shape of slat; with enclosed ladders and tapes to prevent contact with sill.

E. Maximum Light-Blocking Blinds: Designed for eliminating all visible light gaps if slats are tilted closed; with tight tape spacing indicated and slats with minimal-sized rout holes for ladders hidden and placed near back edge for maximum slat overlap; with headrail and bottom rail extended and formed for light-tight joints between rail and adjacent slats or construction.
   1. Finish: Color texture, pattern, and gloss differing from slats as selected by Architect from manufacturer's full range.

F. Ladders: Evenly spaced to prevent long-term slat sag.
   1. For Blinds with Nominal Slat Width 1 Inch or More: Manufacturer's standard.
      a. Tape Color, Texture, and Pattern: Color, texture, and pattern as selected by Architect from manufacturer's full range.

G. Lift Cords: Manufacturer's standard.

H. Tilt Control: Enclosed worm-gear mechanism, slip clutch or detachable wand preventing overrotation and linkage rod, and the following:
   2. Length of Tilt Control: Manufacturer's standard.
   3. Tilt: Full.
4. **Tilt:** Two-direction, positive stop or lock-out limited at an angle of 70 degrees from zero-degree horizontal, both directions.

I. **Lift Operation:** Manual, cord lock; locks pull cord to stop blind at any position in ascending or descending travel.

J. **Tilt-Control and Cord-Lock Position:** Right side of headrail, unless otherwise indicated.

K. **Valance:** Manufacturer's standard.

1. **Finish Color Characteristics:** Match color, texture, pattern, and gloss of slats.

L. **Mounting:** End mounting, permitting easy removal and replacement without damaging blind or adjacent surfaces and finishes; with spacers and shims required for blind placement and alignment indicated.

1. Provide intermediate support brackets if end support spacing exceeds spacing recommended by manufacturer for weight and size of blind.

M. **Hold-Down Brackets and Hooks or Pins:** Manufacturer's standard.

N. **Side Channels and Perimeter Light Gap Seals:** Manufacturer's standard.

O. **Colors, Textures, Patterns, and Gloss:** As selected by Architect from manufacturer's full range.

### 2.2 HORIZONTAL LOUVER BLIND FABRICATION

A. **Concealed Components:** Noncorrodible or corrosion-resistant-coated materials.

1. **Lift-and-Tilt Mechanisms:** With permanently lubricated moving parts.

B. **Unit Sizes:** Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:

1. **Blind Units Installed between (inside) Jambs:** Width equal to 1/4 inch per side or 1/2 inch total, plus or minus 1/8 inch, less than jamb-to-jamb dimension of opening in which each blind is installed. Length equal to 1/4 inch, plus or minus 1/8 inch, less than head-to-sill dimension of opening in which each blind is installed.

2. **Blind Units Installed outside Jambs:** Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. **Installation Brackets:** Designed for easy removal and reinstallation of blind, for supporting headrail, valance, and operating hardware, and for hardware position and blind mounting method indicated.

D. **Installation Fasteners:** No fewer than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.

E. **Color-Coated Finish:**
1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

F. Component Color: Provide rails, cords, ladders, and exposed-to-view metal and plastic matching or coordinating with slat color, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances and other conditions affecting performance.

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

3.2 INSTALLATION

A. Install horizontal louver blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior slat edges in any position are not closer than 1 inch to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware if any.

B. Flush Mounted: Install horizontal louver blinds with slat edges flush with finish face of opening if slats are tilted open.

C. Jamb Mounted: Install headrail flush with face of opening jamb and head.

3.3 ADJUSTING

A. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free of binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean horizontal louver blind surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.

C. Replace damaged horizontal louver blinds that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.
3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 12 21 13
SECTION 122413    ROLLER WINDOW SHADES

PART 1 – GENERAL

1.1  SECTION INCLUDES

A.  Provide manually and motor-operated, sunscreen and blackout roller shades as applicable.

B.  Related Sections:
   1.  Division 09 - Gypsum Board Assemblies: Coordination with gypsum board assemblies for blocking, installation of shade pockets, closures and related accessories.
   2.  Division 09 - Acoustical Ceilings: Coordination with acoustical ceiling systems for blocking, installation of shade pockets, closures and related accessories.

1.2  SUBMITTALS

A.  Product Data: Manufacturer’s data sheets on each product to be used, including:
   1.  Preparation instructions and recommendations.
   2.  Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
   3.  Storage and handling requirements and recommendations.
   4.  Mounting details and installation methods.

B.  Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
   1.  Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C.  Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.

D.  Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. Shade cloth samples and aluminum finish sample as selected. Mark face of material to indicate interior faces.

E.  Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

F.  Warranty: Provide manufacturer’s warranty documents as specified in this Section.

1.3  MAINTENANCE MATERIAL SUBMITTALS

A.  Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of ten years experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section. This includes but is not limited to all required extrusions, accessories, controls and fabricated roller shades or else all stated and published warranties may be void.

B. Installer Qualifications: Engage an installer, which shall assume responsibility for installation of all system components, with the following qualifications.
   1. Installer for roller shade system shall be trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.

C. Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

D. Shadecloth Anti-Microbial Characteristics: ‘No Growth’ per ASTM G 21 results for fungi ATCC9642, ATCC 9644, and ATCC9645.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver components in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 WARRANTY

A. Warranty: Provide manufacturer’s standard warranties, including the following:
   1. Roller Shade Hardware, and Shadecloth: Manufacturer’s standard non-depreciating twenty-five year limited warranty.
2. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to access to the work above 12’ Feet AFF, which are the responsibility of others.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Basis of Design Manufacturer for Window Shade System: Mechoshade Mech/5 & SlimLine or Equivalent

2.2 SHADE BANDS

A. Shade Bands: Construction of shade band includes the fabric, the enclosed hem weight, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.

1. Concealed Hembar: Shall be continuous extruded aluminum for entire width of shade band and with the following characteristics:
   a. Hembar shall be heat sealed on all sides.
   b. Open ends shall not be accepted.

2. Shade Band and Shade Roller Attachment:
   a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection.
   b. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable/replaceable with a “snap-on” “snap-off” spline mounting, without having to remove shade roller from shade brackets.
   c. Mounting Spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
   d. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets, does not meet the performance requirements of this specification and shall not be accepted.

2.3 ROLLER SHADE FABRICATION

A. Fabricate shade cloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8 inch (3.18 mm) in either direction per 8 feet (2438 mm) of shade height due to warp distortion or weave design.

B. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shade bands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer’s standards or, in absence of such standards, shall be responsible for establishing appropriate standards to assure proper tracking and rolling of the shadecloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.

C. For railroaded shade bands, provide seams in railroaded multi-width shade bands as required to meet size requirements and in accordance with seam alignment as acceptable to Architect. Seams shall be properly located. Furnish battens in place of plain seams when the width, height, or weight of the shade exceeds manufacturer’s standards. In absence of
such standards, assure proper use of seams or battens as required to, and assure the proper tracking of the railroaded multi-width shade bands

D. Provide battens for railroaded shades when width-to-height (W:H) ratios meet or exceed manufacturer’s standards. In absence of manufacturer’s standards, be responsible for proper use and placement of battens to assure proper tracking and roll of shade bands.

E. Blackout shade bands, when used in side channels, shall have horizontally mounted, roll-formed stainless steel or tempered-steel battens not more than 3 feet (115 mm) on center extending fully into the side channels. Battens shall be concealed in an integrally colored fabric to match the inside and outside colors of the shade band, in accordance with manufacturer’s published standards for spacing and requirements.
   1. Battens shall be roll formed of stainless steel or tempered steel and concave to match the contour of the roller tube.

2.4 ROLLER SHADE COMPONENTS

A. Access and Material Requirements:
   1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
   2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
   3. Use only Delran engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and/or polyester, or reinforced polyester shall not be accepted.

B. Manual Operated Chain Drive Hardware and Brackets:
   1. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.
   2. Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.
   3. Provide shade hardware system that allows for removable regular and/or reverse roll fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.
   4. Provide shade hardware system that allows for operation of multiple shade bands (multi-banded shades) by a single chain operator, subject to manufacturer’s design criteria. Connectors shall be offset to assure alignment from the first to the last shade band.
   5. Provide shade hardware system that allows multi-banded manually operated shades to be capable of smooth operation when the axis is offset a maximum of 6 degrees on each side of the plane perpendicular to the radial line of the curve, for a 12 degrees total offset.
   6. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable.
   7. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel or heavier as required to support 150 percent of the full weight of each shade.
8. Drive Bracket / Brake Assembly:
   a. MechoShade Drive Bracket model M5 shall be fully integrated with all MechoShade accessories, including, but not limited to: SnapLoc fascia, room darkening side / sill channels, center supports and connectors for multi-banded shades.
   b. M5 drive sprocket and brake assembly shall rotate and be supported on a welded 3/8 inch (9.525 mm) steel pin.
   c. The brake shall be an over running clutch design which disengages to 90 percent during the raising and lowering of a shade. The brake shall withstand a pull force of 50 lbs. (22 kg) in the stopped position.
   d. The braking mechanism shall be applied to an oil-impregnated hub on to which the brake system is mounted. The oil impregnated hub design includes an articulated brake assembly, which assures a smooth, non-jerky operation in raising and lowering the shades. The assembly shall be permanently lubricated. Products that require externally applied lubrication and or not permanently lubricated are not acceptable.
   e. The entire M5 assembly shall be fully mounted on the steel support bracket, and fully independent of the shade tube assembly, which may be removed and reinstalled without effecting the roller shade limit adjustments.

9. Drive Chain: #10 qualified stainless steel chain rated to 90 lb. (41 kg) minimum breaking strength. Nickel plate chain shall not be accepted.

2.5 MOTOR-OPERATED, SINGLE-ROLLER SHADES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Draper Inc.
3. Levolor.
4. Lutron Electronics Co., Inc.
5. MechoShade Systems, Inc.

B. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

   1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Electric Motor: Manufacturer's standard tubular, enclosed in roller.
      a. Electrical Characteristics: 110-V ac
      b. Maximum Total Shade Width: As required to operate roller shades indicated
      c. Maximum Shade Drop: As required to operate roller shades indicated
      d. Maximum Weight Capacity: As required to operate roller shades indicated
3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for surface mounting. Provide the following for remote-control activation of shades:
   a. Group Control Station: Maintained contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for single-switch group control.
   b. Color: As selected by Architect from manufacturer's full range

4. Crank-Operator Override: Crank and gearbox operate shades in event of power outage or motor failure.

5. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.

6. Operating Features:
   a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
   1. Roller Drive-End Location: Right side of interior face of shade
   2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller
   3. Shadeband-to-Roller Attachment: Manufacturer's standard method

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Shadebands:
   2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
      a. Type: Enclosed in sealed pocket of shadeband material] [Exposed with endcaps, or Exposed with endcaps and integral light seal at bottom where it meets the sill
      b. Color and Finish: As selected by Architect from manufacturer's full range

F. Installation Accessories:
   1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
      a. Shape: L-shaped
      b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches
   2. Endcap Covers: To cover exposed endcaps.
3. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
   a. Closure-Panel Width: 2 inches

4. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.

5. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.

6. Installation Accessories Color and Finish: As selected from manufacturer's full range

2.6 ROLLER SHADE SCHEDULE

A. Roller Shade Schedule: Refer to the Reflected Ceiling Drawings for locations.
   1. Shade Type WS1: Manual operating, chain drive, sunscreen roller shades in all exterior windows of rooms and spaces shown on the Drawings as Note 3 on Reflected Ceiling Plans
      a. Shade pockets.
   2. Shade Type WS1: Manual operating interior, chain drive room darkening blackout roller shades with blackout fabric in all exterior windows of rooms and spaces shown on Drawings, and related mounting systems and accessories.
      a. Shade pockets.
      b. Room darkening side and sill channels.

2.7 SHADECLOTH

A. Visually Transparent Single-Fabric Shadecloth: MechoSystems, ThermoVeil® group, single thickness, opaque non-raveling 0.030-inch (0.762 mm) thick vinyl fabric, woven from 0.018-inch (0.457 mm) diameter extruded vinyl yarn comprising of 21 percent polyester and 79 percent reinforced vinyl, in colors selected from manufacturer’s available range.
   1. Dense Basket Weave: “1300 series”, 5 percent open, 2 by 2 dense basket-weave pattern. Color: Selected from manufacturer’s standard colors

B. Room Darkening (PVC Free) Shadecloth with Opaque Acrylic Backing: MechoSystems, “Equinox 0100 series”, .008 inches thick (.19 mm) blackout material and weighing .94 lbs. per square yard, comprising of 53% fiberglass, 45% acrylic, 2% poly finish.
   1. Color: Selected from manufacturer’s standard colors.

2.8 ROLLER SHADE ACCESSORIES

A. Shade Pocket: For recessed mounting in acoustical tile or drywall ceilings as indicated on the drawings.
   1. Either extruded aluminum and or formed steel shade pocket, sized to accommodate roller shades, with exposed extruded aluminum closure mount, tile support and removable closure panel to provide access to shades.
2. Provide “Vented Pocket” such that there will be a minimum of four 1 inch (25.4 mm) diameter holes per foot allowing the solar gain to flow above the ceiling line.

B. Room Darkening Side and Sill Channels:
   1. Extruded aluminum with polybond edge seals and SnapLoc-mounting brackets and with concealed fastening. Exposed fastening is not acceptable. Channels shall accept one-piece exposed blackout hembar with vinyl seal to assure side light control and sill light control.
      a. MechoSystems side channels, 1-15/16 inches (49.2 mm) wide by 1-3/16 inches (30.1 mm) deep, two-band center channels, 2-5/8 inches (66.6 mm) wide by 1-3/16 inches (30.1 mm) deep. The 2-5/8-inch (66.6 mm) double-center channels may be installed at center-support positions of multi-band-shade ElectroShades. MechoSystems side channels 2-5/8 inch (66.6 mm) may be used as center supports for ElectroShades; shade bands up to 8 high. For shade bands over 8 feet (2438 mm), provide ElectroShade side channels.
      b. ElectroShade side channels, 2-1/2 inches (63.5 mm) wide by 1-3/16 inches (30.1 mm) deep; two-band center channels 5 inches (127 mm) wide by 1-3/16 inches (30.1 mm) deep. The 2-5/8-inch (66.6 mm) double-center channels may be installed at center-support positions of multi-band-shade ElectroShades. MechoSystems side channels 2-5/8 inches (66.6 mm) may be used as center supports for ElectroShades. Also provide for use with manually operated room darkening MechoSystems’s over 8 feet (2438 mm) in height.
      c. Color: Selected from manufacturer’s standard colors or custom color as selected by Architect.

PART 3 – EXECUTION

3.1 EXAMINATION
   A. Do not begin installation until substrates have been properly prepared. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION
   A. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION OF ROLLER SHADES
   A. Contractor Furnish and Install Responsibilities:
      1. Window Covering Contractor (WC) shall provide an on site, Project Manager, and shall be present for all related jobsite scheduling meetings.
      2. WC shall supervise the roller shade installation, and setting of intermediate stops of all shades to assure the alignment of the shade bands within a single EDU group, which shall not exceed +/- 0.125 inches (3.175mm), and to assure the alignment between EDU groups, which shall not exceed +/- 0.25 inches (6.35mm).
3. WC shall be responsible for field inspection on an area-by-area and floor-by-floor basis during construction to confirm proper mounting conditions per approved shop drawings.

4. Verification of Conditions: examine the areas to receive the work and the conditions under which the work would be performed and notify General Contractor and Owner of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected. Commencement of installation shall constitute acceptance of substrate conditions by the installer.

5. WC shall provide accurate to 0.0625 inch (1.5875mm); field measurements for custom shade fabrication on the Roller Shades manufacturers input forms.

6. WC Installer shall install roller shades level, plumb, square, and true according to manufacturer’s written instructions, and as specified here in. Blocking for roller shades installed under the contract of the interior General Contractor shall be installed plumb, level, and fitted to window mullion as per interior architect’s design documents and in accordance with industry standard tolerances. The horizontal surface of the shade pocket shall not be out-of-level more than 0.625 inch (15.875mm) over 20 linear feet (6.096 meters)

7. Shades shall be located so the shade band is not closer than 2 inches (50 mm) to the interior face of the glass. Allow proper clearances for window operation hardware.

8. Adjust, align and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

9. Installer shall set Upper, Lower and up to 3 intermediate stop positions of all motorized shade bands, and assure alignment in accordance with the above requirements.

10. WC shall certify the operation of all motorized shades and turn over each floor for preliminary acceptance.

11. The WC shall participate and cooperate with the electrical contractor, the window shade manufacturer and the Commissioning agent to verify and certify the installation is in full conformance with the specifications and is fully operational. This work to occur during the commissioning stage and is in addition to preliminary acceptance required for each floor.

12. Clean roller shade surfaces after installation, according to manufacturer’s written instructions.

13. WC shall train Owner’s maintenance personnel to adjust, operate and maintain roller shade systems.

14. Protect installed products until completion of project.

15. Touch-up, repair or replace damaged products before Substantial Completion.

B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.
3.5  ADJUSTING

1. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.6  CLEANING AND PROTECTION

1. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

2. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

3. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.7  DEMONSTRATION

Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION
SECTION 12 36 16 – METAL COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes stainless-steel countertops.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, sections, details, and attachments to other work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

B. Sealant for Countertops: Manufacturer's standard sealant of characteristics indicated below that complies with applicable requirements in Section 079200 "Joint Sealants."

1. Mildew-Resistant Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, silicone.
2. Color: Clear.
3. Sealant shall have a VOC content of 250 g/L or less.

2.2 STAINLESS-STEEL COUNTERTOPS

A. Countertops: Fabricate from 0.062-inch- thick, stainless-steel sheet. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Provide front and end overhang of 1 inch over the base cabinets.

2. Sound deaden the undersurface with heavy-build mastic coating.
3. Extend the top down to provide a 1-inch- thick edge with a 1/2-inch return flange.
4. Form the backsplash coved to and integral with top surface, with a 1/2-inch- thick top edge and 1/2-inch return flange.

2.3 STAINLESS-STEEL FINISH

A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each
When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install metal countertops level, plumb, and true; shim as required, using concealed shims.

B. Field Jointing: Where possible, make field jointing in the same manner as shop jointing; use fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

C. Secure tops to cabinets with Z- or L-type fasteners or equivalent; use two or more fasteners at each front, end, and back.

D. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.

E. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant.

3.2 CLEANING AND PROTECTION

A. Protection: Provide 6-mil plastic or other suitable water-resistant covering over the countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c.
SECTION 123653 SOLID PHENOLIC WORK SURFACES

PART 1 - GENERAL

Solid Phenolic Resin Composite Laboratory Work Surfaces

REFERENCES

A. ASTM International (ASTM):
   2. D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
   5. D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30\(^\circ\) C and 30\(^\circ\) C with a Vitreous Silica Dilatometer.


D. Scientific Certification Systems (SCS) - Recycled Content Certifications.

E. Scientific Equipment and Furniture Association (SEFA) 3 - Work Surfaces.

Materials and Fabrication:

General: Material shall be a solid, hard and made of wood-based fibers with thermosetting phenolic resin pressed under high heat and pressure to form a composite material formulated to provide a work surface with chemical and heat resistance characteristics. The combination of asbestos free inert filler material, wood fibers and phenolic resin shall be press cured in order to achieve maximum chemical resistance and physical strength and stability. Surfaces shall have a uniform low-sheen matte crystal smooth surface finish and the material shall be extremely hard, resistant to heat, chemical attack, self-extinguishing and non-absorptive in nature.
Material Description - Basis of Design Trespa TopLab Plus:

TopLab®Plus is a flat panel based on 30% thermosetting resins homogenously reinforced with 70% wood fibers and manufactured under high pressure and temperature to form a composite panel. The panels have an integrated, decorative surface with pigmented resins cured using ‘Electron Beam Curing’ (EBC) technology, rendering the panel highly chemical resistant and highly antibacterial activity of > 99.99% reduction after 24 hours using testing method based on JIS Z 2801: 2000. TopLab®Plus provides high aesthetics and a quality appearance for applications for sterile and chemically resistant laboratory work surface environments.

Trespa® TopLab Plus® solid phenolic is manufactured by Trespa®. TopLab®Plus is a self-supporting flat panel based on thermosetting resins, homogeneously reinforced with cellulose fibers and manufactured under high heat and pressure. The panels have a pigmented resin, decorative surface that is electron-beam cured.

**Thickness:**

3/4" thick (20 mm)

**Edges and Corners:**

Exposed work surface edges and corners, except as indicated, shall be furnished with:

1/8" (3.175 mm) machined beveled top edge with blended bevel corners

**Surface:** Work surfaces shall be furnished as:

Flat only with finished exposed edges (Industry Standard)

**Backs and Side Splashes:**

Supplied loose, cut to size, for field application in the same material as countertops. Applied splash may be ½” (20 mm) or 1” (25 mm) thickness. Curbs as installed shall be 4” high (100 mm) typical, unless otherwise indicated on drawings. Backsplash and return side splash curbs will be bonded to the tops at the jobsite with epoxy resin adhesive. Include top mounted end curb where worksurfaces abut walls, fume hoods, and locations detailed on drawing.

**Colors:** Slate Gray (New - Similar to Graphite Gray Epoxy) - Code: T 70.0.0

**Warpage:** Inspect work surface for warpage before fabrication or installation. Measure in unrestrained condition. Work surface will be accepted for use if there is no gap exceeding 1/16" (1.59 mm) in a 36" (914 mm / 0.9 mtr) span or 3/16" (4.5 mm) in 96" (2438 mm) span.

**Fabrication:** Provide in longest practical lengths, 96” (2438 mm) or 120” (3048 mm) being maximum available.

All seam joints shall be bonded with a highly chemical and corrosion resistant 2 part epoxy adhesive. Provide 1/8" (3.17 mm) drip groove on front underside of exposed edges set back 1/2" (12.5 mm) from edge at all sink areas and where shown on drawings. All exposed edges to be finished.

**Slab Sizes:** 60.24” x 120.08” Nominal 5’ x 10’; and 73.23” x 100.40” Nominal 6’ x 8’. (1530 x 3050 mm and 1860 x 2550 mm), supplied in slab form or fabricated, cut to size required.
Thickness Tolerances: Each top corner shall not deviate more than plus / minus 1/16" (1.59 mm) from nominal.

Size Tolerances: Length, plus / minus 1/8" Width (3.17 mm), plus / minus 1/16" (1.59 mm).

Squareness: Compare the diagonal corner-to-corner measurements across the width of each work surface.
   The diagonal measurements must be within 1/16" (1.59 mm).

Penetrations: Location of cutouts and drillings: Plus / minus 1/8" (3.17 mm).
   Cutout sizes and drillings: Plus / minus 1/16" (1.59 mm).

Fastening Tops to Base Cabinets:
1. Secure solid phenolic Trespa® TopLab® Plus to base cabinets with silicone adhesive, applied at each corner and with a continuous bead along perimeter edges or spotted every 30” (762 mm) on center.
2. Maximum penetration of screws into underside of solid phenolic countertops shall not be installed closer than ¼” (6 mm) below the top surface.
3. Abut solid phenolic top and edge surfaces in one true plane with flush hairline joints or with 1/16” to 1/8” (1.58 mm to 3.17 mm) seam, filled with either epoxy resin adhesive or silicone.

Volatile chemicals (organic solvents): A cotton ball, saturated with the test chemical (reagent) is placed in a one-ounce bottle (10 x 75 mm test tube or similar container) with a reservoir of liquid above the ball. The container is inverted on the test material for a period of 24 hours at a standard temperature of 23° plus / minus 2°C. (73°F plus / minus 4°F).

Non-Volatile Chemicals: Five drops (1/4 cc) of the test chemical are placed on the test material surface. The chemical is covered with a watch glass 1” (25 mm) for a period of no less than 24 hours at a standard temperature of 23° plus / minus 2°C. (73°F plus / minus 4°F).

Evaluation Ratings:
After exposure for 24 hours, all surfaces are washed with clear clean water, then a detergent solution, finally with naphtha, then rinsed with distilled water and dried with a cloth. Change in surface finish and function shall be described by the following (1-5) ratings:

1) No Effect: No detectable change in the material surface.
2) Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material.
3) Good: Clearly discernible change in color or gloss, but no significant impairment of surface life or function.
4) Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over an extended period.
5) Failure: Pitting, cratering or erosion of work surface material; obvious and significant deterioration.
Chemical resistance is affected by the type of chemical, its concentration, ambient temperature, humidity, time and housekeeping practices. Panels are to be provided with minimum performance in accordance with chemical resistance test per SEFA 8. End users should test phenolic panels in actual work environments. Generally, with proper housekeeping (spills cleaned immediately), the following listed chemicals cause no detectable stain, loss of gloss or change in work surface.

After 24 hours, the following showed a slight or noticeable stain with Black Trespa TLP: 98% Sulfuric, 65% Nitric, Iodine Crystal and Iodine solution 1%. The balance of chemicals tested did not stain or stains could be cleaned leaving a normal surface. Resistance to staining may be color dependent

Other Characteristics:

A. Finish: Matte sheen – Crystal smooth finish on TopLab®Plus

B. Core color – Black only

C. Modulus of Elasticity: 1,500,000 psi minimum

D. Shear Strength: 2000 psi minimum

E. Compressive Strength: 24,000 psi minimum.

F. Weight: 93 pcf maximum.

G. Fire Performance: Maximum flame-spread of 25 per ASTM E84 (Class 1, Class A) for panels 5/8” (16mm) thick and greater.

H. Porosity: Nonporous surface and edges.

I. Microbial Characteristics: Will not support micro organic growth.

J. Chemical Resistance: Provide panel with minimum performance in accordance with chemical resistance test per SEFA 8.

Testing Requirements:

   Hardness (ASTM D785):
   Test Method: Hardness, Rockwell M “M” Scale; average of five readings.
   Minimum Acceptable Test Results:
   Average value of 100 over the five samples.

   Water Absorption (ASTM D570):
   Test Method: Specimens measuring 3” (75 mm) in length by 1” (25 mm) in width by the thickness of the material should be used. At least three specimens should be tested. After weighing, specimens should be entirely immersed in distilled water maintained at a temperature of 23° plus or minus
1°C. (73.4° plus or minus 1.8°F) for a period of 24 hours. The samples should then be removed, dried and weighed to the nearest 0.001g. The percentage of increase in weight calculated to the nearest 0.01% should then be calculated. Minimum Acceptable Test Results: 0.01%.

Flammability or Rate of Burning (ASTM D794):
Test Method: Measure “Average Time of Burning (ATB)” as described in test. At least 5 samples (125 mm +/- 5 mm in length by 12.5mm +/- 0.2 mm in width) should be tested.
Minimum Acceptable Test Results: ATB should equal zero.

Porcelain Crucible - Test A (Non-Standard Test)
Test Method: a high-form porcelain crucible, size D, 15ml capacity, shall be heated over a Bunsen burner until the crucible bottom attains an incipient red heat. Immediately, the hot crucible shall be transferred to the top surface and allowed to cool to room temperature.
Minimum Acceptable Test Results: Upon removal of the cooled crucible, there shall be no blisters or cracks. Slight dulling or color change is acceptable.

Heat Deflection @ 264 psi (ASTM 648) Minimum Acceptable Test Results: 193ºC (380ºF)

Falling Ball Impact Resistance (ERF 23-69):
Test Method: Careful attention to details of test procedure should be followed. A wooden supporting frame must be used with the test. Size of samples: 12" x 12" (305 x 305 mm) by the thickness of the material. Steel balls of 2 lbs. (0.907 kgs) should be used. Three or more samples should be tested from a maximum height of 8′ (2.42 m).
Minimum Acceptable Test Result: No fracture to a height of 7′ (2.12 m).

Thermal Shock Resistance (Non-Standard Test):
Test Method: Two cubes 2" x 2" (50 x 50 mm) by thickness of material are immersed in a dry ice/acetone bath maintained at minus 78ºC. The cubes are allowed to remain in the bath for 15 minutes. Each cube is removed and immediately placed in a container of boiling water at 100ºC. The procedure is repeated until failure occurs (i.e., cracking, warpage, distortion) for a series of five repetitions.
Minimum Acceptable Test Results: No visible changes should be observed.

Flexural Strength and Modulus of Rupture (ASTM D790):
Test Method: Test specimens should be prepared from 1" thick (25 mm) production material with a support span 16 times the depth (thickness) of the beam. The original surface of the sample should be unaltered. Recommended sample size is 19.5" x 1.0" x 1.0" (495 x 25 x 25 mm) (length x width x depth). A minimum of five samples are to be tested. Testing should be carried out to failure of the test sample. Modulus of rupture should be measured as described in the ASTM method.
Minimum Acceptable Test Result: Flexural Strength: 10,000 psi / Modulus of Rupture: 1,000,000psi.

END OF SECTION
SECTION 123661.19 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Quartz agglomerate countertops and backsplashes and end splashes.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

C. Samples for Initial Selection: For each type of material exposed to view.

D. Samples for Verification: For the following products:
   1. Countertop material, 6 inches square.
   2. One full-size quartz agglomerate countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.
1.1 FIELD CONDITIONS

1.2 Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.3 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.4 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

A. Configuration: Provide countertops with the following front and backsplash style:

1. Front: Straight, slightly eased at top.
2. Backsplash: Straight, slightly eased at corner.

B. Countertops: 3/4-inch-thick, solid surface material with front edge built up with same material.

C. Backsplashes: 3/4-inch-thick, solid surface material.

D. Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

2.2 COUNTERTOP MATERIALS

A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.

1. **Manufacturers:** Basis of Design: Silestone. Subject to compliance with requirements, provide products by one of the following:

   a. Ceasarstone
   b. Corian Quartz
   c. Cambria natural Quartz Surfaces
2. Colors and Patterns: As selected by Architect from manufacturer's full range.
3. Colors and Patterns: Match Architect's samples

B. Particleboard: ANSI A208.1, Grade M-2

C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by quartz agglomerate manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Install metal splines in kerfs in countertop edges at joints Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.

2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

I. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 12 36 61
SECTION 13 10 10

BULLET RESISTANT PARTITIONS AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Bullet Resistant Doors.

RELATED SECTIONS

B. Section 06 10 00 - Rough Carpentry.

C. Section 08 70 00 - Hardware.

1.2 REFERENCES

A. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.


C. NIJ Standard 0108.01 - (National Institute of Justice) Standard for Ballistic Resistant Protective Materials.

D. Underwriters Laboratories: UL 752 - Standard for Bullet Resisting Equipment.

1.3 PERFORMANCE REQUIREMENTS

A. Design, fabricate and install all partition materials specified in this section to meet or exceed the requirements of UL 752.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Submit Manufacturer approved shop drawings detailing plan, section and elevation views as necessary to ensure proper field installation procedures. Coordinate locations with those listed in the Contract Drawings.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten (10) years experience.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

A. At project closeout, provide to Owner or Owners Representative an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Total Security Solutions, which is located at: 170 National Park Dr.; Fowerville, MI 48836; Toll Free Tel: 888-839-6752; Tel: 517-223-7807; www.tssbulletproof.com

B. Substitutions: Equal products meeting this specification.

2.2 COMPONENTS

A. Glazing: Bullet Resistant Glazing:
   1. Glazing Type: Laminated bullet resistant glass.
   2. Rating: UL 752 Level 3.
3. Glazing Thickness: 1 1/4 inch (32mm).
4. All panels finish 48 inches (1219mm) above the teller riser, 60 inches (1524mm) above the teller counter or to the underside of an existing soffit if lower than 100 inches (2540mm) Above the Finished Floor (A.F.F.).

B. Aluminum Sections: Extruded aluminum alloy 6063 T5 manufactured in accordance with ASTM B209. Anodized or powder coated finish to match the existing decor and be free of sharp edges or burrs when in place.
   1. Glazing Channel: U-Channel specifically designed for securing transparencies tightly in place. Angles and stops are only acceptable for top attachment.
   2. Door Frames: 1 3/4 inch by 4 inches by 1/8 min. (44mm x 102mm x 3mm) wall thickness. Anodized or powder coated finish to match the existing decor and be free of sharp edges or burrs when in place.

2.3 BULLET RESISTANT DOORS

A. Door Type:
   1. Wood Door: Lumber core lined with a sheet of fiberglass. Door has no exposed fasteners and is finished to match exterior.

B. Door Construction:
   1. Aluminum: Ballistic aluminum frame, pre-drilled in accordance with the Contract Documents for installation into specified system. Extruded and keyed aluminum spline joinery with continuous 3/8 inch (10mm) diameter steel tie rod at door top and bottom rails.
      a. Clear anodized
      b. Dark Bronze anodized
   2. Glazing: As specified in Article 2.2 of this section. Meets Underwriters Laboratories Standard 752 for bullet resistance and/or tested by H.P. White Laboratory for specified bullet resistance.
   3. Hardware:
      a. Lockset: Schlage D80PD lockset.
      b. Closer: Title 24 compliant automatic door closer.
      c. Hinges: Select 21 continuous hinge.
      e. Strike Release: Electric, as specified in Section 08 74 13.
      f. Exit Device: As specified in Section 08 71 53.
      g. Custom Security Hardware: As specified in Section 08 71 53.
      h. Peephole.
      i. View window.
      j. Door scope.

2.4 STRUCTURAL SUPPORTS

A. Where installation requires lateral bracing, locate braces no wider than 96 inches (2438mm) on centerlines. The depth of the brace below the counter and vertical support (brace) above the counter must maintain a ratio of at least 20 percent of the total installation height.

B. Install 1 1/2 inch (39mm) square steel tube braces below the counter and hoods with a minimum wall thickness of 1/8 inch (3mm). Welded in place and include two vertical and
horizontal members. Bolt or weld a diagonal member between the two horizontal members.

C. Extend braces located above the counter and hoods to the top of the acrylic slotted jump shield. Material to be of the specified bullet resistant material. At no time shall the vertical supports be less than 10 inches (254mm) in depth.

PART 3 EXECUTION

3.1 EXAMINATION
A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION
A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION
A. Install in accordance with manufacturer's instructions.

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

END OF SECTION
SECTION 133419 – METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes a single-story, single-span, rigid-frame-type pre-engineered metal building of the nominal length, width, eave height, and roof pitch indicated.

1. Exterior walls are covered with factory-assembled insulated wall panels attached to framing members using concealed fasteners. Endwalls are not expandable.
2. Exterior walls are covered with field-assembled insulated wall panels attached to framing members using exposed fasteners. Endwalls are not expandable.
3. Roof System consists of the manufacturer's standard lap-seam insulated roof.
4. Roof system consists of the manufacturer's standard standing-seam insulated roof.
5. Manufacturer's standard building components and accessories may be used, provided components, accessories, and complete structure conform to design indicated and specified requirements.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Concrete floor and foundations and installation of anchor bolts are specified in Division 03 Section "Concrete Work."
2. Brick masonry exterior walls are specified in Division 04 Section "Unit Masonry."
3. Sealants and calking are specified in Division 07 Section "Joint Sealers."
4. Finish hardware and provisions for master-keying are specified in Division 08 Section "Finish Hardware."

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. General: Engineer, design, fabricate and erect the pre-engineered metal building system to withstand loads from winds, gravity, structural movement including movement thermally induced, and to resist in-service use conditions that the building will experience, including exposure to the weather, without failure.

1. Design each member to withstand stresses resulting from combinations of loads that produce the maximum allowable stresses in that member as prescribed in MBMA's "Design Practices Manual."
B. Design Loads: Basic design loads, as well as auxiliary and collateral loads, are indicated on the drawings.

1. Basic design loads include live load, wind load, and seismic load, in addition to the dead load.
2. Auxiliary loads include dynamic live loads such as those generated by cranes and material handling equipment.
3. Collateral loads include additional dead loads over and above the weight of the metal building system such as sprinkler systems and roof-mounted mechanical systems.

C. Structural Framing and Roof and Siding Panels: Design primary and secondary structural members and exterior covering materials for applicable loads and combinations of loads in accordance with the Metal Building Manufacturers Association's (MBMA) "Design Practices Manual."

1. Structural Steel: Comply with the American Institute of Steel Construction's (AISC) "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" for design requirements and allowable stresses.
2. Light Gage Steel: Comply with the American Iron and Steel Institute's (AISI) "Specification for the Design of Cold Formed Steel Structural Members" and "Design of Light Gage Steel Diaphragms" for design requirements and allowable stresses.

D. Building Accessories: Provide metal building system accessories that comply with the following criteria:

1. Hollow Metal Doors and Frames: Comply with the Steel Door Institute's SDI-100 for types, styles, and design requirements and with ANSI A115 for hardware preparation.
2. Aluminium Windows: Comply with AAMA 101 for window-type designations and performance requirements.
3. Steel Windows: Comply with the Steel Window Institute's (SWI) "Recommended Specifications for Steel Windows" for grade classification and types.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.

B. Product data consisting of metal building system manufacturer's product information for building components and accessories.

C. Shop drawings for metal building structural framing system, roofing and siding panels, and other metal building system components and accessories that are not fully detailed or dimensioned in manufacturer's product data.
1. Structural Framing: Furnish complete erection drawings prepared by or under the supervision of a professional engineer legally authorized to practice in the jurisdiction where the Project is located. Include details showing fabrication and assembly of the metal building system. Show anchor bolts settings and sidewall, endwall, and roof framing. Include transverse cross-sections.

2. Roofing and Siding Panels: Provide layouts of panels on walls and roofs, details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashings, closures, and special details. Include transverse cross-sections.

3. Building Accessory Components: Provide details of metal building accessory components to clearly indicate methods of installation including the following:
   a. Personnel doors: Provide elevations and details of each type of door and frame, including anchors and reinforcement; show location and installation requirements for finish hardware. Provide schedule of doors and frames using the same reference numbers for details and openings as those indicated on the drawings; include complete hardware schedule.
   b. Overhead Coiling Service Doors: Provide fully dimensioned details of construction, including 1/4-inch scale elevations of door units and not less than 3/4-inch scale details showing door curtain, guides, counterbalance, and method of operation.
   c. Overhead Sectional Service Doors: Provide fully dimensioned details of construction, including 1/4-inch scale elevations of door units and not less than 3/4-inch scale details showing door sections, tracks, brackets, guides, hardware, and method of operation.
   d. Aluminum Windows: Provide 1/4-inch scale elevations of window units and not less than 3/4-inch scale details showing anchors, hardware, operators, and glazing details.
   e. Steel Windows: Provide 1/4-inch scale elevations of window units and not less than 3/4-inch scale details showing anchors, hardware, operators, and glazing details.
   f. Sheet Metal Accessories: Provide layouts at 1/4-inch scale. Provide details of ventilators, louvers, gutters, downspouts, and other sheet metal accessories at not less than 1-1/2-inch scale showing profiles, methods of joining, and anchorages.

D. Wiring diagrams from the manufacturer of motor operated overhead service doors detailing power, signal, and control systems differentiating clearly between field-installed and manufacturer-installed wiring.

E. Samples for initial selection purposes in form of manufacturer's color charts or chips showing full range of colors, textures, and patterns available for metal roofing and siding panels with factory-applied finishes.

F. Samples for verification purposes of roofing and siding panels. Provide sample panels 12-inch long by actual panel width, in the profile, style, color, and texture indicated. Include clips, battens, fasteners, closures, and other panel accessories.

G. Installer certificates signed by metal building manufacturer written certification certifying that the installer complies with requirements included under the "Quality Assurance" Article.
H. Professional engineer's certificate prepared and signed by a Professional Engineer, legally authorized to practice in the jurisdiction where Project is located, verifying that the structural framing and covering panels meet indicated loading requirements and codes of authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer to erect the pre-engineered metal building who has specialized in the erection and installation of types of metal buildings systems similar to that required for this project and who is certified in writing by the metal building system manufacturer as qualified for erection of the manufacturer's products.

B. Manufacturer's Qualifications: Provide pre-engineered metal buildings manufactured by a firm experienced in manufacturing metal buildings systems that are similar to those indicated for this project and have a record of successful in-service performance.

C. Single-Source Responsibility: Obtain the metal building system components, including structural framing, wall and roof covering, and accessory components, from one source from a single manufacturer.

D. Design Criteria: The drawings indicate sizes, profiles, and dimensional requirements of the pre-engineered metal building system. Metal building systems having equal performance characteristics with deviations from indicated dimensions and profiles may be considered, provided deviations do not change the design concept or intended performance. The burden of proof for equality is on the proposer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver prefabricated components, sheets, panels, and other manufactured items so they will not be damaged or deformed. Package wall and roof panels for protection against transportation damage.

B. Handling: Exercise care in unloading, storing, and erecting wall and roof covering panels to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal wall and roof panels so that water accumulations will drain freely. Do not store panels in contact with other materials that might cause staining, denting or other surface damage.

1.7 WARRANTY

A. Roofing and Siding Panel Finish Warranty: Furnish the roofing and siding panel manufacturer's written warranty, covering failure of the factory-applied exterior finish on metal wall and roof panels within the warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
1. Warranty period for factory-applied exterior finishes on wall and roof panels is 20 years after the date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Maintenance Stock: Furnish at least 5 percent excess over required amount of nuts, bolts, screws, washers, and other required fasteners for each metal building. Pack in cartons labeled to identify the contents and store on the site where directed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering metal building systems that may be incorporated in the work include but are not limited to the following:

1. A & M Building Systems, Inc.
4. American Steel Building Co., Inc.
5. Armco Steelox Building Systems.
8. Bigbee Steel Buildings, Inc.
11. Chief Industries, Inc.
12. Dean Steel Buildings, Inc.
15. Kirby Building Systems, Inc.
17. Package Steel Buildings Corp.
19. Southern Structures, Inc.
20. Space Master Buildings.
22. United Structures of America.
23. Varco-Pruden Buildings.
24. Whirlwind Steel Buildings, Inc.

2.2 MATERIALS

A. Hot-Rolled Structural Steel Shapes: Comply with ASTM A 36 or A 529.

B. Steel Tubing or Pipe: Comply with ASTM A 500, Grade B, ASTM A 501, or ASTM A 53.
C. Steel Members Fabricated from Plate or Bar Stock: Provide 42,000 psi minimum yield strength. Comply with ASTM A 529, ASTM A 570, or ASTM A 572.

D. Steel Members Fabricated by Cold Forming: Comply with ASTM A 1011, Grade 50.

E. Cold-Rolled Carbon Steel Sheet: Comply with requirements of ASTM A 366 or ASTM A 568.

F. Hot-Rolled Carbon Steel Sheet: Comply with requirements of ASTM A 568 or ASTM A 569.

G. Structural Quality Zinc-Coated (Galvanized) Steel Sheet: Comply with ASTM A 446 with G90 coating complying with ASTM A 525. Grade to suit manufacturer's standards.

H. Commercial Quality Zinc-Coated (Galvanized) Steel Sheet: Comply with ASTM A 526 with G60 coating complying with ASTM A 525.

I. Aluminum-Coated Steel Sheets: Comply with ASTM A 463 with T1-40 coating.

J. Aluminum Sheets: Comply with ASTM B 209 for Alclad alloy 3003 or 3004 with temper as required to suit forming operations.

K. Bolts for Structural Framing: Comply with ASTM A 307 or ASTM A 325 as necessary for design loads and connection details.

L. Glass and Glazing Materials: Provide glass complying with ASTM C 1036, of quality and type indicated. Place manufacturer's label identification on each glass light.

1. Float Glass: Type I, Class 1, Quality q3, clear float glass.
2. Polished Wired Glass: Type II, Class 1, Form I, Mesh m1 (welded diamond), UL labeled, nominal 1/4 inch thick, polished wired glass.
3. Patterned Wired Glass: Type II, Class 1, Form 2 (pattern as selected), Mesh m1 (welded diamond), UL labeled, nominal 1/4 inch thick, patterned wired glass.

4. Silicone Sealant: Single-component elastomeric silicone sealant complying with FS TT-S-001543, Class A, nonsag, and ASTM C 920, Type S, Grade NS, Class 25, Uses G, A, and O. Provide low modulus nonacid curing type, except use acid type if channel surfaces are porous.
5. Polysulfide Sealant: 2-component elastomeric polysulfide sealant complying with FS TT-S-00227, Class A, Type 2, and ASTM C 920, Type M, Grade NS, Class 25, Uses G, A, and O, as applicable.
6. Acrylic Sealant: Single-component acrylic terpolymer or polypropylene solvent-based thermo-plastic sealant complying with FS TT-S-00230, Class B, Type II, and ASTM C 920, Type S, Grade NS, Class 12-1/2, Uses G, A, and O, as applicable.
7. Glazing Tape: Preformed butyl-polyisobutylene glazing tape, complying with AAMA 807.1 packaged on rolls with release paper on side, with or without continuous spacer rod.
9. Glazing Gasket: Extruded or molded close cell, integral-skinned preformed neoprene of profile and hardness required to maintain watertight seal, complying with ASTM C 509, Type II, black.
10. Setting Blocks: Neoprene, EPDM, or silicone setting blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.
11. Spacers: Neoprene, EPDM, or silicone blocks or continuous extrusions, as required for compatibility with glazing sealant, of size, shape, and hardness recommended by glass and sealant manufacturer for application indicated.

12. Edge Blocks: Neoprene, EPDM, or silicone as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement of glass.

13. Filler Rods: Compressible closed-cell or waterproof-jacketed rod stock of flexible and resilient synthetic rubber or plastic foam with 5-10 psi compression strength for 25 percent deflection.

M. Translucent Panels: Glass-fiber-reinforced polyester translucent plastic glazing panels complying with ASTM D 3841, Type CC1, limited flammability, Grade 2, weather resistant, crinkle finish both sides, weighing not less than 8 oz. per sq. ft. Match configuration of adjacent metal panels.

N. Translucent Panels: Glass-fiber-reinforced polyester translucent plastic glazing panels complying with ASTM D 3841, Type CC2, general purpose, Grade 2, weather resistant, crinkle finish both sides, weighing not less than 8 oz. per sq. ft. Match configuration of adjacent metal panels.

2. Color: Green.
5. Mastic: Nonstaining saturated vinyl polymer as recommended by panel manufacturer for sealing laps.

O. Thermal Insulation: Glass fiber blanket insulation, complying with ASTM C 991, of 0.5 lb per cu. ft. density, thickness as indicated, with UL flame spread classification of 25 or less, and 2 inch wide continuous vapor-tight edge tabs.

2. Vapor Barrier: Vinyl-reinforced foil.
4. Retainer Strips: 26-gage (0.0179-inch) formed galvanized steel retainer clips colored to match the insulation facing.

P. Paint and Coating Materials: Comply with performance requirements of the federal specifications indicated. Unless specifically indicated otherwise, compliance with compositional requirements of federal specifications indicated is not required.

1. Shop Primer for Ferrous Metal: Fast-curing, lead-free, universal primer, selected by the manufacturer for resistance to normal atmospheric corrosion, compatibility with finish paint systems, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure. Comply with FS TT-P-645.

2. Shop Primer for Ferrous Metal: Fast-curing, lead-free, abrasion-resistant, rust-inhibitive primer selected by the manufacturer for compatibility with substrates with types of alkyd finish paint systems indicated and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure. Comply with FS TT-P-86, Types I, II, or III.

3. Shop Primer for Galvanized Metal Surfaces: Zinc dust-zinc oxide primer selected by the manufacturer for compatibility with substrate. Comply with FS TT-P-641.
4. Shop Primer for Wood Surfaces: Alkyd primer as selected by the manufacturer for compatibility with the substrate. Comply with FS TT-P-25.

2.3 STRUCTURAL FRAMING

A. Rigid Frames: Fabricate from hot-rolled structural steel shapes. Provide factory-welded, shop-painted, built-up "I-beam"-shape or open-web-type frames consisting of tapered or parallel flange beams and tapered columns. Furnish frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly.

1. Provide length of span and spacing of frames indicated. Slight variations in length of span and frame spacing may be acceptable if necessary to meet manufacturer's standard.

2. Provide rigid frames at endwalls where indicated.

B. Primary Endwall Framing: Provide the following primary endwall framing members fabricated for field-bolted assembly:

1. Endwall Columns: Manufacturer's standard shop-painted, built-up factory-welded "I"-shape or cold-formed "C" sections, fabricated from 14-gage (0.0747-inch) steel.

2. Endwall Beams: Manufacturer's standard shop-painted "C"-shape roll-formed sections fabricated from 16-gage (0.0598-inch) steel.

C. Secondary Framing: Provide the following secondary framing members:

1. Roof Purlins, Sidewall and Endwall Girts: "C"-or "Z"-shaped sections fabricated from 16-gage (0.0598-inch) shop-painted roll-formed steel. Purlin spacers shall be fabricated from 14-gage (0.0747-inch) cold-formed galvanized steel sections.

2. Eave Struts: Unequal flange "C"-shaped sections formed to provide adequate backup for both wall and roof panels. Fabricate from 16-gage (0.0598-inch) shop-painted roll-formed steel.

3. Flange and Sag Bracing: 1-5/8- by 1-5/8 inch angles fabricated from 16-gage (0.0598-inch) shop-painted roll-formed steel.

4. Base or Sill Angles: Fabricate from 14-gage (0.0747-inch) cold-formed galvanized steel sections.

5. Secondary endwall structural members, except columns and beams, shall be the manufacturer's standard sections fabricated from 14-gage (0.0747-inch) cold-formed galvanized steel.

D. Wind Bracing: Provide adjustable wind bracing using 1/2 inch diameter threaded steel rods; comply with ASTM A 36 or ASTM A 572, Grade D. Locate interior end bay bracing only where indicated.

E. Bolts: Provide shop-painted bolts except when structural framing components are in direct contact with roofing and siding panels. Provide zinc-plated or cadmium-plated bolts when structural framing components are in direct contact with roofing and siding panels.
F. Shop Painting: Clean surfaces to be primed of loose mill scale, rust, dirt, oil, grease, and other matter precluding paint bond. Follow procedures of SSPC-SP3 for power-tool cleaning, SSPC-SP7 for brush-off blast cleaning, and SSPC-SP1 for solvent cleaning.

1. Prime structural steel primary and secondary framing members with the manufacturer’s standard rust-inhibitive primer.
2. Prime galvanized members, after phosphoric acid pretreatment, with manufacturer's standard zinc dust-zinc oxide primer.

2.4 ROOFING AND SIDING PANELS

A. Face Sheets: Fabricate wall and roof panel face sheets to the profile or configuration indicated from 26-gage (0.0179-inch), structural quality, Grade C, zinc-coated steel sheets.

B. Face Sheets: Fabricate wall and roof panel face sheets to the profile or configuration indicated from 26-gage (0.00179-inch), drawing quality, aluminum-coated steel sheets.

C. Face Sheets: Fabricate wall and roof panel face sheets to the profile or configuration indicated from 0.032-inch-thick 3003 or 3004 Alclad alloy stucco embossed finish aluminum sheets.

D. Insulated Wall Panels: Provide factory- or field-assembled wall panel units, consisting of a central insulating core with metal interior and exterior face sheets. Securely fasten units together with rivets, bolts, studs, "snap-on," or other approved methods of fastening, including interlocking with basic wall units.

1. Fabricate wall panels in a manner that will eliminate condensate on the interior side. Design joints between panels to form weathertight seals.

2. Insulating core of panels shall provide "U"-factor indicated.

E. Lap-Seam Roof Panels: Manufacturer’s standard factory-formed lap-seam roof panel system designed for mechanical attachment of panels to roof purlins using exposed fasteners and sealants. Form panels of 26-gage (0.0179-inch), Grade C, zinc-coated steel sheets.

F. Standing Seam Roof Panels: Manufacturer's standard factory-formed standing-seam roof panel system designed for mechanical attachment of panels to roof purlins using a concealed clip. Form panels of 26-gage (0.0179-inch), Grade C, zinc-coated steel sheets.

1. Clips: Provide 16-gage (0.0598-inch) panel clips.
2. Cleats: Factory-calked, mechanically seamed cleats formed from 24-gage (0.0239-inch), Grade C, zinc-coated steel sheets.

G. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets, self-locking bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.

1. Provide metal-backed neoprene washers under heads of fasteners bearing on weather side of panels.
2. Use aluminum or stainless steel fasteners for exterior application and galvanized or cadmium-plated fasteners for interior applications.
3. Locate and space fastenings in true vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of neoprene washer.

4. Provide fasteners with heads matching color of roofing or siding sheets by means of plastic caps or factory-applied coating.

H. Accessories: Provide the following sheet metal accessories factory-formed of the same material in the same finish as roof and wall panels:

1. Flashings.
2. Closers.
3. Fillers.
4. Metal expansion joints.
5. Ridge covers.
6. Fascias.

I. Flexible Closure Strips: Closed-cell, expanded cellular rubber, self-extinguishing flexible closure strips. Cut or premold to match configuration of roofing and siding sheets. Provide closure strips where indicated or necessary to ensure weathertight construction.

J. Sealing Tape: Pressure-sensitive 100 percent solids grey polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

K. Joint Sealant: One-part elastomeric polyurethane, polysulfide, or silicone rubber sealant as recommended by the building manufacturer.

L. Baked Enamel Finish: Provide the manufacturer's standard shop-applied baked enamel finish to galvanized steel roof and wall panels, and related trim and accessory elements. For roofing and siding, apply finish coat on exterior facings and manufacturer's standard wash coat on reverse face.

1. Clean galvanized steel with an alkaline compound, then treat with a zinc phosphate conversion coating, and seal with a chromic acid rinse.
2. Apply baked-on thermo-setting modified acrylic enamel to pretreated steel sheets, in one or more coats as standard with the manufacturer to achieve a minimum dry film thickness of 1.5 mils.
   a. Color: As indicated by reference to the manufacturer's standard color designations.
   b. Color: As selected by the Architect from the manufacturer's standard colors.
   c. Color: Match the Architect's sample.

M. Fluoropolymer Finish: Provide shop-applied fluoropolymer finish to galvanized steel roofing and siding panels and related trim and accessory elements.

1. Clean galvanized steel with an alkaline compound, then treat with a zinc phosphate conversion coating and seal with a chromic acid rinse.
2. Apply a 2-coat fluoropolymer coating system to pretreated steel. Coating shall consist of a specially formulated inhibitive primer applied to a dry film thickness of 0.15 mil to 0.25 mil and a fluorocarbon color coat containing not less than 70 percent polyvinylidene fluoride resin by weight applied to a dry film thickness of 0.80 mils to 1.3 mils.
a. Color: As indicated by reference to the manufacturer's standard color designations.
b. Color: As selected by the Architect from the manufacturer's standard colors.
c. Color: Match the Architect's sample.

2.5 PERSONNEL DOORS

A. Materials: Fabricate personnel doors and frames from commercial quality, cold-rolled carbon steel sheet or commercial quality hot-rolled, pickled and oiled carbon steel sheet.

1. Zinc-coated Steel Sheets: Comply with ASTM A 526; with G60 coating complying with ASTM A 525, mill phosphatized.

B. Anchors and Accessories: Provide manufacturer's standard units. For items built into exterior walls, use galvanized units complying with ASTM A 153.

C. Doors: Provide doors of types and styles indicated. Comply with SDI-100 for material quality, metal gages, and construction details.

1. Provide sightproof louvers for interior doors where indicated, constructed of 24-gage (0.0239-inch) steel V-shaped or Y-shaped blades, set into 20-gage (0.0359-inch) steel frame.

D. Frames: Provide frames of the types and sizes indicated. Comply with SDI-100 for material quality, metal gages, and construction details.

1. Provide standard hollow metal frames for doors, transoms, sidelights, borrowed lights, and other openings as indicated.
2. Prepare frames to receive 3 silencers on strike jambs of single door frames and 2 silencers on heads of frames for pairs of doors.

E. Fabrication: Fabricate units to be rigid, neat in appearance, and free from defects, warp, or buckle. Provide continuous welds on exposed joints; grind, dress, and make welds smooth, flush, and invisible.

F. Hardware: Prepare hollow metal units to receive mortised and concealed finish hardware, including cutouts, reinforcing, drilling, and tapping. Comply with ANSI A115.

1. Reinforce to receive field-applied, surface-mounted finish hardware.
2. Locate finish hardware as indicated.
3. Locate finish hardware in accordance with "Recommended Locations for Builder's Hardware," published by the Door and Hardware Institute.
4. Provide hardware for each door leaf, as follows:

   a. Hinges: 1-1/2 pair, steel, template hinges, 4-1/2 inch by 4-1/2 inch.
   b. Lockset: Cylindrical type, key in knob.
   c. Threshold: Extruded aluminum (exterior doors only).
   d. Silencers: Pneumatic rubber type for metal frames.
G. Shop-paint exposed surfaces, including galvanized surfaces, using manufacturer’s standard baked-on rust-inhibitive primer.

2.6 OVERHEAD COILING DOORS

A. General: Provide complete overhead coiling door assemblies including door curtain, guides, counterbalance, hardware, operators, and installation accessories.

B. Performance Requirements: Provide doors certified to withstand a 20-psf wind load pressure with maximum deflection of 1/120 of the opening width.

C. Door Curtain: Interlocking steel slat door curtain with one-piece slats for the full length of door width. Form from 20-gage (0.0359-inch), Grade A, structural quality, zinc-coated steel sheets. Phosphate treat before fabrication.

D. Door Curtain: Interlocking aluminum slat door curtain with one-piece slats for the full length of door width. Form from 0.04-inch-thick aluminum 5052 alloy in standard mill finish.
   1. Provide heavier metal gages as required for load deflection limitation.

E. Endlocks: Provide endlocks fabricated from malleable iron castings, galvanized after fabrication, secured to curtain slats with galvanized rivets.

F. Windlocks: Provide windlocks fabricated from malleable iron castings, galvanized after fabrication, secured to curtain slats at 24 inches on center on both edges with galvanized rivets.

G. Bottom Bar: Provide bottom bar on door curtain consisting of two 1/8-inch-thick angles of the same metal as the door curtain slats. Provide flexible rubber, vinyl, or neoprene weather seal and cushion bumper on the bottom bar.


I. Vision Panel: 1/4-inch-thick cast thermo-plastic, methyl metacrylate vision panels, set in neoprene or vinyl glazing channels in the arrangement indicated.

J. Weather Seals: 1/8-inch-thick continuous rubber or neoprene sheet weather seals on metal pressure bars secured to inside of curtain coil hood. At door jambs, use 1/8-inch-thick continuous strip secured to exterior side of jamb guide.

K. Counterbalance: Adjustable steel helical torsion spring counterbalance, mounted around a steel shaft in a spring barrel and connected to door curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

L. Brackets: Cast-iron or cold-rolled steel plate mounting brackets with bell-mouth guide groove for curtain.

M. Hood: Form to enclose the coiled curtain and operating mechanism entirely at the opening head and to act as a weather seal. Contour to suit end brackets to which attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods, and any
portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets to prevent sag.

1. Fabricate hoods for steel doors of 24-gage (0.0239-inch), zinc-coated steel sheet. Phosphate treat before fabrication.

2. Fabricate hoods for aluminum doors of Alloy 3003 aluminum sheet 0.032 inch thick, mill finish.

N. Shop Finish: Except for tightly joined and lubricated surfaces, shop-clean and prime ferrous and galvanized metal surfaces, both exposed and concealed, with the manufacturer's standard rust-inhibitive primer.

O. Manual Door Operators: Provide manual door operators. When type of operation is not indicated, provide chain hoist operator unit.

1. Manual Push-Up Operation: Design counterbalance so required lift or pull for operation does not exceed 25 lbs. Adjust so that the curtain can be stopped at any point in its travel and remain in that position until movement is reactivated. Provide galvanized steel lifting handle and slide bolt lock on inside bottom bar.

2. Chain Hoist Operation: Provide operator consisting of an endless cadmium-plated alloy steel hand chain, chain pocket wheel and guard, and geared reduction unit with maximum 35-lb. pull for door operation. Design chain hoist with self-locking mechanism allowing curtain to be stopped at any point in its travel and to remain in that position until movement is reactivated. Furnish chain with chain holder secured to operator guide.

3. Crank Hoist Operation: Provide operator consisting of crank and crank gear box, steel crank drive shaft, and gear reduction unit. Size gear to require no more than 25 lb. effort to turn crank. Fabricate oil-tight gear box to enclose operating mechanism completely. Design unit so curtain may be stopped at any point in its travel and remain in that position until movement is reactivated. Provide crank locking device. Locate gear box on inside wall on jamb approximately 36 inches above floor.

P. Electric Door Operators: Furnish electric operator assembly of size and capacity recommended by manufacturer, complete with NEMA rated motor and factory-prewired motor controls, gear reduction unit, solenoid-operated brake, remote control stations, control devices, conduit and wiring from controls to motor and central stations, and accessories required for proper operation.

1. Provide a hand-operated disconnect or mechanism for automatically engaging a sprocket and chain operator and releasing the brake for emergency manual operation. Include interlock device to automatically prevent motor from operating when manual operator is engaged.

2. Electric Motors: High-starting torque, reversible, constant duty. Class A insulated electric motor with overload protection, sized to move door in either direction, from any position, at not less than 2/3 ft. nor more than 1 ft. per second. Coordinate wiring requirements and current characteristics of motors with building electrical system.

3. Furnish open-drip-proof-type motor and controller with NEMA Type 1 enclosure.

4. Remote Control Station: NEMA-approved, momentary contact, 3-button control station with push button controls labeled "open," "close," and "stop."
2.7 SECTIONAL OVERHEAD DOORS

A. General: Provide complete operating sectional overhead door assemblies including frames, sections, brackets, guides, tracks, counterbalance, hardware, operators, and installation accessories.

B. Steel Door Sections: Construct door sections from 24-gage (0.0239-inch), Grade A, structural quality carbon steel sheets with a minimum yield strength of 33,000 psi.
   1. Exterior Face: Manufacturer's standard flat, ribbed, or fluted exterior section face.
   2. Fabricate sections from a single sheet to provide units not more than 24 inches high and nominal 2 inches deep. Roll horizontal meeting edges to form a continuous shiplap, rabbeted, or keyed weatherseal with a continuous reinforcing flange.
   3. Enclose open section with 16-gage (0.0598-inch) galvanized steel channel end stiles welded in place. Provide intermediate stiles, cut to door section profile, spaced not more than 48 inches on center and welded in place.
   4. Reinforce bottom section with a continuous channel or angle conforming to bottom section profile. Reinforce sections with continuous horizontal and diagonal reinforcing, as required by door width, and design wind loading.
   5. Insulate inner core of door sections with glass fiber, polystyrene, or polyurethane foam-type insulation.
   6. Finish by cleaning, pretreating, and applying the manufacturer's standard prime coat to both door faces after forming.

C. Wood Door Sections: Construct sections complete with wood jamb and head molds, glazing stops, and glazing, as indicated. Fabricate stiles and rails of clear vertical grain, straight, kiln-dried, Douglas Fir, West Coast Hemlock, or Sitka Spruce, 1-3/4 inches thick, finished S4S. Use clear all-heart redwood or cedar for head and jamb molds. Form meeting rails to provide a rabbeted weather seal joint. For panel inserts use 1/4-inch-thick tempered hardboard, smooth 2 sides, exterior grade, complying with ANSI A135.4, Class 1.

D. Wood Door Sections: Construct flush-type sections with top, bottom, and end closures of clear, straight, kiln-dried Douglas Fir, West Coast Hemlock, or Sitka Spruce. Provide wood blocking
glued and doweled in place to receive hardware, end stiles, and frames for glazing. Form meeting rails to provide rabbeted weather seal joint.

1. **Core**: Manufacturer's standard polystyrene, polyurethane, or kraft paper honeycomb core, bonded to door facing.
2. **Facing**: 1/8-inch-thick tempered hardboard, complying with ANSI A135.4, Class 1, smooth one side with maximum water absorption of 10 percent and maximum thickness swelling of 5 percent.

E. Fabricate sections of mortise-and-tenon construction with waterproof glue and steel dowels, or rabbeted construction, doweled and steel-pinned and glued with waterproof glue. Finished door assembly shall be rigid and free of warp, twist, or deformation.

1. Treat sections with a minimum 3-minute immersion water-repellent and toxic treatment in accordance with NWMA standards.
2. Reinforce with continuous galvanized steel horizontal and diagonal members as required by door width to meet wind loading.
3. Finish sections with the manufacturer's standard exterior primer.

F. **Aluminum Door Sections**: Construct of extruded aluminum shapes of 6063-T6 alloy, with 0.065-inch wall thickness for sections 1-3/4 inches deep. Join stiles and rails with concealed 1/4-inch-minimum-diameter aluminum or nonmagnetic stainless steel through-bolts full height of section. Fabricate panels of aluminum sheet in continuous vinyl channels retained with rigid snap-in extruded moldings.

1. Finish doors in manufacturer's standard mill finish.
2. Finish doors in manufacturer's standard clear anodizing.

G. **Translucent Door Sections**: Construct of 0.0625-inch-thick extruded aluminum stiles and rails of 6063-T6 alloy to provide sections at least 1-3/4 inches deep. Fabricate with overlapped or interlocked weatherseal joints at meeting rails. Reinforce or truss each section for strength and rigidity. Provide translucent, reinforced fiberglass ribbed panels, secured and sealed weathertight to framing.

2. Color: Green.

H. **Tracks**: Provide complete galvanized steel track assembly including brackets, bracing, and reinforcing for rigid support of ball-bearing roller guides, as required for type and size of door. Size track assembly for door size and weight; design for clearances indicated. Slot vertical sections of track at 2 inches on center for door drop safety device. Slope tracks at proper angle from vertical, or otherwise design to ensure tight closure at jambs when door unit is closed. Weld or bolt to track supports.

I. **Track Reinforcement and Supports**: Provide galvanized steel track reinforcement and support members. Secure, reinforce, and support tracks as required for size and weight of door to provide strength and rigidity and to ensure against sag, sway, and detrimental vibration during opening and closing.
J. Weather Seals: Continuous rubber, neoprene, or flexible vinyl adjustable weatherstrip gasket on top and compressible astragal on the bottom of each overhead door.

K. Vision Panels: Furnish "B"-grade double-strength sheet glass panels in arrangement shown. Set in rubber or neoprene channel glazing strips for metal framed doors and elastic glazing compound for wood doors, as required. Provide removable stops of same material as door section frames.

L. Hardware: Heavy-duty, rust-resistant hardware, with galvanized, cadmium-plated, or stainless steel fasteners to suit type of door.
   1. Hinges: Provide heavy steel hinges at each end stile and at each intermediate stile in accordance with manufacturer's recommendations for the type of door.
   2. Rollers: Provide heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Provide case-hardened steel roller tires of diameter to suit track size.
   3. Lifting Handles: Provide galvanized steel lifting handles on inside and outside of doors.
   4. Locking Bars: Provide cremone-type locking bar, operable from inside and outside. Fabricate locking device assembly with mortise lock, spring-loaded dead bolt, chromium-plated operating handle, cam plate and adjustable locking bar to engage through slots in track, and lock cylinder.

M. Counterbalance: Extension spring counterbalance assembly with aircraft-type steel cable over ball-bearing sheaves.

N. Counterbalance: Torsion spring counterbalance assembly consisting of adjustable-tension, tempered steel torsion springs mounted on a case-hardened shaft.

O. Manual Door Operator: Provide lift handles and pull rope for raising and lowering doors, operating with not more than 25-lb. lift or pull.

P. Direct-Drive Chain Hoist: Side-mounted unit consisting of an endless steel hand chain, cast-iron pocket pulley, and chain guard, mounted on counterbalance shaft, and operating with not more than 35-lb. pull.

Q. Reduction-Drive Chain Hoist: Side-mounted unit consisting of an endless steel hand chain, chain, pocket wheel and reduction unit of at least 3 to 1, roller chain and sprocket drive mounted on counterbalance shaft, and operating with not more than 35-lb. pull.

R. Electric Door Operator: Electric operator assembly of size and capacity recommended and provided by door manufacturer, complete with electric motor and factory prewired motor controls, gear reduction unit, solenoid operated brake, clutch, remote control stations, and control devices.
   1. Electric Motors: High-starting torque, reversible, constant duty, Class A insulated electric motor with overload protection, sized to move the door in either direction, from any position, at not less than 2/3 ft. or more than 1 ft. per second.
   2. Remote Control Station: Surface-mounted, interior type, heavy duty, full geared, momentary contact, 3-button control station, with push-button controls labeled "open," "close," and "stop" in general-purpose NEMA Type 1 enclosure.
3. **Automatic Reversing Control:** Furnish each door with automatic safety switch, extending full width of door bottom, located within neoprene or rubber astragal mounted to bottom rail of the door. Contact with switch shall immediately reverse downward door travel.

### 2.8 STEEL WINDOWS

A. **Steel Window Members:** Form from standard hot-rolled steel shapes, or cold-formed steel plate, bar, sheet, or strip, as designed by the manufacturer to comply with specified requirements.

B. **Trim members include glazing beads, screen frames, weatherstrip retainers, flashing, and similar items not functioning as prime structural members. Provide units of extruded aluminum or of formed sheet aluminum or stainless steel.**

C. **Mullions and Subframes:** Form of hot-rolled or cold-formed steel, of manufacturer's standard profile for span and spacing indicated.

D. **Fasteners:** Provide bronze, brass, stainless steel, or other metal fasteners warranted by the manufacturer to be noncorrosive and compatible with window members, trim, hardware, anchors, and other components of connected work.

E. **Anchors, Clips, and Window Accessories:** Depending on strength and corrosion-inhibiting requirements, fabricate units of stainless steel, hot-dip zinc-coated steel or iron complying with ASTM A 123, or bronze/brass.

F. **Weatherstripping:** Provide weatherstripping as recommended by the manufacturer, applied to each operable sash.

G. **Glazing Stops:** Provide extruded aluminum or formed steel, snap-on or screwed-type glazing stops.

H. **Insect Screens:** Provide removable units for each operable sash. Fabricate from extruded aluminum or formed steel with replaceable 18 by 14 mesh of 0.013-inch-diameter aluminum wire and vinyl retainer spline.

I. **Hardware:** Provide standard design for operation indicated, of die-cast steel, malleable iron, or bronze, with steel or bronze operating arms.

J. **Window Types (Operation):** Drawings indicate locations of operating sash of the following types:

1. Fixed units (without vents).
2. Projected units with balance arms, friction shoes, cam latch, and lever handle.
3. Casement units with roto-operators, hook/cam-type latch and lever, and extension hinges or pivots.
4. Double/single-hung units with each operating sash equipped with pair of counterbalancing mechanisms, pair of lift handles (or eye for pole), and a latch at the meeting rails.

K. **Window Classification (Grade):** As follows:

1. **Standard Intermediate Windows:** Provide units complying with SWI recommended specifications (3.0 lbs. per ft.).
2. Commercial Projected Windows: Provide units complying with SWI recommended specifications (1-3/8 inch by 1/8 inch, inside glazing).

3. Semi-Intermediate Windows: Provide units complying with SWI recommended specifications (2.88 lbs. per ft.).

L. Shop Prime Coat Finish: Provide hot alkali cleaning, rinse, hot phosphate treatment, chromic acid rinse, metal primer dip coating, 1-mil dry film thickness.

M. Galvanized and Prime Coat Finish: Provide SSPC-SP1 cleaning, SSPC-SP8 pickling, and ASTM A 123 hot-dip galvanizing, followed by hot phosphate treatment, chromic acid rinse, metal primer dip coating, 1-mil dry film paint thickness.

N. Pole Operator: Provide one pole operator per room where required.

2.9 ALUMINUM WINDOWS

A. Aluminum Extrusions: Provide extrusions of alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000 psi ultimate tensile strength and 0.062-inch thickness at any location for main frame and sash members. Comply with ASTM B 221.

1. Provide "Thermal-Break" construction. Separate frame and sash members exposed on the exterior from metal parts exposed on the interior by a continuous gasket or filler of rubber or plastic, locked into construction.

2. Mullions: Provide Mullions between adjacent windows, fabricated of extruded aluminum matching the finish of window units.

B. Fasteners: Aluminum, nonmagnetic stainless steel, or other material warranted by the manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components of window units.

1. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.125 inch thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads or provide standard noncorrosive pressed-in splined grommet nuts.

2. Provide exposed fasteners that match the finish of members and hardware being fastened.

C. Anchors, Clips, and Window Accessories: Depending on strength and corrosion-inhibiting requirements, fabricate of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel complying with ASTM A 123.

D. Compression Glazing Strips and Weatherstripping: Molded neoprene gaskets complying with ASTM D 2000 designation 2BC415 to 3BC620, molded PVC gaskets complying with ASTM D 2287, or molded expanded neoprene gaskets complying with ASTM C 509, Grade 4.

E. Sliding Weatherstripping: Woven pile weatherstripping of wool, polypropylene or nylon pile and resin-impregnated backing fabric, and aluminum backing strip; comply with AAMA 701.
F. Sealants: Type recommended for joint size or movement, to remain permanently elastic, nonshrinking, and nonmigrating.

G. Insect Screens: Provide removable insect screen on each operable exterior sash, with finish matching window.
   1. Wire Fabric Insect Screen: Aluminum mesh, FS RR-W-365, Type VII, 18 by 18, 0.013-inch wire size.
   2. Wire Fabric Insect Screen: Stainless steel mesh, FS RR-W-365, Type VI, 18 by 18, 0.009-inch wire size.

H. Commercial Windows: Provide units complying with AAMA Grade and Performance Class C20 for "Commercial" type buildings.

I. Heavy Commercial Windows: Provide units complying with AAMA Grade and Performance Class HC40 for "Heavy Commercial" type buildings.
   1. Design wind velocity at project site is 100 mph.

J. Window Types (Operation): Drawings indicate locations of operating sash, of the following types and grades:
   1. Double-Hung Units: Comply with AAMA DH-C20 for commercial grade double-hung windows.
   2. Double-Hung Units: Comply with AAMA DH-HC40 for heavy commercial grade double-hung windows.
   3. Horizontal Sliding Units: Comply with AAMA HS-C20 for commercial grade horizontal sliding windows.
   4. Horizontal Sliding Units: Comply with AAMA HS-HC40 for heavy commercial grade horizontal sliding windows.
   5. Aluminum Finish: Cleaned, mill finish.

K. Preglazed Construction: To the greatest extent possible, glaze units at the shop prior to installation.

L. Pole Operator: Provide one pole operator for each room or space where required for operation.

2.10 SHEET METAL ACCESSORIES

A. General: Provide coated steel sheet metal accessories with coated steel roofing and siding panels.

B. General: Provide aluminum sheet metal accessories with aluminum roofing and siding panels.
C. Gutters: Form in 8-foot-long sections, complete with end pieces, outlet tubes, and other special pieces as required. Size in accordance with SMACNA. Join sections with riveted and soldered or sealed joints. Provide expansion-type slip joint at center of runs. Furnish gutter supports spaced 36 inches on center, constructed of same metal as gutters. Provide bronze, copper, or aluminum wire ball strainers at outlets. Finish to match roof fascia and rake.

D. Downspouts: Form in 10-foot-long sections, complete with elbows and offsets. Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 5 feet on center in between. Finish to match wall panels.

E. Roof Ventilators: Provide low-profile, ridge-type circular gravity roof ventilators, size and spacing indicated. Furnish with matching base, bird screen, hood, flashing, closures, and fittings. Finish to match roof panels.

1. Provide directional revolving-type gravity roof ventilators.

2. Provide stationary revolving-type gravity roof ventilators.

3. Reinforce and brace units, with joints properly formed and edges beaded to be watertight under normal positive pressure conditions. Mount ventilators on square-to-round bases designed to match roof pitch and roll-formed to match corrugation profile of roof panels.

4. Provide bird screens of 1/2-inch by 1/2-inch galvanized steel or aluminum mesh.

5. Provide pull-chain-operated, spring-loaded disc-type damper, with fusible link connection.

F. Continuous Ridge Ventilators: Provide factory-engineered and -fabricated, continuous ridge ventilator of the continuous-heat-valve type as furnished by the building manufacturer. Provide in standard length sections in locations indicated. Provide throat size and total length indicated, complete with side baffles, ventilator assembly, operating damper, hardware, bird screen, end caps, splice plates, flashing, reinforcing diaphragms, closures, and fasteners. Finish to match roof panels.

1. Provide bird screens of 1/2-inch by 1/2-inch galvanized steel or expanded diamond mesh.

2. Provide manually operated dampers with chain and worm gear operator.

G. Wall Louvers: Provide louvers, size and design indicated, of 18-gage (0.0478-inch) steel. Fold or bead blades at edges, set at an angle that excludes driving rains, and secure to frames by riveting or welding. Finish to match wall panels.

1. Provide vertical mullions for louvers 4 feet and more in width, with one mullion for each 4 feet of width.

2. Provide flanges on interior face of frames where air intake or exhaust louvers are indicated to be connected with mechanically operated dampers or metal ductwork.

3. Provide 1/2-inch by 1/2-inch galvanized steel mesh bird screens in rewirable frames on exterior face of louvers. Secure with clips to ensure ease of removal for cleaning and rewiring. Fabricate screens and frames of same type metal as louvers.
2.11 FABRICATION

A. General: Design prefabricated components and necessary field connections required for erection to permit easy assembly and disassembly.

1. Fabricate components in such a manner that once assembled, they may be disassembled, repackaged, and reassembled with a minimum amount of labor.
2. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.

B. Structural Framing: Shop-fabricate framing components to indicated size and section with base plates, bearing plates, and other plates required for erection, welded in place. Provide holes for anchoring or connections shop-drilled or punched to template dimensions.

1. Shop Connections: Provide power riveted, bolted, or welded shop connections.
2. Field Connections: Provide bolted field connections.

PART 3 - EXECUTION

3.1 ERECTION

A. Framing: Erect framing true to line, level, plumb, rigid, and secure. Level base plates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use a non-shrink grout to obtain uniform bearing and to maintain a level base line elevation. Moist cure grout for not less than 7 days after placement.

B. Purlins and Girts: Provide rake or gable purlins with tight-fitting closure channels and fascias. Locate and space wall girts to suit door and window arrangements and heights. Secure purlins and girts to structural framing and hold rigidly to a straight line by sag rods.

C. Bracing: Provide diagonal rod or angle bracing in roof and sidewalls as indicated.

1. Movement-resisting frames may be used in lieu of sidewall rod bracing, to suit manufacturer’s standards.
2. Where diaphragm strength of roof or wall covering is adequate to resist wind forces, rod or angle bracing will not be required.

D. Framed Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to building structural frame.

3.2 ROOFING AND SIDING

A. General: Arrange and nest sidelap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid “panel creep” or application not true to line. Protect factory finishes from damage.
1. Field cutting of exterior panels by torch is not permitted.
2. Provide weathershield under ridge cap. Flash and seal roof panels at eave and rake with rubber, neoprene, or other closures to exclude weather.

B. Roof Sheets: Provide sealant tape at lapped joints of ribbed or fluted roof sheets and between roof sheets and protruding equipment, vents, and accessories.

   1. Apply a continuous ribbon of sealant tape to clean, dry surface of the weather side of fastenings on end laps, and on side laps of corrugated nesting-type, ribbed, or fluted panels and elsewhere as needed to make roof sheets weatherproof to driving rains.

C. Standing-Seam Roof Panel System: Fasten roof panels to purlins with concealed clip in accordance with the manufacturer's instructions.

   1. Install clips at each support with self-drilling fasteners.
   2. At end laps of panels, install tape caulk between panels.
   3. Install factory-caulked cleats at standing-seam joints. Machine-seam cleats to the panels to provide a weathertight joint.

D. Wall Sheets: Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as necessary for waterproofing. Handle and apply sealant and backup in accordance with the sealant manufacturer's recommendations.

   1. Align bottom of wall panels and fasten panels with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws. Fasten window and door frames with machine screws or bolts. When building height requires two rows of panels at gable ends, align lap of gable panels over wall panels at eave height.
   2. Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
   3. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

E. Sheet Metal Accessories: Install gutters, downspouts, ventilators, louvers, and other sheet metal accessories in accordance with manufacturer's recommendations for positive anchorage to building and weathertight mounting. Adjust operating mechanism for precise operation.

F. Hollow Metal Doors and Frames: Install doors and frames straight, plumb, and level. Securely anchor frames to building structure. Set units with 1/8-inch maximum clearance between door and frame at jambs and head and 3/4-inch maximum between door and floor. Adjust hardware for proper operation.

G. Overhead Coiling Doors: Set doors and operating equipment complete with necessary hardware, jamb and head mold stops, anchors, inserts, hangers, and equipment supports in accordance with manufacturer's instructions. Adjust moving hardware for proper operation.

H. Overhead Sectional Doors: Set doors and operating equipment with necessary hardware, jamb and head mold stops, anchors, inserts, hangers, and equipment supports in accordance with manufacturer's instructions. Adjust moving hardware for proper operation.
I. Windows: Anchor windows securely in place. Seal perimeter of each unit with the elastomeric sealant used for panels. Adjust and lubricate operating sash and hardware for proper operation. Clean surfaces of window units. Mount screens direct to frames with tapped screw clips.

J. Glazing: Clean channel surfaces and prime as recommended by sealant manufacturer. Cut glass to required size for measured opening; provide adequate edge clearance and glass bite all around. Do not install glass that has significant edge damage or other defects.
   1. Install setting blocks at quarter points, set in a bed of sealant if heel-bead is used. Install spacers inside and out, all around, wherever liquid or plastic/mastic compounds are used, except on glass sizes smaller than 50 united inches.
   2. Replace glass that is broken or damaged prior to the time of acceptance. Each piece of exterior glass must be airtight and watertight through normal weather/temperature cycles and through normal door/window operation.

K. Thermal Insulation: Install insulation concurrently with installation of roof panels in accordance with manufacturer's directions. Install blankets straight and true in one-piece lengths with both sets of tabs sealed to provide a complete vapor barrier. Locate insulation on underside of roof sheets, extending across the top flange of purlin members and held taut and snug to roofing panels with retainer clips. Install retainer strips at each longitudinal joint, straight and taut, nesting with roof rib to hold insulation in place.

L. Translucent Panels: Attach plastic panels to structural framing in accordance with the manufacturer's instructions.
   1. Provide end laps of not less than 6 inches and side laps of not less than 1-1/2 inch corrugations for translucent roofing panels.
   2. Provide end laps of not less than 4 inches and side laps of not less than 1-1/2 inch corrugations for translucent siding panels.
   3. Align horizontal laps with adjacent roofing and siding panels.
   4. Seal intermediate end laps and side laps of translucent panels with translucent mastic.
   5. Clean panels in accordance with manufacturer's instructions.

M. Cleaning and Touch-Up: Clean component surfaces of matter that could preclude paint bond. Touch up abrasions, marks, skips, or other defects to shop-primed surfaces with same type material as shop primer.

END OF SECTION 133419
SECTION 14 24 00 - MACHINE ROOM-LESS HYDRAULIC PASSENGER ELEVATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Machine room-less hydraulic passenger elevators as shown and specified. Elevator work includes:
   2. Elevator car enclosures, hoistway entrances and signal equipment.
   3. Operation and control systems.
   4. Jack(s).
   5. Accessibility provisions for physically disabled persons.
   6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
   7. Materials and accessories as required to complete the elevator installation.

B. Related Sections:
   1. Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.
   2. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.
   3. Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.
   4. Division 5 Metals:
      a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
      b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
   5. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
   6. Division 16 Sections:
      a. Providing electrical service to elevators, including fused disconnect switches where permitted. (note: fused disconnect switch to be provided as part of elevator manufacture product, see section 2.11 Miscellaneous elevator components for further details.)
      b. Emergency power supply, transfer switch and auxiliary contacts.
      c. Heat and smoke sensing devices.
      d. Convenience outlets and illumination in control room (if applicable), hoistway and pit.
   7. Division 22 Plumbing
      a. Sump pit and oil interceptor.
   8. Division 23 Heating, Ventilation and Air Conditioning
      a. Heating and ventilating hoistways and/or control room.

C. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Part 3 for hydraulic elevators. State or local requirements must be used if more
stringent. The cost of this work is not included in the thyssenkrupp Elevator’s proposal, since it is a part of the building construction.

1. Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.

2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.

3. Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2” at any point.

4. Elevator hoistways shall have barricades, as required.

5. Install bevel guards at 75° on all recesses, projections or setbacks over 2” (4” for A17.1 2000 areas) except for loading or unloading.

6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.

7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.

8. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42” minimum, (48” minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.

9. All wire and conduit should run remote from the hoistways.

10. When heat, smoke or combustion sensing devices are required, connect to elevator control cabinet terminals. Contacts on the sensors should be sided for 12 volt D.C.

11. Install and furnish finished flooring in elevator cab.

12. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.

13. Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.

14. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.

15. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.

16. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.

17. General Contractor shall fill and grout around entrances, as required.

18. All walls and sill supports must be plumb where openings occur.

19. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.

20. Provide telephone line, light fixture (200 lx / 19 fc), and convenience outlet in the hoistway at the landing where the elevator controller is located. Typically this will be at
the landing above the 1st floor. Final location must be coordinated with elevator contractor.

21. As indicated by elevator contractor, provide a light outlet for each elevator, in center of hoistway.

22. For signal systems and power operated door: provide ground and branch wiring circuits.

23. For car light and fan: provide a feeder and branch wiring circuits to elevator control cabinet.

24. Controller landing wall thickness must be a minimum of 8 1/2 inches thick. This is due to the controller being mounted on the second floor landing in the door frame on the return side of the door. For center opening doors, the controller is located on the right hand frame (from inside the elevator cab looking out). These requirements must be coordinated between the general contractor and the elevator contractor.

25. Cutting, patching and recesses to accommodate hall button boxes, signal fixtures, etc..

1.02 SUBMITTALS

A. Product data: When requested, the elevator contractor shall provide standard cab, entrance and signal fixture data to describe product for approval.

B. Shop drawings:
   1. Show equipment arrangement in the corridor, pit, and hoistway and/or optional control room. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
   2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
   3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
   4. Indicate electrical power requirements and branch circuit protection device recommendations.

C. Powder Coat paint selection: Submit manufacturer’s standard selection charts for exposed finishes and materials.

D. Plastic laminate selection: Submit manufacturer’s standard selection charts for exposed finishes and materials.

E. Metal Finishes: Upon request, standard metal samples provided.

F. Operation and maintenance data. Include the following:
   1. Owner’s manuals and wiring diagrams.
   2. Parts list, with recommended parts inventory.

1.03 QUALITY ASSURANCE
A. Manufacturer Qualifications: An approved manufacturer with minimum 15 years of experience in manufacturing, installing, and servicing elevators of the type required for the project.
   1. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment.
      a. The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system.
   2. The manufacturer shall have a documented, on-going quality assurance program.
   3. ISO-9001:2000 Manufacturer Certified
   4. ISO-14001:2004 Environmental Management System Certified
   5. LEED Gold certified elevator manufacturing facility.

B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.

C. Regulatory Requirements:
   1. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
   5. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)
   6. Section 407 in ICC A117.1, when required by local authorities
   7. CAN/CSA C22.1 Canadian Electrical Code
   9. California Department of Public Health Standard Method V1.1–2010, CA Section 01350

D. Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).

E. Inspection and testing:
   1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
   2. Arrange for inspections and make required tests.
   3. Deliver to the Owner upon completion and acceptance of elevator work.

F. Sustainable Product Qualifications:
   1. Environmental Product Declaration:
      a. GOOD: If Product Category Rules (PCR) are not available, produce a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate scope.
b. BEST: If Product Category Rules (PCR) are available, produce and publish an Environmental Product Declaration (EPD) based on a critically reviewed life-cycle assessment conforming to ISO 14044, with external verification recognized by the EPD program operator.

2. Material Transparency:
   a. GOOD: Provide Health Product Declaration at any level
   b. BETTER: Provide Health Product Declaration (HPD v2 or later). Complete, published declaration with full disclosure of known hazards, prepared using the Health Product Declaration Collaborative's "HPD builder" on-line tool.
   c. BEST: Cradle to Cradle Material Health Certificate v3, Bronze level or higher.


1.04 DELIVERY, STORAGE AND HANDLING

A. Manufacturing shall deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

1.05 PROJECT CONDITIONS

A. Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

1.06 WARRANTY

A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months after final acceptance.

1.07 MAINTENANCE

A. Furnish maintenance and call back service for a period of 12 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.
   1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.
   2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
   3. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

PART 2 PRODUCTS
MACHINE ROOM-LESS HYDRAULIC ELEVATOR
2.01 MANUFACTURERS

A. Manufacturer: Design based around thyssenkrupp Elevator’s endura Machine Room-Less hydraulic elevator.

2.02 MATERIALS, GENERAL

A. All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD, and shall meet the California Department of Public Health Standard Method V1.1–2010, CA Section 01350 as mentioned in 1.03.9 of this specification.

B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.

C. Steel:
   1. Shapes and bars: Carbon.
   2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
   3. Finish: Factory-applied baked enamel for structural parts, powder coat for architectural parts. Color selection must be based on elevator manufacture’s standard selections.

D. Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050” thickness. Laminate selection must be based on elevator manufacture’s standard selections.

E. Flooring by others.

2.03 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.

B. Sling: Steel stiles bolted or welded to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.

C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.

D. Guides: Slide guides shall be mounted on top and bottom of the car.

E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.
F. Jack: A jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to ensure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless. Two jacks piped together, mounted one on each side of the car with a polished steel hydraulic plunger housed in a sealed steel casing having sufficient clearance space to allow for alignment during installation. Each plunger shall have a high pressure sealing system which will not allow for seal movement or displacement during the course of operation. Each Jack Assembly shall have a check valve built into the assembly to allow for automatically re-syncing the two plunger sections by moving the jack to its fully contracted position. The jack shall be designed to be mounted on the pit floor or in a recess in the pit floor. Each jack section shall have a bleeder valve to discharge any air trapped in the section.

G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.

H. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit.

I. Pit moisture/water sensor located approximately 1 foot above the pit floor to be provided. Once activated, elevator will perform “flooded pit operation”, which will run the car up to the designated floor, cycle the doors and shut down and trip the circuit breaker shunt to remove 3 phase power from all equipment, including pit equipment.

J. Motorized oil line shut-off valve shall be provided that can be remotely operated from the controller landing service panel. Also a means for manual operation at the valve in the pit is required.

2.04 POWER UNIT

A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit located in the elevator pit consisting of the following items:
   1. NEMA 4/Sealed Oil reservoir with tank cover including vapor removing tank breather
   2. An oil hydraulic pump.
   3. An electric motor.
   4. Electronic oil control valve with the following components built into single housing: high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.

B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and
quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.

C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating – motors shall be capable of 80 starts per hour with a 30% motor run time during each start.

D. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
   1. Relief valve shall be adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.
   2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
   3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
   4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.
   5. Provided with constant speed regulation in both up and down direction. Feature to compensate for load changes, oil temperature, and viscosity changes.
   7. A secondary hydraulic power source (powered by 110VAC single phase) must be provided. This is required to be able to raise (reposition) the elevator in the event of a system component failure (i.e. pump motor, starter, etc.)
   8. Oil Type: Provide a zinc free, inherently biodegradable lubricant formulated with premium base stocks to provide outstanding protection for demanding hydraulic systems, especially those operating in environmentally sensitive areas.

2.05 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted/knock down construction.
   1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware.
   2. Main landing door & frame finish: Stainless steel panels, no. 4 brushed finish.
   3. Typical door & frame finish: Stainless steel panels, No. 4 brushed finish.

B. Integrated Control System: the elevator controller to be mounted to hoistway entrance above 1st landing. The entrance at this level, shall be designed to accommodate the control system and
provide a means of access to critical electrical components and troubleshooting features. See section 2.09 Control System for additional requirements.

C. At the controller landing, the hoistway entrance frame shall have space to accommodate and provide a lockable means of access (group 2 security) to a 3 phase circuit breaker. See section 2.11 Miscellaneous Elevator Components for further details

D. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.

E. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.
   1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
   2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
   3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

F. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.06 PASSENGER ELEVATOR CAR ENCLOSURE

A. Car Enclosure:
   1. Walls: Cab type a steel shell design, reinforced cold-rolled steel with an applied panel design. The applied panels design, shall be arranged vertically on wood core panels covered on both sides with stainless steel: ASTM A 167, No. 4 brushed finish. Applied panels shall be removable.
   2. Reveals and frieze: Stainless steel, No. 4 brushed finish
   3. Canopy: Cold-rolled steel with hinged exit.
   4. Ceiling: Downlight type, metal pans with suspended LED downlights and dimmer switch. Number of downlights shall be dependent on platform size with a minimum of six. The metal pans shall be finished with a stainless steel, no. 4 brushed finish.
   5. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with No. 4 brushed stainless steel
   6. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
      a. Door Finish: Stainless steel panels: No. 4 brushed finish.
      b. Cab Sills: Extruded aluminum, mill finish.
   7. Handrail: Provide 4" flat metal bar on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, No. 4 brushed finish.
   8. Ventilation: Manufacturer’s standard exhaust fan, mounted on the car top.
9. Protection pads and buttons: Provide one set of vinyl protection pads with metal grommets for the project. Provide pad buttons on cab front(s) and walls.

B. Car Top Inspection: Provide a car top inspection station with an “Auto-Inspection” switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.07 DOOR OPERATION

A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.

1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.

2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.

3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel shall reverse and the door shall reopen to answer the other call.

4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.

5. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.
6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.

7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.

8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Door Protection Device: Provide a door protection system using microprocessor controlled infrared light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.08 CAR OPERATING STATION

A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Wrap return shall have a No. 4 brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED’s shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.

B. Emergency Communications System: Integral phone system provided.

C. Auxiliary Operating Panel: Not Required

D. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.

E. Special Equipment: Not Applicable

2.09 CONTROL SYSTEMS

A. Controller: Shall be integrated in a hoistway entrance jamb. Should be microprocessor based, software oriented and protected from environmental extremes and excessive vibrations in a NEMA 1 enclosure. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.
B. Service Panel – to be located outside the hoistway in the controller entrance jamb and shall provide the following functionality/features:
   1. Access to main control board and CPU
   2. Main controller diagnostics
   3. Main controller fuses
   4. Universal Interface Tool (UIT)
   5. Remote valve adjustment
   6. Electronic motor starter adjustment and diagnostics
   7. Operation of pit motorized shut-off valve with LED feedback to the state of the valve in the pit
   8. Operation of auxiliary pump/motor (secondary hydraulic power source)
   9. Operation of electrical assisted manual lowering
   10. Provide male plug to supply 110VAC into the controller
   11. Run/Stop button

C. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.

D. Emergency Power Operation: Full automatic operation (Simplex 10-D4A) Upon loss of the normal power supply, building-supplied standby power is available to the elevator on the same wires as the normal power. Once the loss of normal power has been detected and standby power is available, the elevator is lowered to a pre-designated landing and will open the doors. After passengers have exited the elevator, the doors are closed. At this time the elevator is automatically allowed to continue service using the building-supplied standby power.

E. Special Operation: Not Applicable

2.10 HALL STATIONS

A. Hall Stations, General: Vandal resistant buttons with center jewels which illuminate to indicate that a call has been registered at that floor for the indicated direction. Each button shall be provided with an internal automatic stop to prevent damage of switches that register the call. Provide 1 set of pushbutton risers. All fixtures shall be vandal resistant type.
   1. Provide one pushbutton riser with faceplates having a No. 4 brushed stainless steel finish.
      a. Phase 1 firefighter’s service key switch, with instructions, shall be incorporated into the hall station at the designated level.

B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

C. Hall Position Indicator: Not Applicable

D. Hall lanterns: Not Applicable
E. Special Equipment: Not Applicable

2.11 MISCELLANEOUS ELEVATOR COMPONENTS

A. Oil Hydraulic Silencer: Install multiple oil hydraulic silencers (muffler device) at the power unit location. The silencers shall contain pulsation absorbing material inserted in a blowout proof housing.

B. Lockable three phase circuit breaker with auxiliary contact with shunt trip capability to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb and should be sized according to the National Electrical Code.

C. Lockable single phase 110V circuit breaker for cab light and fan to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb should be sized according to the National Electrical Code.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. Install elevator systems components and coordinate installation of hoistway wall construction.
   1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
   2. Comply with the National Electrical Code for electrical work required during installation.

B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.

C. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.
D. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.

E. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.

F. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.

G. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.

H. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.

I. Lubricate operating parts of system, where recommended by manufacturer.

3.03 FIELD QUALITY CONTROL

A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.

B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.05 CLEANING
A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.

B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.
   1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

3.06 PROTECTION

A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.07 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.08 ELEVATOR SCHEDULE

A. Elevator Qty. 1
   1. Elevator Model: enduraMRL Above-Ground (1-stage)
   2. Elevator Type: Hydraulic Machine Room-Less, Passenger
   4. Rated Speed: 150 ft./min.
   5. Operation System: TAC32H
   6. Travel: 12'-0"
   7. Landings: 2 total
   8. Openings:
      a. Front: 1
      b. Rear: 0
   9. Clear Car Inside: 6' - 8" wide x 5' - 5" deep
   10. Cab Height: 8'-0" standard
11. Hoistway Entrance Size: 3' - 6" wide x 7'-0" high
12. Door Type: Single Speed
14. Seismic Requirements: Zone 1
15. Hoistway Dimensions: 8' - 4" wide x 6' - 11" deep
16. Pit Depth: 4' - 0"
17. Button & Fixture Style: Vandal Resistant Signal Fixtures
18. Special Operations: None

3.09 SPECIAL CONDITIONS (Note: Add Special Conditions as Needed)

END OF SECTION
SECTION 145810 - PNEUMATIC TUBE SYSTEMS

PART 1 — GENERAL

1.01 SUMMARY

A. PTS Contractor shall design and provide one complete vacuum/pressure pneumatic tube system where shown on the Drawings, as specified herein, and as needed for a complete and proper installation. Such point to point system shall be made upon One (1) “Master” station and one (1) “Sub” station. The system shall provide air-cushioned soft handling/delivery between Master station and it’s slave station. Provide system controls, stations, blowers, carriers, control wiring, and all associated equipment necessary for a complete system.

B. System Locations: As shown on plans.

C. Work in this section is to be coordinated with millwork vendor at terminal cabinet in Dispatch and Clerk Court.

D. Related Work
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications.

1.02 RELATED WORK BY OTHERS

The following items shall be performed by and at the expense of others:

A. 120 VAC volt electrical wiring to devices as noted — Coordinate with Electrical.

B. Conduit for low voltage control cable.

C. Any finish painting of terminal, equipment and exposed tubing to match surrounding wall, fixtures, etc. Terminal equipment shall be provided by the Pneumatic tube manufacturer in a standard factory finish.

D. Provide hoist or elevator services as required for convenient movement of materials, tools, and equipment.

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product Data: Within 35 calendar days after the Contractor has received the Owner’s Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer’s specifications and other data needed to prove compliance with the specified requirements.
   3. Shop Drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades;
4. Manufacturer’s recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.04 QUALITY ASSURANCE
A. Use adequate members of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.
B. Use a subcontractor currently approved in writing by the manufacturer of the approved equipment.

1.05 DELIVERY, STORAGE AND HANDLING
A. Comply with pertinent provisions of Section 01620.

PART 2 — PRODUCTS

2.01 PNEUMATIC TUBE SYSTEM
A. MANUFACTURERS:
   1. Kelly Systems, Inc. Air Communications Co., Inc., 32219 Tamina Road, Magnolia, Texas 77354, (281)-448-1333 1-800-352-1333 aircom@sbcglobal.net
   2. Equal Manufacturer when approved in advance by Architect.

2.02 OPERATION
System shall be on demand operating system and blowers shall time out after each transaction.

2.03 SYSTEM DESIGN
A. Design a system to the locations shown on Drawings, permitting safe and controlled transmission of carriers from any station in the system to any other station in the system by means of direct tube connection or manual transfer. Each system to operate independently with a blower and control system per relationship. No tandem configurations or sharing of components will be accepted.
B. All tubing shall run above ground at all times unless specifically called out in documents.
C. Provide a system utilizing pressure/vacuum air circuit complete with necessary valves to deliver carriers softly at each station.
D. Provide system status lights to indicate system operation:
   1. In Use and Carrier arrival
E. Provide carrier speed averaging 25 feet per second.
F. Provide two way audio between stations

2.04 EQUIPMENT

a) Tubing:
   (1) Provide 16 gauge 4" Transalum tubing with flash removed tubing in accordance with ASTM Commercial. Only aluminum tubing will be permissible.
   (2) Provide bends of the same material and dimensions as the straight sections, formed to a centerline radius of 36" or shortest allowable, of true circular cross section at all points, and free from wrinkles and distortions. All cuts shall be squared, filed and mandrel for proper fit and finish. No expanded bends allowed.
   (3) Join bends to other bends to straight tubing in a manner to produce a tight connection.
   (4) When bends are cut in the field for offsets and small angle turns, provide square cut ends with mandrelling as required for proper jointing.

b) Hangers and Supports:
   (1) Provide 5/16" diameter steel rod hangers attached to tube clamps at one end and screwed into suitable inserts or clamps anchored to structural members at not more than 10'-0" on centers.
   (2) Where two or more tubes are run together, provide tube spacing clamps constructed of galvanized band iron held together with ¼" 20 gage bolts and washers, spaced as standard with the manufacturer.
   (3) Do not permit scoring or break joints to weaken the cross-sectional area of clamps.
   (4) Provide bracing for all transmission and adjacent air piping against motion caused by passage of the carrier.

c) Stations
   (1) All stations shall be K-619 type, ACC-4000, and 915 type down receive single line type, utilizing the same line to send as to receive, and shall be constructed of a minimum 14 gauge cold rolled steel with bake-on powder coat finishes, appropriately welded and sealed to provide an air tight chamber. Slip or sliding sleeve and down send type terminals are not acceptable alternate, one up receive, down send streamflow terminal at dispatch may be furnished.
   (2) Each station shall be provided with the following hardware:
   (3) All stations will be equipped with 24V push buttons and “in use” lights to assist the operator in using the system and indicates the system is in use and arrival lights
   (4) Clear plexiglass or equal (minimum U4" thick) access door and door seal with stainless steel frame and piano hinges for easy viewing of the chamber area.
   (5) The outside pneumatic tube station for police use at secure parking and drop off area and shall have an aluminum pedestal 12” X 12” X 40” tall. This station shall have a twist open/close terminal mounted on top of pedestal which will automatically close when sending and open when carrier has arrived. The pedestal and terminal shall be powder coated black and beige finish ACC#40-1. In addition, this station will be equipped with two way audio between Police Station and Dispatch Office and between Dispatch Office and Court.
   (6) Black vise action or chrome plated positive latching door handle to ensure air tight seal.
   (7) Air cushioned soft delivery for safety and prolonged carrier life.
   (8) Stations will be surface mounted on wall brackets supplied by PTS contractor all
penetrations in ceilings will be finished in matching trims or escutcheon plates. (9) Any exposed wire to stations will be installed in conduit.

d) Carriers:
Provide two carriers for each station for a total of eight carriers. Carriers will be of a single piece design, end opening with a clear inside length of 9” X 3”. Two-piece carriers will be acceptable along with side open style. The carrier design will prevent the carrier from being inserted into system without being closed.

e) System Controller:
The system controller shall be fully integrated electronic design to provide each system with:
a. “On-Demand” blower control
b. Adjustable timer function
c. Low voltage 24 volts AC control power
d. Manual blower control
e. Ability to power two blower units

f) Blower Unit:
a. Blower unit shall be self-contained pressure-vacuum
b. Each blower shall be 120 volts and shall deliver 120 CFM, @ 95 dBA
c. Blower units shall be factory assembled and UL/ETL listed
d. Provide a sufficient number of blower unit(s) to provide sufficient air to maintain an average carrier velocity of 25 feet per second.
e. Locate blowers and arrange so as to produce a smooth flow of air in all lines at all times. If installed in occupied areas, even if above ceilings, mufflers shall be added to reduce noise level to 40 dBA.

2.02 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

PART 3 — EXECUTION

3.1 SURFACE CONDITIONS
A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION
A. Coordinate as required with other trades to assure proper and adequate provision in the work trades for interface with the work of this Section.
B. Install the work of this Section in strict accordance with the original design, the approved Shop Drawings, pertinent requirements of governmental agencies having jurisdiction, and the manufacturer’s recommended installation procedures
C. as approved by the Architect, anchoring all components firmly into position for long life under hard use.
D. The PTS Contractor shall provide a necessary rigging, scaffolding, tools, tackle, labor etc for the complete installation of the pneumatic tube system. The PTS Contractor shall have a competent job superintendent on the job at all times.
during his work progress with authority to act for him and to supervise the
installation of the work and to consult with other trades as to the proper execution
and conduct of the work under this section. All workmanship shall be first class
in every respect and shall be performed only by skilled mechanics in compliance
with industry standards.

E. Tubing stations must be installed according to industry accepted standards.
Install stations and blower units with clamp style sleeves. Make joints in tubing
airtight by sealing with a suitable compound or shrink sleeve or as otherwise
indicated herein. Do not permit tubing to contact partition framing. Allow
sufficient clearance around all components for service and repair. Tubing/Bends
shall be joined to other bends or straight tubing with steel sleeves or bolt clamp
sleeve when tube bends are not belled. Field cutting shall be cut squarely, file
and straighten by mandrelling to produce straight segment sufficient for air tight
joining.

F. Hangers and Support horizontal Tubes shall be spaced clamps at not more than
10 foot intervals; screw rods into couplings and attach to hanger bolts or concrete
hangers. Hangers may not be suspended from piping above. Vertical tubes shall
be supported with floor or row clamps at intervals equal to floor or interstitial
height. All bends are to be sway braced as appropriate and support with not less
than two (2) hangers.

G. Stations shall be mounted on appropriate structure to ensure easy removal for
remodeling. Tube and bend shall be supported from above and not dependent
upon station for support.

3.03 ELECTRICAL REQUIREMENTS
A. Provide necessary low voltage control wiring strapped to pipe as required,
conduit where necessary.

B. System Controller shall be provided with 120 VAC single phase by others.
Amperage to be based on system requirements. Provide suitable information and
instructions to others so that a higher voltage electrical requirements can be
determined.

3.04 ADJUSTMENT
A. Upon completion of the work of this Section, carefully and properly adjust all
components of the system to achieve an optimum level of operation.

3.05 INSTRUCTION
A. Thoroughly and adequately instruct the Tenant’s operation and maintenance
personnel in proper use, care, and servicing of the work of this Section as
required between 8:00 am to 5:00 pm for four hours.

END OF SECTION
PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions 013100 and Supplementary Conditions apply to all Work herein.

1.2 COORDINATION DRAWINGS

A. The Mechanical Contractor shall take the lead in coordinating the Mechanical, Electrical, Plumbing, and Fire Protection systems within the building.

B. The Mechanical Contractor shall coordinate a three-dimensional (3D) model of the building which includes the Mechanical, Electrical, Plumbing, and Fire Protection systems. The Electrical, Plumbing, and Fire Protection Contractors shall prepare their work and generate 3D models which will be given to the Mechanical Contractor for coordination. The Contractor will be provided with the REVIT model that was used to generate the contract documents, this file may be used as the background file. The Contractor shall replace the systems drawn with the actual shop drawing models. The Contractor is not limited to using REVIT but may use any 3-D software in generating and combining the coordination model.

C. Submitting the contract drawings as coordination drawings will not be acceptable.

D. The model shall include detailed and accurate representations of all equipment to be installed based upon the reviewed equipment submittals.

E. The Mechanical Contractor shall hold a 3-D coordination meeting with all sub-contractors present to review the model and discuss coordination of the installation of the building systems.

F. Upon completion of the coordination meeting, the Contractor shall submit the 3-D model and ¼” scale drawings for review.

G. The model shall detail major elements, components, and systems in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:
   a. Wall and type locations.
   b. Clearances for installing and maintaining insulation.
   c. Locations of light fixtures and sprinkler heads.
   d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
   e. Equipment connections and support details.
   f. Exterior wall and foundation penetrations.
   g. Routing of storm and sanitary sewer piping.
h. Fire-rated wall and floor penetrations.
i. Sizes and location of required concrete pads and bases.
j. Valve stem movement.
k. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

H. Sequence of Coordination
Below is hierarchy of model elements and the sequencing by which the models will be coordinated.

1. Structural and Architectural model
2. Miscellaneous steel
3. Perform preliminary space allocation
4. Identify hard constraints (locations of access panels, lights, A/V space requirements, etc.)
5. Main and medium pressure ducts from the shaft out
6. Main graded plumbing lines and vents
7. Sprinkler mains and branches
8. Cold and hot water mains and branches
9. Lighting fixtures and plumbing fixtures
10. Smaller sized ducts and flex ducts
11. Smaller size cold water and hot water piping, flex ducts, etc.

I. The Contractor and Sub-Contractors shall not install any item until the coordination has been completed and reviewed by the Construction Manager, Owner, and A/E team.

J. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

K. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.
END OF SECTION 21 02 01
SECTION 21 05 29 – HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

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 RELATED WORK

A. Section 21 13 13 – Wet Pipe Sprinkler System.

1.3 REFERENCES


1.4 QUALITY ASSURANCE

A. Supports for Sprinkler Piping: In conformance with NFPA 13.

1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.
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

K. For installation of protective shields refer to specification section 22 05 29 -3.03.

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. Fire Stopping Insulation: Glass fiber type, non-combustible, U.L. listed.
E. Caulk: Paintable 25-year acrylic sealant.
F. 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>
</tr>
<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>
</tbody>
</table>
(PVC Pipe)

<table>
<thead>
<tr>
<th>Size</th>
<th>Diameter</th>
<th>Length</th>
<th>Thckess</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2 to 4 inch</td>
<td>4&quot;</td>
<td>3/8&quot;</td>
<td></td>
</tr>
<tr>
<td>6 to 8 inch</td>
<td>4&quot;</td>
<td>1/2&quot;</td>
<td></td>
</tr>
<tr>
<td>10 and over</td>
<td>4&quot;</td>
<td>5/8&quot;</td>
<td></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 manufactures instructions.

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 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 14</td>
<td>24</td>
<td>0.075</td>
</tr>
<tr>
<td>16 THROUGH 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 penetrates weather or waterproofed walls, floors, and roofs.

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 penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with U.L. listed fire stopping insulation and caulk seal air tight. 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 21 05 29
SECTION 21 13 13 - WET PIPE SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

B. The scope and work shall include providing treatment for MIC (Microbiologically Influenced Corrosion).

C. The Fire Protection Contractor shall provide the Owner with a periodic plan for the testing of the system’s water.

1.3 REGULATORY CODES

A. Work in accordance with:

1. NFPA.
2. Local municipal codes that have jurisdiction.

B. Products in accordance with:

1. United Laboratories (UL) listed.
2. Factory Mutual (FM) approved.

1.4 CERTIFICATE OF TESTING

A. Furnish Owner with test certificate certifying the system approved by:

2. Insurance Services Officials

PART 2 - PRODUCTS

2.1 FIRE SPRINKLER SYSTEM

A. GENERAL:

1. Work Included:

   a. Design, coordination and installation of inside and outside piping, including sprinkler heads, valves, hangers and supports sleeves.
b. The sprinkler system is a wet type and is designed to provide coverage for entire building. The Contract Drawings indicate the extent and general arrangement, and the various occupancy classifications.

c. Sprinkler heads are not shown.

d. The plans provide a preliminary layout with riser assembly location, flow switch locations, valve locations, and fire department Siamese connections. These are a guide for subsequent preparation of the Contractor's detailed working drawings.

e. Interface system with building fire and smoke alarm system.

2. Quality Assurance: Equipment and installation to meet requirements of NFPA Number 13, latest edition and local authority having jurisdiction. All components of the completed system shall be UL listed for the intended service.

2.2 SUBMITTALS:

A. Submit shop drawings in accordance with Section 22 02 00.

B. Submit preliminary layout showing only head locations for review by Architect/Engineer. Furnish additional heads which may be required for coordinated ceiling pattern without added cost, even though number of heads may exceed minimum code requirements.

C. Submit shop drawings of entire sprinkler system including hydraulic calculations to Architect/Engineer.

D. Provide Architect with six complete sets of final approved shop drawings before starting the installation. Include details of the sprinkler system showing sections, light fixtures, air conditioning, ducts, and a plan giving fire department connections, location of all exposed structures within twenty feet of this structure, and other equipment to be used. Drawings shall bear the stamp of review of the local fire insurance rating organization having jurisdiction.

E. Service Utility Diagram: Furnish Architect with an accurately marked print showing location of underground pipes and valves as installed upon completion of underground Work.

F. Provide a printed sheet giving brief instructions relative to all necessary aspects of sprinkler controls and emergency procedures next to sprinkler riser mains. Instruction sheet to be protected by glass or a transparent plastic cover.

G. Materials:

1. Piping:
   a. All piping above grade shall be:
      - schedule 10 black steel pipe with a rolled groove ends, joined with mechanical coupling and cut groove cast iron fittings for pipe 2-1/2” and greater.
      - schedule 40 black steel threaded pipe and fittings for pipe 2” and smaller.
   b. Acceptable manufacturer:
      - American Tube
      - Wheatland Tube
      - Gem Sprinkler
   c. Acceptable mechanical coupling manufacturer:
      - Victaulic
      - Grinnell
      - Reliable
      - Gruvlok
2. Sprinkler Heads:
   a. Suspended Ceiling Type: Standard Concealed pendant type with white cover plate.
   b. Exposed Area Type: Standard upright type with brass finish.
   c. Sidewall Type: Chrome plated finish with matching escutcheon.
   d. Temperature rating on fusible links to suit specific hazard area with minimum margin or safety 50 degrees F.
   e. Sprinkler heads of the “O”-ring seal type are not acceptable.
   f. In natatoriums and pool equipment rooms provide chrome plated or wax coated heads for corrosive environments.
   g. Flexible type sprinkler head connection systems are not acceptable.
   h. Acceptable manufacturer:
      - Reliable
      - Grinnell
      - Viking

3. Sprinkler Alarm Valve:
   a. Provide approved automatic sprinkler valve with one or two pole (as required) flow detectors, pressure switch, outside water motor gong and inside electric gong and circuit breaker.
   b. Acceptable manufacturer:
      - Reliable
      - Grinnell
      - Viking

4. Valves:
   a. 2” and smaller: bronze, rising stem, inside screw, solid wedge, U.L. listed valve.
   b. 2-1/2” and larger: iron body, bronze trim, rising stem, OS&Y, solid wedge, U.L. listed valve.
   c. Check valve: cast iron flanged body, bronze fitted, non-slam type.
   d. Install valves with stems upright or horizontal, not inverted.
   e. Acceptable manufacturer:
      - Nibco
      - Grinnell
      - Stockham
      - Victaulic

5. Fire Department Connection: shall be a Potter-Roemer #5761, polished chrome plated, equipped with chrome plated ball drip and with required lettering per N.F.P.A.

6. Insulation:
   a. All piping and valves exposed to the weather or within building and exposed to the weather shall be insulated with Phenolic foam with ASJ and all joints sealed. Insulation density shall not be less than 1.5 pounds per cubic foot, and conductivity (K) not higher than 0.25 and 75°F mean temperature difference, with factory applied all weather vapor barrier jacket.
   b. All insulated pipe and valves subject to damage shall be protected with an aluminum jacket with sealed joints.
   c. Refer to Section 22 07 19 for detailed specification.

7. Products:
   a. All piping, fitting, equipment, sprinkler heads, and valves shall be by a domestic manufacturer.

PART 3 - EXECUTION
3.1 All equipment shall be installed in accordance with the manufacturer’s recommendations and printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items as required by NFPA and installed as per manufacturer’s recommendations.

3.3 DESIGN

A. Design spacing of sprinkler heads and selection sizes shall conform to the requirement of NFPA 13 for the indicated occupancy.

B. Uniform discharge density design shall be based on hydraulic calculations utilizing the method outlined in NFPA 13. Density of discharge from sprinkler heads shall conform to NFPA 13.

C. Friction losses in pipe will be based on a value of "C" =120 in the Hazen - Williams formula.

D. Design and install the system so that no part will interfere with doors, windows, heating, plumbing, or electrical equipment. Do not locate sprinkler heads within 6 inches of lighting fixtures, HVAC diffusers and other obstructions. Sprinkler piping cannot penetrate ductwork or lighting fixtures.

E. The Contractor shall conform to the National Fire Protection Association's Fire Code No. 13, latest edition. Special attention shall be given to Article 1-9, working plans. It shall be the Registered Fire Protection Engineer’s responsibility to determine if any deficiency or deviations, such as an inadequate water supply, or any other item which would materially affect the acceptability of the system.

3.4 INSTALLATION

A. Install all items in accordance with applicable codes.

B. Install piping so that mains and branches are not located directly underneath HVAC equipment or other items needing access.

C. All sprinkler heads shall be located as near the center of ceiling tiles as is practical (±1/2”). Location shall present a uniform pattern with all heads aligned when completely installed.

D. Run piping concealed above furred ceilings and in joists to minimize obstructions. Expose only heads. Exact routing of piping shall be approved by Architect or relocated as required at no additional cost to Owner.

E. Wire guards on all pendant or upright sprinklers heads in mechanical rooms, gymnasiums, athletic areas, wood and metal shops.

F. Protect sprinkler heads against mechanical injury with standard guards.

G. Locate outside alarms on wall of building adjacent to siamese fire department connection.

H. Provide on wall near sprinkler valve, cabinet containing six extra sprinkler heads of each type and wrench suitable for each head type.

I. Provide 1-inch diameter nipple and 1-inch x 1/2 inch reducing fitting for each upright head.
J. Painting shall be as follows:

1. Exposed sprinkler riser, alarm valve and all related piping shall be painted red.

2. Exposed sprinkler piping in finished areas shall be painted as directed by Architect.

3.5 REPLACEMENT

Upon receipt of written notice of failure of any part of the guaranteed equipment during the guaranteed period, the Contractor will replace the affected part or parts promptly at no additional cost.

3.6 TESTING

A. Prior to testing, the entire sprinkler system shall be thoroughly flushed clean.

B. Upon completion of the installation and flushing, test the system and obtain approval of the local fire insurance rating organization having jurisdiction. Particular attention is called to the requirements of NFPA 13 pamphlet.

3.7 TRAINING

A. Owner's people shall be fully briefed in the normal start-up of the system, operation, normal and emergency shutdown, and maintenance of the system.

B. Routine maintenance, yearly maintenance, winterization, and spring start-up shall be fully discussed and documented.

C. Names of those instructed and dates, as well as a list of information handed over to the owner, shall be included in the final report.

END OF SECTION 21 13 13
PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 RELATED SECTIONS

A. Section 09900 – Painting.
B. Section 21 13 13 – Wet Pipe Sprinkler System.
C. Section 23 05 29 – Hangers and Support for Piping and Equipment HVAC.
D. Section 23 05 53 – Identification for HVAC Piping and Equipment.
E. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
F. Section 23 05 93 – Testing, Adjusting and Balancing.
G. Section 28 31 00 – Fire Alarm and Smoke Detection System.

1.3 SCOPE

A. Scope of the work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

1.4 REGULATORY CODES

A. WORK IN ACCORDANCE WITH:

2. Local municipal codes that have jurisdiction.
3. Applicable State of Texas Codes, Standards and Regulations.

B. Products in accordance with:

1. United Laboratories (UL) listed.
2. Factory Mutual (FM) approved.

1.5 CERTIFICATE OF TESTING

A. Furnish Owner with test certificate certifying the system approved by:

1. City Fire Marshal.
2. Insurance Services Officials.

PART 2 - PRODUCTS

2.1 PRE-ACTION SPRINKLER SYSTEM

A. GENERAL:

1. WORK INCLUDED:
   a. Design, coordination and installation of inside piping, including sprinkler heads, deluge and check valves, air compressor, all interconnecting piping, hangers and supports sleeves. Coordination with releasing devices, electric releasing control equipment, fire detection devices, manual pull stations and signaling devices.
   b. The sprinkler system shall provide coverage for sensitive areas where indicated on the drawings. The Contract Drawings indicate the extent and general location of pre-action sprinkler system.
   c. Sprinkler heads and alarm devices are not shown.
   d. The plans provide a preliminary layout with valve assembly location. These are a guide for subsequent preparation of the Contractor's detailed working drawings.

2. QUALITY ASSURANCE: Equipment and installation to meet requirements of NFPA Number 13, latest edition and local authority having jurisdiction. Design shall be performed by a fully qualified professional engineer registered in the State of Texas.

3. Submittals:
   a. Submit shop drawings in accordance with Section 23 02 00.
   b. Submit preliminary layout showing only head and alarm device locations for review by Architect/Engineer. Furnish additional heads, which may be required without added cost, even though number of heads may exceed minimum code requirements.
   c. Submit shop drawings of entire sprinkler system including hydraulic calculations to Architect/Engineer.
   d. Provide Architect with six complete sets of final approved shop drawings before starting the installation. Include details of the sprinkler system showing sections, light fixtures, air conditioning, ducts, and other equipment to be used. Drawings shall bear the stamp of review of the local fire insurance rating organization having jurisdiction.
   e. Provide a printed sheet giving brief instructions relative to all necessary aspects of sprinkler controls and emergency procedures next to sprinkler riser mains. Instruction sheet to be protected by glass or a transparent plastic cover.

B. MATERIALS:

1. All piping above grade shall be schedule 40 black steel grooved pipe and fittings with mechanical coupling joints.

2. Sprinkler Head:
   a. Temperature rating on fusible links to suit specific hazard area with minimum margin or safety 50 degrees F.
b. Typical automatic sprinklers shall be standard chrome pendant sprinkler heads with polished aluminum two piece escutcheons.

c. Manufacturers:
   1) Tyco
   2) Reliable
   3) Viking

3. Sprinkler Valve:
   a. Provide approved deluge valve, differential diaphragm valve with rubber faced bronze clapper, actuated with electrically operated alarms, with test trim.
   b. Manufacturers:
      1) Tyco
      2) Reliable
      3) Viking

PART 3 - EXECUTION

3.1 All equipment shall be installed in accordance with the manufacturer’s recommendations and printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items as required by NFPA and installed as per manufacturers recommendations.

3.3 DESIGN

A. The pre-action system shall be designed in such a manner that the system shall not discharge unless the detection system has activated the pre-action valve and a sprinkler head has fused.

1. Provide a complete automatic detection and activation system utilizing smoke detectors; electric manual control stations and supervision of the detection circuit.

2. Provide supervised air pressure control.

3. Provide pre-action system control panel with visual audible trouble alarm and electric pre-action valve with visual annunciation.

4. Interface this system with the building fire detection and alarm system.

B. Design spacing of sprinkler heads and selection sizes shall conform to the requirement of NFPA 13 for the indicated occupancy.

C. Uniform discharge density design shall be based on hydraulic calculations utilizing the method outlined in NFPA 13. Density of discharge from sprinkler heads shall conform with NFPA 13.

D. Friction losses in pipe will be based on a value of "C" =120 in the Hagen and Williams formula.

E. Design and install the system so that no part will interfere with heating, plumbing, or electrical equipment. Do not locate sprinkler heads within 6 inches of lighting fixtures, and other obstructions. Sprinkler piping cannot penetrate ductwork or lighting fixtures.
F. The Contractor shall conform to the National Fire Protection Association's Fire Code No. 13, latest edition. Special attention shall be given to Article 1-9, working plans. It shall be the Contractor's responsibility to determine if any deficiency or deviations, such as an inadequate water supply, or any other item which would materially affect the acceptability of the system.

G. Coordinate the operation of the pre-action valve with the detection system specified by Division 16.

H. The automatic sprinklers, deluge and check valves, air compressor, releasing devices, electric releasing control equipment, fire detection devices, manual pull stations, and signaling devices which are utilized with the Double Interlock System must be UL Listed or FM Approved, as applicable.

3.4 INSTALLATION

A. Install all items in accordance with applicable codes.

B. Run piping concealed above furred ceilings and in joists to minimize obstructions. Expose only heads. Exact routing of piping shall be approved by Architect or relocated as required at no additional cost to Owner.

C. Protect sprinkler heads against mechanical injury with standard guards.

D. Provide on wall near sprinkler valve, cabinet containing four extra sprinkler heads of each type and wrench suitable for each head type.

E. Provide 1 inch diameter nipple and 1 inch X 1/2 inch reducing fitting for each upright head.

F. Paint the exposed Fire Sprinkler riser "red".

G. The entire Fire Sprinkler Pipe system shall be identified with plastic pipe markers.

H. The deluge valve, check valve, and all interconnecting piping must be located in a readily visible and accessible location and in an area which can be maintained at a minimum temperature of 40°F/4°C. NOTE: HEAT TRACING IS NOT PERMITTED.

I. The Type D Double Interlock System and associated equipment shall periodically be given a thorough inspection and test. NFPA 25 "Inspection, Testing and Maintenance of Water Based Fire Protection Systems," provides minimum maintenance requirements. The double interlock system shall be tested, operated, cleaned and inspected at least annually, and parts replaced as required.

J. Upon completion of work, the entire system shall be flushed clean and free of foreign matter.

3.5 REPLACEMENT

Upon receipt of written notice of failure of any part of the guaranteed equipment during the guaranteed period, the Contractor will replace the affected part or parts promptly at no additional cost.

3.6 TESTING
Upon completion of the installation, test the system and obtain approval of the local fire insurance rating organization having jurisdiction. Particular attention is called to the requirements of NFPA 13 pamphlet.

3.7 TRAINING

A. Owner's personnel shall be fully briefed in the normal start-up of the system, operation, normal and emergency shutdown, and maintenance of the system.

B. Routine maintenance, yearly maintenance, winterization, and spring start-up shall be fully discussed and documented.

C. Names of those instructed and dates, as well as a list of information handed over to the owner, shall be included in the final report.

END OF SECTION 21 13 19
PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

A. The Ecaro-25 clean agent system installation shall be made in accordance with the drawings, specifications and applicable standards. Should a conflict occur between the drawings and specifications, the specifications shall prevail. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 RELATED SECTIONS

A. Section 21 05 29 – Hangers and Supports for Fire Suppression Piping and Equipment.
B. Section 21 05 53 – Identification for Fire Suppression, Piping and Equipment.
C. Section 21 05 87 – Sleeves for Fire Suppression Piping.
D. Division 28 – Fire Alarm System.

1.3 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use. The work described in this specification includes all engineering labor, materials, equipment and services necessary, and required, to complete and test the detection and suppression system.

B. This specification, NFPA 72 and 2001 (latest edition) define the requirements for an Ecaro-25 Clean Agent total flooding fire suppression system. There is to be a complete system provided for IT Server and Evidence Storage room as shown on construction drawing. Protection is to include detection and suppression for the room, under the raised floor, and in the ceiling plenum.

C. This installation shall be made in accordance with applicable National Fire Protection Association Standards (latest edition) and the State of Texas. NFPA. 2001 – 2008 Edition – Clean Agent Fire Suppression Systems
No. 70 - National Electrical Code
No. 72 – National Fire Alarm Code
FM Approvals
Underwriters Laboratory
Requirements of the Authority Having Jurisdiction (AHJ)

D. Exclusions:
   1. 120VAC dedicated power supply to the system control panel
   2. Interlock wiring and conduit for shutdown of HVAC, dampers and/or electric power supplies or shunt trip breakers
   3. Connection to local/remote fire alarm systems for monitoring

PART 2 – PRODUCTS
2.1 The contractor shall furnish, install, and test a complete and ready for operation HFC-125, (Ecaro-25™), fire suppression system, including charged agent storage containers, piping, nozzles, control panels, detectors, wiring, alarms, graphic annunciator, and all other equipment necessary for completely new, operational conventional systems free from defects for each protected zone.

2.2 All equipment and devices used shall be listed for their intended use in either the UL Fire Protection Equipment List or the Factory Mutual Approval Guide. All equipment shall be manufactured and/or supplied by Fike Protection Systems or approved equal. For approved equal status the contractor must submit considered equal within 96 hours of the bid date and provide a detailed summary of each specification section, subsection, and paragraph for deviation or equivalent.

2.3 The manufacturer of the clean agent system hardware and detection components shall have a minimum of 10 years’ experience in the design and manufacture of similar types of suppression system and who refer to similar installations providing satisfactory service.

2.4 All valves operated automatically shall be provided with independent means for manual operation.

2.5 The clean agent fire suppression system shall provide a minimum design concentration of 8% by volume, in all areas and/or protected spaces, at the minimum anticipated temperature within the protected area. Per NFPA 2001, the system design shall not exceed a maximum exposure limit concentration level of 11.5%, by volume, unless provisions for room evacuation, before agent release, are provided. All personnel should be able to leave protected space prior to the discharge or at least within 5 minutes of the commencement of discharge.

2.6 Detection shall consist of conventional, photoelectric detectors with spacing of 250 square feet per detector with a minimum of two per space. All information, such as air changes per minute and total CFM, must be taken into account for the quantity of detectors, per NFPA 72E. If the air changes within the protected space exceed 60 per hour then 1/2 of this quantity or the maximum spacing of one per 250 square feet shall be used, whichever results in a greater number of detectors. Model # 63-1017 detectors shall be located within the protected zone. All detectors, manual pull station, abort stations, low pressure switches, shall be displayed on graphic annunciator.

2.7 The system shall include a standby power supply. Upon loss of normal power supplying the control unit, the system shall automatically transfer to standby battery power supplied by the control unit and alarm the transfer. The standby system shall be capable of staying on-line for 24 hours and then operate the system for 10 minutes in the alarm condition.

2.8 Storage containers and distribution piping shall be in accordance with the latest requirements listed in NFPA Standard 2001. All discharge piping and fittings shall be galvanized. All fittings shall be 300 pound extra heavy.

2.9 All piping shall be internally swabbed or blown free of residual fabrication oil or particle matter prior to nozzles or discharge devices being installed.

2.10 All Ecaro-25™ containers shall include liquid level indicators. These indicators shall precisely show the level of agent in the container without the need of scales or the removal of these cylinders. A calibrated liquid reading device shall not be accepted. All containers shall also include a supervised low-pressure switch to monitor internal cylinder pressure.

A. Ecaro-25™ containers shall be located on the floor where shown on the drawings. The quantity of cylinders shall be adhered to. This shall ensure the proper maximum cylinder fill quantities and nozzle throw distance.
Containers shall be actuated by the following methods:

A. Single container applications (Electric) – By an Impulse Valve Operator (IVO) wired through a Fike P/N 10-2748 Impulse Releasing Module (IRM). This method allows mechanical release.

2.12 The Fike addressable control unit shall control circuits to the detectors, time delays, initiators, manual discharge switches, alarm horns and lights, pressure switches and other required equipment. All such circuits shall be supervised so that a visible and audible trouble signal occurs at the control unit should a fault occur. The control panel shall be multi zone panel located where shown on the drawings. Panel shall be sized to house all controls, such as time delays, detection/suppression, and aux. relays. This control panel shall be a Fike part number 10-068-R-1.

Control panel shall be UL and/or FM listed for releasing and shall provide the following capabilities and functions:

A. Two (2) Class B (Style Y), indicating appliance circuits rated for 2.0 amps @ 24 VDC.

B. Two (2) Signal Line Circuits, Style 4/6 (Class A/B). Communicates to up to 254 addressable devices per circuit. Addressable devices described below.

C. Two auxiliary supply circuits rated 2A @ 24Vdc, each

D. One resettable auxiliary supply circuit rated 2A @ 24 Vdc.

E. Three (3) Form “C” relays, rated 2 amps @30 Vdc. These relays provide alarm, trouble, and supervisory annunciation.

F. Optional CRM4, Relay module (P/N 10-2204) provides 4 programmable contacts rated 2A @ 30 Vdc. CHEETAH Xi can support two (2) CRM4 modules.

G. Optional SLM, Supplemental Loop Module (P/N 10-2473) provides two additional Signal Line Circuits, Style 4/6 (Class A/B). Communicates to up to 254 addressable devices per circuit. Addressable devices described below.

H. Optional SPS, Supplemental Power Supply (P/N 10-2474-p). Operates from 120Vac, 50/60 Hz (p=1) or 240 Vac, 50/60 Hz (p=2). Increases CHEETAH XI Xi’s external normal standby current from 2.0A to 4.0A and CHEETAH XI Xi’s external alarm current from 6.0A to 12.0 A. Provides two (2) auxiliary supply circuits rated 2A @ 24 Vdc, each. Supports up to 75 Ah of standby battery capacity.

I. Ten (10) Status LEDs plus alpha-numeric display for troubleshooting: AC power; alarm; trouble; supervisory; silence; predischarge; release: release disabled: abort and ground fault.

J. Programmable pre-discharge and discharge timers

K. Six (6) optional Abort types

L. Intelligent Transistor protection to prevent noise spikes and microprocessor failure from inadvertently activating release outputs.
M. Disarm function to disable release outputs

N. Multiple input power source - 120 VAC or 240 VAC @ 50/60 Hz

O. 6.0 amps @ 24 VDC power supply to operate high current draw horns and strobes. Capable of allowing expansion to 12 amps by use of optional module Supplemental Power Supply (SPS) which also is capable of supporting 75 Ah of standby batteries.

P. Available in either Red or Gray finish

Manual Release Station

A. The electric manual release switch shall be a dual action device which provides a means of manually discharging the ECARO-25 clean agent system.
1. The Manual Release switch shall be a P/N 10-1638 or a Manual Pull station, P/N 02-3710.
2. The Manual Release switch or Manual Pull station shall be a dual action device requiring two distinct operations to initiate a system actuation.
3. Manual actuation shall bypass the time delay and abort functions, shall cause the system to discharge and shall cause all release and shutdown devices to operate in the same manner as if the system had operated automatically.
4. A Manual Release or Manual Pull switch shall be located at each exit from the protected hazard and shall have an advisory sign, P/N 02-10312, provided at each location.

Abort Station

A. Abort stations shall be located where shown on drawings and shall always be located within the hazard they protect. Model # 10-1639.

2.13 AUDIBLE DEVICES SHALL BE AS FOLLOWS:

A. Horn/strobes shall be 90 dBA 10 feet with the horns having the ability to be modulated.
B. Discharge strobes shall be located outside the protected hazard by each egress door.

2.14 Design information to be submitted for Engineer's approval shall include the "Sequence of Operation", "Bill of Materials", and drawings.

2.15 SUBMITTALS

A. Submit shop drawings in accordance with project requirements.
B. Submit shop drawings of entire ECARO-25™ fire suppression system including calculations to Architects/Engineer.
C. Provide Architect with six complete sets of final approved shop drawings before starting installation.
D. All details of system design shall be shown on the plan drawings as follows:
   Actual Area (ft²)
   Actual Volume (ft³)
Pounds of gaseous agent
Filling density of container
Air flow
Maximum pipe length (ft)
Hydraulic calculations
Type of Nozzles
Piping details
Pressure of system
Size and type of pipe
Number of fittings (elbows, tees, etc.)
Routing of piping including indication that system does not exceed the piping limitations
Equipment used
Location of detectors
Location of gas supply
Location of manual releases and abort switches
Electrical wiring details
Standby power details
Interlocks with:
  Duct Dampers
  Air-conditioning Units
  Electrical Equipment
  Building Fire Alarm- (3) zones (Alarm, Supervisory, Trouble)

PART 3 – EXECUTION

3.1 All equipment shall be installed in accordance with the manufacturers’ recommendations and printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturers requirements.

3.3 The area of unclosable openings shall be minimized with all doors and windows weather-stripped, and where not used on a daily basis, they shall be sealed. Ventilating ducts shall be closed with automatic dampers activated by the Ecaro-25™ discharge. The Dampers and the control wiring of these dampers are covered under other Divisions of the work.

3.4 Contractor shall provide instruction plates detailing emergency procedures at each system control panel and at each hazard area manual discharge station/abort switch location. Permanent nameplates shall be used in the control panel to identify control logic units, contacts, and major circuits.

3.5 Sequence of Operations shall be as follows

A. Upon activation of a photoelectric smoke/heat detector in a ECARO-25 protected zone the following will happen:

1. Strobes activate in zone of alarm
2. Horns pulse slowly in zone of alarm
3. Alarm relay is energized for building fire alarm monitoring

B. Upon activation of a second photoelectric smoke detector in the same ECARO-25 protected zone the following will happen:
1. Strobes continue in zone of alarm
2. Horns pulse fast in zone of alarm
3. 30 Second discharge time delay begins
4. dedicated relay energizes for ahu/damper shutdown

C. After completion of the time delay sequence, the following will happen:

1. Strobes continue in zone of alarm
2. Horns sound steady in zone of alarm
3. ECARO-25 agent is discharged in zone of alarm
4. Discharge strobe activates outside zone of alarm
5. Pre-action solenoid is energized

D. A loss of pressure in the clean agent storage cylinder will cause the following to happen:

1. Supervisory LED lights up at control panel
2. Supervisory relay energizes for building fire alarm monitoring

E. A trouble condition in the ECARO-25 system will cause the following to happen:

1. Trouble LED lights up at control panel
2. Trouble relay energizes for building fire alarm monitoring

3.6 TRAINING

A. Owner's personnel shall be fully briefed in the normal start-up of the system, the operation, normal and emergency shutdown, and maintenance of the equipment.

B. Routine maintenance, yearly maintenance and spring start-up shall be fully discussed and documented.

C. Names of those instructed and dates, as well as a list of information handed over to the owner, shall be included in the final report.

3.7 TESTING

A. After the installation is complete, the system shall be inspected by factory trained personnel in accordance with the manufacturer's recommended procedures.

B. All wiring shall be tested for proper connection, continuity, and resistance to ground.

C. The complete system shall be tested by the contractor in the presence of the Owner and the Engineer, and all functions including system and equipment interlocks must be operational.

D. Contractor shall provide all necessary labor, apparatus, and instrumentation for the test.

E. A test evaluation team consisting of Engineer's, contractor, distributor, and insurance representative shall meet before the test to establish ground rules and the method of conducting the test in accordance with this specification and manufacturer's recommendations.
F. ECARO-25 Design and Test Summary, shall be prepared for the acceptance test and completed upon successful test.

G. The hazards shall be tested for room integrity by use of a fan pressurization unit. The test shall be performed as described in NFPA 2001. Twelve, (12) hours of testing shall be included. These tests shall be recorded and distributed in a test result format. Should these tests fail, the Fire Protection Contractor shall help determine the cause so the General Contractor may address it.

H. Testing shall be performed prior to computer equipment installation.

I. Bid shall include all applicable taxes, permits, and fees.

J. At a minimum, one two-hour educational seminar shall be given to the owner at his direction.

K. The Clean Agent System contractor shall be responsible for testing all interconnect and shut down wiring for the following equipment: V.A.V. boxes, self-contained H.V.A.C. units, building H.V.A.C. system, building Fire Alarm system, power distributing unit(s) and dampers etc.

3.8 CONTRACTOR QUALIFICATIONS

A. The Clean Agent contractor’s bid shall include the name of the person providing the proposal, and the designer who will “stamp” the drawings. These persons SHALL be a minimum of a N.I.C.E.T. level 3 in Special Hazards, with a State of Texas Planners License.

B. The Clean Agent contractor’s bid shall employ a C.F.P.S. person. This person shall be “Certified in Fire Protection Systems” by the National Fire Protection Association.

3.9 WARRANTY

A. All FIKE system components furnished and installed under this contract, shall be guaranteed against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer, but no case less than one (1) year from the date of system acceptance.

END OF SECTION 21 22 00
SECTION 22 02 00 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted to the Architect for approval as soon as practicable. No such departures shall be made without the prior written approval of the Architect.

C. Notwithstanding any reference in the Specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, such reference shall not be construed as limiting competition; and the Contractor, in such cases, may at his option use any article, device, product, material, fixture, form or type of construction which in the judgment of the Architect, expressed in writing, is equal to that specified.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form the complete and functioning systems in all of its various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The contractor shall review all pertinent drawings, including those of other contracts prior to commencement of Work.

B. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Mechanical (HVAC) and Plumbing items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of
outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

E. All discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning heating, ventilating and air conditioning system shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. The Contractor shall participate in the commissioning process as required. Including, but not limited to meeting attendance, completion of checklists and participation in functional testing.

1.3 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the approved shop drawings.

B. All piping or equipment locations as indicated on the documents do not indicate every transition, offset, or exact location. All transitions, offsets clearances and exact locations shall be established by actual field measurements, coordination with the structural, architectural and reflected ceiling plans, and other trades. Submit shop drawings for approval.

C. All transitions, offsets and relocations as required by actual field conditions shall be performed by the contractor at no additional cost to the owner.

D. Additional coordination with electrical contractor may be required to allow adequate clearances of electrical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.4 SITE VISIT AND FAMILIARIZATION

A. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.
B. Understand the existing utilities from which services will be supplied; verify locations of utility services and determine requirements for connections.

C. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.5 WORK SPECIFIED IN OTHER SECTIONS

A. Finish painting is specified. Prime and protective painting are included in the work of this Division.

B. Owner and General Contractor furnished equipment shall be properly connected to Plumbing systems.

C. Furnishing and installing all required Plumbing equipment control relays and electrical interlock devices, conduit, wire and J-boxes are included in the Work of this Division.

1.6 PERMITS, TESTS, INSPECTIONS

A. Arrange and pay for all permits, fees, tests, and all inspections as required by governmental authorities.

1.7 DATE OF FINAL ACCEPTANCE

A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division 01 for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the architect, owner and contractor.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or valves properly protected from incidental damage and weather damage.

C. Damaged equipment, valves or pipe shall be promptly removed from the site and new, undamaged equipment, pipe and valves shall be installed in its place promptly with no additional charge to the Owner.

1.9 NOISE AND VIBRATION

A. The pumping systems and the component parts thereof, shall be guaranteed to operate without objectionable noise and vibration.

B. Provide foundations, supports and isolators as specified or indicated, properly adjusted to prevent transmission of vibration to the Building structure, piping and other items.

C. Carefully fabricate pipe and fittings with smooth interior finish to prevent turbulence and generation or regeneration of noise.

D. All equipment shall be selected to operate with minimum of noise and vibration. If, in the opinion of the Architect, objectionable noise or vibration is produced or transmitted to or
through the building structure by equipment, piping or other parts of the Work, the Contractor shall rectify such conditions without extra cost to the Owner.

1.10 APPLICABLE CODES

A. Obtain all required permits and inspections for all work required by the Contract Documents and pay all required fees in connection thereof.

B. Arrange with the serving utility companies for the connection of all required utilities and pay all charges, meter charges, connection fees and inspection fees, if required.

C. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations and the applicable requirements of the following nationally accepted codes and standards:

1. American Society of Plumbing Engineers, ASPE.

2. American Standards Association, ASA.


4. American Society of Mechanical Engineers, ASME.

5. American Society of Plumbing Engineers, ASPE.

6. American Society of Testing Materials, ASTM.

7. American Water Works Association, AWWA.

8. National Fire Protection Association, NFPA.

9. Underwriters' Laboratories, Inc., UL.

10. International Energy Conservation Code, IECC.

D. Where differences existing between the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, the more stringent or costly application shall govern. Promptly notify the Engineer in writing of all differences.
E. When directed in writing by the Engineer, remove all work installed that does not comply with the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, correct the deficiencies, and complete the work at no additional cost to the Owner.

1.11 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 01.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.
I. Installer: Entity person or firm engaged by the Contractor or its subcontractor or Sub-contractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances) or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by 2009 ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.12 DRAWINGS AND SPECIFICATIONS

A. These Specifications are intended to supplement the Drawings and it will not be the province of the Specifications to mention any part of the work which the Drawings are competent to fully explain in every particular and such omission is not to relieve the Contractor from carrying out portions indicated on the Drawings only.

B. Should items be required by these Specifications and not indicated on the Drawings, they are to be supplied even if of such nature that they could have been indicated thereon. In case of disagreement between Drawings and Specifications, or within either Drawings or Specifications, the better quality or greater quantity of work shall be estimated, and the matter referred to the Architect or Engineer for review with a request for information and clarification at least 7 working days prior to bid opening date for issuance of an addendum.

C. The listing of product manufacturers, materials and methods in the various sections of the Specifications, and indicated on the Drawings, is intended to establish a standard of quality only. It is not the intention of the Owner or Engineer to discriminate against any product, material or method that is equal to the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturers' standard product will meet the requirements of the project design, Drawings, Specifications and space constraints.
D. The Architect or Engineer and Owner shall be the sole judge of quality and equivalence of equipment, materials and methods.

E. Products by other reliable manufacturers, other materials, and other methods, will be accepted as outlined, provided they have equal capacity, construction, and performance. However, under no circumstances shall any substitution by made without the written permission of the Architect or Engineer and Owner. Request for prior approval must be made in writing 10 days prior to the bid date without fail.

F. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method is the only one that shall be used without prior approval.

G. Wherever a definite material or manufacturer's product is specified and the Specification states that products of similar design and equal construction from the specified list of manufacturers may be substituted, it is the intention of the Owner or Engineer that products of manufacturers that are specified are the only products that will be acceptable and that products of other manufacturers will not be considered for substitution without approval.

H. Wherever a definite product, material or method is specified and there is a statement that "OR EQUAL" product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method or an "OR EQUAL" product, material or method may be used if it complies with the specifications and is submitted for review to the Engineer as outlined herein.

I. Where permission to use substituted or alternative equipment on the project is granted by the Owner or Engineer in writing, it shall be the responsibility of the Contractor or Subcontractor involved to verify that the equipment will fit in the space available which includes allowances for all required Code and maintenance clearances, and to coordinate all equipment structural support, plumbing and electrical requirements and provisions with the Mechanical and Plumbing Design Documents and all other trades, including Division 26.

J. Changes in architectural, structural, electrical, mechanical, and plumbing requirements for the substitution shall be the responsibility of the bidder wishing to make the substitution. This shall include the cost of redesign by the affected designer(s). Any additional cost incurred by affected subcontractors shall be the responsibility of this bidder and not the owner.

K. If any request for a substitution of product, material or method is rejected, the Contractor will automatically be required to furnish the product, material or method named in the Specifications. Repetitive requests for substitutions will not be considered.

L. The Owner or Engineer will investigate all requests for substitutions when submitted in accordance with above and if accepted, will issue a letter allowing the substitutions.

M. Where equipment other than that used in the design as specified or shown on the Drawings is substituted (either from an approved manufacturers list or by submittal review), it shall be the responsibility of the substituting Contractor to coordinate space requirements, building provisions and connection requirements with his trades and all other trades and pay all additional costs to other trades, the Owner, the Architect or Engineer, if any, due to the substitutions.
A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty-day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

1. A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.

2. An index page with a listing of all data included in the Submittal.

3. A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.

4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.

5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.

6. Identification of each item of material or equipment matching that indicated on the Drawings.

7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.

8. Additional information as required in other Sections of this Division.

9. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 01 for additional information on shop drawings and submittals.

C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted
can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

1. REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.

2. REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.

3. NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not approved, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.
4. **REVISE AND RESUBMIT:** Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.

5. **CONTRACTOR’S CERTIFICATION REQUIRED:** Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor’s stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.

6. **MANUFACTURER NOT AS SPECIFIED:** Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. **Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.**

H. **Submittals are required for, but not limited to, the following items:**

1. Basic Materials.
2. Plumbing Fixture and Valves.
3. Support and Couriers.
4. Floor Drain, Roof Drain and Cleanouts.
5. Water Heaters
7. Plumbing Piping.
8. Expansion Compensation.
12. Plumbing Specialties.

13. Water Filters.

14. Test, Adjust and Balance Reports.

15. Testing, Adjusting and Balancing Contractor Qualifications.

16. Coordination Drawings.

I. Refer to Division 26 sections for additional shop drawing requirements. Provide samples of actual materials and/or equipment to be used on the Project upon request of the Owner or Engineer.

1.4 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, equipment, and other materials. Include the following:
   a. Wall and type locations.
   b. Clearances for installing and maintaining insulation.
   c. Locations of light fixtures and sprinkler heads.
   d. Clearances for servicing and maintaining equipment, including tube removal and space for equipment disassembly required for periodic maintenance.
   e. Equipment connections and support details.
   f. Exterior wall and foundation penetrations.
   g. Routing of storm, sanitary sewer piping and plumbing piping.
   h. Fire-rated wall and floor penetrations.
   i. Sizes and location of required concrete pads and bases.
   j. Valve stem movement.
   k. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Special Project Requirements, in addition to the requirements specified in Division 23, indicate the following installed conditions:

1. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.

2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.


B. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.

C. The Contractor shall maintain a set of clearly marked black line record "AS-BUILT" prints on the job site on which he shall mark all work details, alterations to meet site conditions and changes made by "Change Order" notices. These shall be kept available for inspection by the Owner, Architect or Engineer at all times.

D. Refer to Division 01 for additional requirements concerning record drawings. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect. Mark the drawings with a colored pencil. Delivery of as-built prints and reproducibles is a condition of final acceptance.

E. The record prints shall be updated on a daily basis and shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents which are required for coordination. All dimensions shall include at least two dimensions to permanent structure points.
F. Submit three prints of the tracings for approval. Make corrections to tracings as directed and delivered "Auto Positive Tracings" to the architect. "As-Built" drawings shall be furnished in addition to shop drawings.

G. When the option described in paragraph F., above is not exercised then upon completion of the work, the Contractor shall transfer all marks from the submit a set of clear concise set of reproducible record "AS-BUILT" drawings and shall submit the reproducible drawings with corrections made by a competent draftsman and three (3) sets of black line prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The reproducible record "AS-BUILT" drawings shall have the Engineers Name and Seal removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS

DATE:

(NAME OF GENERAL CONTRACTOR)

BY: ______________________________
(SIGNATURE)

(NAME OF SUBCONTRACTOR)

BY: ______________________________
(SIGNATURE)

1.16 OPERATING MANUALS

A. Prepare maintenance manuals in accordance with Division 01 and in addition to the requirements specified in Division 01, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.
1.17 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 22.

1.18 MAINTENANCE MANUALS

A. Coordinate with Division 01 for maintenance manual requirements, unless noted otherwise bind together in “D ring type” binders by National model no. 79-883 or equal, binders shall be large enough to allow ¼” of spare capacity. Three (3) sets of all approved shop drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and labeled for easy reference and shall utilize the individual specification section numbers shown in the Plumbing Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 22 shall be clearly and legibly set forth in memorandum that shall, likewise, be bound with bulletins.

B. Prepare maintenance manuals in accordance with Special Project Conditions, in addition to the requirements specified in Division 22, include the following information for equipment items:

1. Identifying names, name tags designations and locations for all equipment.

2. Valve tag lists with valve number, type, color coding, location and function.

3. Reviewed shop drawing submittals with exceptions noted compliance letter.

4. Fabrication drawings.

5. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.

6. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

7. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.
8. Equipment and motor name plate data.


10. Exploded parts views and parts lists for all equipment and devices.

11. Color coding charts for all painted equipment and conduit.

12. Location and listing of all spare parts and special keys and tools furnished to the Owner.

13. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

C. Refer to Division 1 for additional information on Operating and Maintenance Manuals.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer a minimum of 14 working days prior to the beginning of the operator training period.

1.19 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include 12 hours of on-site training in three 4-hour shifts.

B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

C. Refer to other Division 22 Sections for additional Operator Training requirements.

1.20 FINAL COMPLETION

A. At the completion of the work, all equipment and systems shall be tested and faulty equipment and material shall be repaired or replaced. Refer to Sections of Division 26 for additional requirements.

B. Clean and adjust all valves and operational devices and replace faulty parts immediately prior to final acceptance.

C. Touch up and/or refinish all scratched equipment and devices immediately prior to final acceptance.

1.21 CONTRACTOR'S GUARANTEE

A. Use of the Plumbing systems to provide temporary service during construction period will not be allowed without permission from the Owner in writing and if granted shall not be cause warranty period to start, except as defined below.

B. Contractor shall guarantee to keep the entire installation in repair and perfect working order for a period of one year after its completion and final acceptance and shall furnish free of additional cost to the Owner all materials and labor necessary to comply with the above guarantee throughout the year beginning from the date of issue of Substantial Completion, Beneficial Occupancy by the Owner or the Certificate of Final Payment as agreed upon by all parties.
C. This guarantee shall not include cleaning or changing equipment except as required by testing, adjusting and balancing.

D. All air compressors shall have parts and labor guarantees for a period of not less than 5 years beyond the date of final acceptance.

E. Refer to Sections in Division 22 for additional guarantee or warranty requirements.

1.22 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner’s risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney’s fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data’s creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long-term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be Contractor’s sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect’s written consent.

It is agreed that “MEP” hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The contract documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.

If the client, Architect/Owner, or developer of the project requires electronic media for “record purposes”, then an AutoCAD based compact disc (“CD”) will be prepared. The “CD” will be submitted with all title block references intact and will be formatted in a “plot” format to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

F. At the Architect/Owner’s request, Engineer will prepare one “CD” of electronic media to assist the contractor in the preparation of submittals. The Engineer will prepare and submit the “CD” to the Architect/Owner for distribution to the contractor. All copies of the “CD” will be reproduced for a cost of reproduction fee of Five Hundred Dollars ($500.00) per “CD”. The “CD” will be prepared and all title blocks, names and dates will be removed. The “CD” will be prepared in a “.dwg” format to permit the end user to revise the drawings.
G. This Five Hundred Dollars ($500.00) per “CD” cost of reproduction will be paid directly from the Contractor to the Engineer. The “CD” will be prepared only after receipt of the Five Hundred Dollars ($500.00). The Five Hundred Dollars ($500.00) per “CD” cost of reproduction is to only recover the cost of the man-hours necessary to reproduce the documents. It is not a contractual agreement between the Contractor and Engineer to provide any engineering services, nor any other service.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide materials and equipment manufactured by a domestic United States manufacturer.

B. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts and other apparatus where concealed. Access doors shall have concealed hinges and screw driver cam locks.

C. All access panels located in wet areas such as restrooms, locker rooms, shower rooms, kitchen and any other wet areas shall be constructed of stainless steel.

D. Access Doors: shall be as follows:

1. Plastic Surfaces: Milcor Style K.

2. Ceramic Tile Surface: Milcor Style M.

3. Drywall Surfaces: Milcor Style DW.

4. Install panels only in locations approved by the Architect.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected via reviewed submittals.

B. Refer to equipment specifications in Divisions 21 through 22 for additional rough-in requirements.

3.2 PLUMBING INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of plumbing and fire systems, materials, and equipment. Comply with the following requirements:

1. Coordinate plumbing systems, equipment, and materials installation with other building components.

2. Verify all dimensions by field measurements.

3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for plumbing installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

7. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

8. Install systems, materials, and equipment to conform with architectural action markings on submittal, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, resolve conflicts and route proposed solution to the Architect for review.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location and label.

11. Install access panel or doors where valves and equipment are concealed behind finished surfaces. Access panels and doors are specified.

12. Contractor shall coordinate with Architect all access panel sizes and locations.

13. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.


15. The equipment to be furnished under this Specification shall be essentially the standard product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the product of the same manufacturer.

16. The architectural and structural features of the building and the space limitations shall be considered in selection of all equipment. No equipment shall be furnished which will not suit the arrangement and space limitations indicated.

17. Lubrication: Prior to start-up, check and properly lubricate all bearings as recommended by the manufacturer.
18. Where the word "Concealed" is used in these Specifications in connection with insulating, painting, piping, ducts, etc., it shall be understood to mean hidden from sight as in chases, furred spaces or suspended ceilings. "Exposed" shall be understood to mean the opposite of concealed.

19. Identification of Plumbing Equipment:
   a. Plumbing equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic or etched metal. Shop drawings shall include dimensions and lettering format for approval. Attachments shall be with escutcheon pins, self-tapping screws, or machine screws.
   b. Tags shall be attached to all valves, including control valves, with nonferrous chain. Tags shall be brass and at least 1-1/2 inches in diameter. Nameplate and tag symbols shall correspond to the identification symbols on the temperature control submittal and the "as-built" drawings.

3.3 CUTTING AND PATCHING

   A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
B. Perform cutting, fitting, and patching of plumbing equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer/Owner's observation of concealed Work, without additional cost to the Owner.
7. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers; refer to the materials and methods required for the surface and building components being patched; Refer to Section "DEFINITIONS" for definition of "Installer."

C. Cut, remove and legally dispose of selected plumbing equipment, components, and materials as indicated, including but not limited to removal of plumbing piping, equipment, plumbing fixtures and trim, and other plumbing items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.4 WORK SEQUENCE, TIMING, COORDINATION WITH OWNER

A. The Owner will cooperate with the Contractor; however, the following provisions must be observed:

1. A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Sub-Contractors and the Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.
2. During the construction of this project, normal facility activities will continue in existing buildings until renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.

END OF SECTION 22 02 00
SECTION 22 02 01 - COORDINATION DRAWINGS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions 013100 and Supplementary Conditions apply to all Work herein.

1.2 COORDINATION DRAWINGS

A. The Mechanical Contractor shall take the lead in coordinating the Mechanical, Electrical, Plumbing, and Fire Protection systems within the building.

B. The Mechanical Contractor shall coordinate a three-dimensional (3D) model of the building which includes the Mechanical, Electrical, Plumbing, and Fire Protection systems. The Electrical, Plumbing, and Fire Protection Contractors shall prepare their work and generate 3D models which will be given to the Mechanical Contractor for coordination. The Contractor will be provided with the REVIT model that was used to generate the contract documents, this file may be used as the background file. The Contractor shall replace the systems drawn with the actual shop drawing models. The Contractor is not limited to using REVIT but may use any 3-D software in generating and combining the coordination model.

C. Submitting the contract drawings as coordination drawings will not be acceptable.

D. The model shall include detailed and accurate representations of all equipment to be installed based upon the reviewed equipment submittals.

E. The Mechanical Contractor shall hold a 3-D coordination meeting with all sub-contractors present to review the model and discuss coordination of the installation of the building systems.

F. Upon completion of the coordination meeting, the Contractor shall submit the 3-D model and ¼” scale drawings for review.

G. The model shall detail major elements, components, and systems in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

   1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:
      a. Wall and type locations.
      b. Clearances for installing and maintaining insulation.
      c. Locations of light fixtures and sprinkler heads.
d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.

e. Equipment connections and support details.

f. Exterior wall and foundation penetrations.

g. Routing of storm and sanitary sewer piping.

h. Fire-rated wall and floor penetrations.

i. Sizes and location of required concrete pads and bases.

j. Valve stem movement.

k. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

H. Sequence of Coordination

Below is hierarchy of model elements and the sequencing by which the models will be coordinated.

1. Structural and Architectural model

2. Miscellaneous steel

3. Perform preliminary space allocation

4. Identify hard constraints (locations of access panels, lights, A/V space requirements, etc.)

5. Main and medium pressure ducts from the shaft out

6. Main graded plumbing lines and vents

7. Sprinkler mains and branches

8. Cold and hot water mains and branches

9. Lighting fixtures and plumbing fixtures

10. Smaller sized ducts and flex ducts

11. Smaller size cold water and hot water piping, flex ducts, etc.
I. The Contractor and Sub-Contractors shall not install any item until the coordination has been completed and reviewed by the Construction Manager, Owner, and A/E team.

J. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

K. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

END OF SECTION 22 02 01
SECTION 22 05 13 – COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

B. WORK SPECIFIED ELSEWHERE:

1. Painting

2. Power control wiring to motors and equipment.

1.3 WARRANTY

Warrant the Work specified herein for one year and motors for five years beginning on the date of substantial completion against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

1.4 SUBMITTALS

A. SHOP DRAWINGS: Indicate size material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures variations, and accessories.

C. MOTOR NAMEPLATE INFORMATION: Manufacturer's name, address, utility and operating data.

D. Refer to Division One for additional information.

1.5 DELIVERY AND STORAGE

A. DELIVERY: Deliver clearly labeled, undamaged materials in the manufacturers' unopened containers.

B. TIME AND COORDINATION: Deliver materials to allow for minimum storage time at the project site. Coordinate delivery with the scheduled time of installation.

C. STORAGE: Store materials in a clean, dry location, protected from weather and abuse.
PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

A. APPROVED MANUFACTURERS: Provide motors by a single manufacturer as much as possible.
   1. Baldor
   2. Marathon
   3. Siemens-Allis
   4. General Electric
   5. U.S. Motor

B. TEMPERATURE RATING: Provide insulation as follows:
   1. CLASS B: 40 degrees C maximum.
   2. CLASS F:
      a. Between 40 degrees C and 65 degrees C maximum.
      b. Totally enclosed motors.

C. STARTING CAPABILITY: As required for service indicated five starts minimum per hour.

D. PHASES AND CURRENT: Verify electrical service compatibility with motors to be used.
   1. UP TO 1/2 HP: Provide permanent split, capacitor-start single phase with inherent
      overload protection.
   2. 3/4 HP AND LARGER: Provide squirrel-cage induction polyphone.
   3. Provide two separate windings on 2-speed polyphone motors.
   4. Name plate voltage shall be the same as the circuit's normal voltage, serving the
      motor.

E. SERVICE FACTOR: 1.15 for polyphase; 1.35 for single phase.

F. FRAMES: U-frames 1.5 hp. and larger.

G. BEARINGS: Provide sealed re-greasable ball bearings; with top mounted zerc lubrication fittings
   and bottom side drains minimum average life 100,000 hours typically, and others as follows:
   1. Design for thrust where applicable.
   2. PERMANENTLY SEALED: Where not accessible for greasing.
   3. SLEEVE-TYPE WITH OIL CUPS: Light duty fractional hp. motors or polyphase
requiring minimum noise level.

H. ENCLOSURE TYPE: Provide enclosures as follows:
   1. CONCEALED INDOOR: Open drip proof.
   2. EXPOSED INDOOR: Guarded.
   3. OUTDOOR TYPICAL: Type II. TEC.
   4. OUTDOOR WEATHER PROTECTED: Type I. TEA.

I. OVERLOAD PROTECTION: Built-in sensing device for stopping motor in all phase legs and signaling where indicated for fractional horse power motors.

J. NOISE RATING: "Quiet" except where otherwise indicated.

K. EFFICIENCY: Minimum full load efficiency listed in the following table, when tested in accordance with IEEE Test Procedure 112A, Method B, including stray load loss measure.

<table>
<thead>
<tr>
<th>NEMA Efficiency</th>
<th>INDEX Letter</th>
<th>Minimum Efficiency %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Horsepower</td>
<td>1800 RPM Synchronous Speed</td>
<td></td>
</tr>
<tr>
<td>7.5-10</td>
<td>F</td>
<td>89.5</td>
</tr>
<tr>
<td>15-20</td>
<td>E</td>
<td>91.0</td>
</tr>
<tr>
<td>25-30</td>
<td>E</td>
<td>92.4</td>
</tr>
<tr>
<td>40</td>
<td>D</td>
<td>93.0</td>
</tr>
<tr>
<td>50</td>
<td>C</td>
<td>93.0</td>
</tr>
<tr>
<td>60</td>
<td>C</td>
<td>93.6</td>
</tr>
<tr>
<td>75</td>
<td>C</td>
<td>94.1</td>
</tr>
<tr>
<td>100-125</td>
<td>B</td>
<td>94.5</td>
</tr>
<tr>
<td>150-200</td>
<td>B</td>
<td>95.0</td>
</tr>
<tr>
<td>1200 RPM Synchronous Speed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-5</td>
<td>G</td>
<td>87.5</td>
</tr>
<tr>
<td>7.5</td>
<td>G</td>
<td>89.5</td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>89.5</td>
</tr>
<tr>
<td>15</td>
<td>F</td>
<td>90.2</td>
</tr>
<tr>
<td>20</td>
<td>E</td>
<td>90.2</td>
</tr>
<tr>
<td>25-30</td>
<td>E</td>
<td>91.7</td>
</tr>
<tr>
<td>40-50</td>
<td>D</td>
<td>93.0</td>
</tr>
<tr>
<td>60</td>
<td>D</td>
<td>93.6</td>
</tr>
<tr>
<td>75</td>
<td>C</td>
<td>93.6</td>
</tr>
<tr>
<td>100-125</td>
<td>C</td>
<td>94.1</td>
</tr>
<tr>
<td>150-200</td>
<td>B</td>
<td>95.0</td>
</tr>
</tbody>
</table>

2.2 MOTOR CONTROLLERS (STARTERS)
   
   A. All motor controllers (for equipment furnished under Division 22) shall be furnished under Division 22 and installed under Division 26 unless otherwise noted on the plans.
   
   1. Starters shall be provided for 3 phase motors 3/4 horsepower and greater.
B. Motor starters shall be furnished as follows.

1. GENERAL: Motor starters shall be Square D Company Class 8536 across-the-line magnetic type, full-voltage, non-reversing (FAVOR) starter. All starters shall be constructed and tested in accordance with the latest NEMA standards, sizes and horsepower. ICE sizes are not acceptable. Starters shall be mounted in a general-purpose dead front, painted steel enclosure and surface-mounted. Provide size and number of poles as shown and required by equipment served. Provide two speed, two winding or two speed, single winding motor starter as required for two speed motors.

2. CONTACTS: Magnetic starter contacts shall be double break solid silver alloy. All contacts shall be replaceable without removing power wiring or removing starter from panel. The starter shall have straight-through wiring.

3. OPERATING COILS: Operating coils shall be 120 volts and shall be of molded construction. When the coil fails, the starter shall open and shall not lock in the closed position.

4. OVERLOAD RELAYS: Provide manual reset, trip-free Class 20 overload relays in each phase conductor in of all starters. Overload relays shall be melting alloy type with visual trip indication. All 3 phase and single-phase starters shall have one overload relay in each underground conductor. Relay shall not be field adjustable from manual to automatic reset. Provide 6 overload relays for two speed motor starters.

5. PILOT LIGHTS: Provide a red running pilot light for all motor starters. Pilot lights shall be mounted in the starter enclosure cover. Pilot lights shall be operated from an interlock on the motor starter and shall not be wired across the operating coil.

6. CONTROLS: Provide starters with HAND-OFF-AUTOMATIC switches. Coordinate additional motor starter controls with the requirements of Division 22. Motor starter controls shall be mounted in the starter enclosure cover.

7. CONTROL POWER TRANSFORMER: Provide a single-phase 480-volt control power transformer with each starter for 120-volt control power. Connect the primary side to the line side of the motor starter. The primary side shall be protected by a fuse for each conductor. The secondary side shall have one leg fused and one leg grounded. Arrange transformer terminals so that wiring to terminals will not be located above the transformer.

8. AUXILIARY CONTACTS: Each starter shall have one normally open and one normally closed convertible auxiliary contact in addition to the number of contacts
required for the "holding interlock", remote monitoring, and control wiring. In addition, it shall be possible to field-install three more additional auxiliary contacts without removing existing wiring or removing the starter from its enclosure.

9. UNIT WIRING: Unit shall be completely pre-wired to terminals to eliminate any interior field wiring except for line and load power wiring and HVAC control wiring.

10. ENCLOSURES: All motor starter enclosures shall be NEMA 1, general purpose enclosures or NEMA-3R if mounted exposed to high moisture conditions. Provide NEMA 4X when located by cooling towers.

11. POWER MONITOR: Provide a square "D" 8430 MPS phase failure and under-voltage relay, base and wiring required for starters serving all 3 phase motors. Set the under-voltage setting according to minimum voltage required for the motor to operate within its range.

C. APPROVED MANUFACTURERS: Controller numbers are based on first named manufacturer. Provide one of the following manufacturer's.

1. Siemens.
2. Square D.
4. Eaton.

2.3 COMBINATION MOTOR STARTERS

A. GENERAL: Combination motor starters shall consist of a magnetic starter and a fusible or non-fusible disconnect switch in a dead front, painted steel NEMA 1 enclosure unless otherwise noted and shall be surface-mounted. Size and number of poles shall as shown and required by equipment served. Combination motor starters shall be as specified for motor starters in Paragraph 2.01/B, except as modified herein.

B. DISCONNECT SWITCH: Disconnect switches shall be as specified in Division 26.

C. APPROVED MANUFACTURERS: Controller numbers are based on first named manufacturer. Provide one of the following manufacturer's.

1. Siemens.
2. Square D.

PART 3 - EXECUTION

3.1 All equipment shall be installed in accordance with the manufacturers’ recommendations and printed installation instructions.
3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Contractors’ price shall include all items required as per manufacturers’ requirements.

3.3 INSTALLATION

A. GENERAL: Install in a professional manner. Any part or parts not meeting this requirement shall be replaced or rebuilt without extra expense to Owner.

B. Install rotating equipment in static and dynamic balance.

C. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building.

D. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.
SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Flexible pipe connections.
B. Expansion joints and compensators
C. Pipe loops, offsets, and swing joints.

1.2 RELATED WORK

A. Section 22 05 29 – Hangers and Support for Plumbing Piping and Equipment.
B. Section 22 10 00 – Plumbing Piping.

1.3 PERFORMANCE REQUIREMENTS

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.
B. Expansion Calculations:
   1. Installation Temperature: 50 degrees F (10 degrees C).
   3. Domestic Hot Water: 140 degrees F (60 degrees C).
   4. Safety Factor: 30 percent.
C. Pipe sizes indicated are to establish a minimum quality of compensator. Refer to manufacturers’ literature for model series for different pipe sizes.

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Division One.
B. Product Data:
   1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
C. Design Data: Indicate selection calculations.
D. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

1.5 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Division One.
B. Record actual locations of flexible pipe connectors, expansion joints, anchor, and guides.

1.6 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Division One.
B. Maintenance Data: Include adjustment instructions.

1.7 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
B. Design expansion compensation system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the state where the project is located.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, project and handle products to site under provisions of Division One.
B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.9 WARRANTY
A. Provide five-year warranty under provisions of Division One.
B. Warranty: Include coverage for leak free performance of packed expansion joints.

1.10 EXTRA MATERIALS
A. Furnish under provisions of Division One.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS
A. Steel Piping (Based on 2" Pipe):
   1. Manufacturers:
      a. Amber/Booth Metal-Flex, Model Type SS-PM or FW
      b. Triplex, Model Flexonics Series 400M
      c. Mercer Rubber Company, Model BSS-EM (Mason Industries)
2. Inner Hose: Type 321, stainless steel, corrugated metal.


4. Pressure Rating: 350 psig WOG and 70 degrees F. For 4-inch pipe - 200 psig WOG and 70 degrees F.

5. Joint: Schedule 40 steel, threaded with male nipple and hex boss each end and Union. Flanged joints for pipe sizes 2½ inch and larger.


7. Maximum offset: 1/2 inch on each side of installed center line.

8. Application: Air handling units cooling and heating coils.

B. Copper Piping (Based on 2" Pipe):

1. Manufacturers:
   a. Amber/Booth Metal-Flex, Model Type BR-SM
   b. Triplex, Model Flexonics Series 300
   c. Mercer Rubber Company, Type BFF (Mason Industries)

2. Inner Hose: Corrugated Bronze


4. Pressure Rating: 250 psig WOG and 70 degrees F.

5. Joint: Threaded with male nipple and hex boss each end with Union. Flanged joints for pipe sizes 2½ inch and larger.


7. Maximum offset: 1/2 inch on each side of installed center line.

8. Application: Air handling units cooling and heating coils.

2.2 EXPANSION JOINTS

A. Bellows Type (Based on 4" Pipe):

1. Manufacturers:
   a. Amber/Booth, Style EB
   b. Triplex, Model Resistoflex R6905
   c. Mercer Rubber Company, Style 803 or 805 (Mason Industries)

2. Body: Monel wire reinforced molded TFE teflon bellows, multiple arch.

3. Pressure Rating: 70 psig WSP and 250 degrees F (66 degrees C).

4. Maximum Compression: 1 inch.
5. Maximum Extension: 1 inch.


8. Size: Use pipe sized units.

9. Accessories: Control rod limit bolts.

10. Application: Steel piping 8 inch and under.

2.3 ACCESSORIES

A. Pipe Alignment Guides to Direct Axial Movement:

1. Manufacturers:
   a. Triplex, Model Flexonics
   b. Metraflex, Style II

2. Two-piece welded steel with shop paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Construct spool pieces to exact size of flexible connection for future insertion.

C. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provided line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E. Provide miscellaneous metals to rigidly anchor pipe to building structure. Provide pipe guides so that movement takes place along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Division One.
B. Provide inspection services by flexible pipe manufacturer's representative for final installing and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION 22 05 16
SECTION 22 05 29 – HANGERS AND SUPPORT FOR PLUMBING PIPING AND EQUIPMENT

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 RELATED WORK
   A. Section 22 05 29 – Hangers and Support for Plumbing Piping and Equipment.
   B. Section 22 07 19 – Plumbing Piping Insulation.
   C. Section 22 07 16 – Plumbing Equipment Insulation.
   D. Section 21 13 13 - Fire Protection and 21 13 13 Wet Pipe Sprinkler System.
   E. Section 22 10 00 - Plumbing System.

1.3 REFERENCES

1.4 QUALITY ASSURANCE
   A. Supports for Sprinkler Piping: In conformance with NFPA 13.

1.5 SUBMITTALS
   A. Submit shop drawings and product data under provisions of Division One.
   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 22 07 19 -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” hold rite 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. Fire Stopping Insulation: Glass fiber type, non-combustible, U.L. listed.

E. Caulk: Paintable 25-year acrylic sealant.

F. 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 SUPPORTS

A. Provide supports for suspending hangers from beams or bar joist. Coordinate with structural engineer for placement of supports.

3.2 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as follows:
POLICE HEADQUARTERS

HANGERS AND SUPPORT FOR PLUMBING PIPING AND EQUIPMENT

<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>
</tr>
<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>
<tr>
<td>(Cast Iron)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 to 3 inch</td>
<td>5'-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>7/8&quot;</td>
</tr>
<tr>
<td></td>
<td>5/8&quot;</td>
<td></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>(PVC Pipe)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-1/2 to 4 inch</td>
<td>4'-0&quot;</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>6 to 8 inch</td>
<td>4'-0&quot;</td>
<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.

3.3 Insulated Piping: Comply with the following installation requirements.

A. Clamps: Attach galvanized clamps, including spacers (if any), to piping with clamps.
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 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 14</td>
<td>24</td>
<td>0.075</td>
</tr>
<tr>
<td>16 THROUGH 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 air tight. 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 22 05 29
SECTION 22 05 48 – VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED
A. Vibration and sound control products.

1.2 RELATED DOCUMENTS
A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division One specification sections, apply to work of this section
B. This section is Division-22 Basic Materials and Methods section and is part of each Division-22 section making reference to vibration control products specified herein.

1.3 QUALITY ASSURANCE
A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of vibration control products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.
B. Vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.
C. Except as otherwise indicated, sound and vibration control products shall be provided by a single manufacturer.

1.4 SUBMITTALS
A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.
B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Amber/Booth Company, Inc.
B. Mason Industries, Inc.
C. Noise Control, Inc.

2.2 GENERAL
A. Provide vibration isolation supports for equipment, piping and ductwork, to prevent transmission of vibration and noise to the building structures that may cause discomfort to the occupants.
B. Model numbers of Amber/Booth products are included for identification. Products of the additional manufacturers will be acceptable provided they comply with all of the requirements of this specification.

2.3 BASE MOUNTED PUMPS

A. Amber/Booth type SP-NR style E flexplate pad isolators consisting of two layers of 3/8” thick alternate ribbed neoprene pad bonded to a 16-gage galvanized steel separator plate.

B. Pads shall be sized for approximately 40 PSI loading and 1/8” deflection.

2.4 PIPING

A. Furnish line size flexible connectors at supply and return of pumps, amber/booth style 2800 single sphere EPDM construction, connector shall include 150 lb. cadmium plated carbon steel floating flanges.

2.5 CORROSION PROTECTION

A. All vibration isolators shall be designed and treated for resistance to corrosion.

B. Steel components: PVC coated or phosphated and painted with industrial grade enamel. Nuts, bolts, and washers: zinc-electroplated.

PART 3 - EXECUTION

3.1 All equipment shall be installed in accordance with the manufacturers recommendations and printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturers requirements.

3.3 The vibration isolation supplier shall certify in writing that he has inspected the installation and that all external isolation materials and devices are installed correctly and functioning properly.

END OF SECTION 22 05 48
SECTION 22 05 53 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

1.3 Refer to Architectural Sections for additional requirements.

PART 2 - PRODUCTS

2.1 VALVE AND PIPE IDENTIFICATION

A. Valves:

1. All valves shall be identified with a 1-1/2" diameter brass disc wired onto the handle. The disc shall be stamped with 1/2" high depressed black filled identifying numbers. These numbers shall be numerically sequenced for all valves on the job.

2. The number and description indicating make, size, model number and service of each valve shall be listed in proper operational sequence, properly typewritten. Three copies to be turned over to Owner at completion.

3. Tags shall be fastened with approved meter seal and 4 ply 0.018 smooth copper wire. Tags and fastenings shall be manufactured by the Seton Name Plate Company or approved equal.

4. All valves shall be numbered serially with all valves of any one system and/or trade grouped together.

B. Pipe Marking:

1. All interior visible piping located in accessible spaces such as above accessible ceilings, equipment rooms, attic space, under floor spaces, etc., shall be identified with all temperature pipe markers as manufactured by W.H. Brady Company, 431 West Rock Ave., New Haven, Connecticut, or approved equal.

2. All exterior visible piping shall be identified with UV and acid resistant outdoor grade acrylic plastic markers as manufactured by Set Mark distributed by Seton nameplate company. Factory location 20 Thompson Road, Branford, Connecticut, or approved equal.

3. Generally, markers shall be located on each side of each partition, on each side of each tee, on each side of each valve and/or valve group, on each side of each piece of equipment, and, for straight runs, at equally spaced intervals not to exceed 75 feet. In congested area, marks shall be placed on each pipe at the points where it enters and leaves the area and at the point of
connection of each piece of equipment and automatic control valve. All markers shall have directional arrows.

4. Markers shall be installed after final painting of all piping and equipment and in such a manner that they are visible from the normal maintenance position. Manufacturer's installation instructions shall be closely followed.

5. Markers shall be colored as indicated below per ANSI/OSHA Standards:

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>COLOR</th>
<th>LEGEND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitary Sewer</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>Sanitary Sewer Vent</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>Storm Drain</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>domestic Water</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>Domestic Hot Water Supply</td>
<td>Yellow</td>
<td></td>
</tr>
<tr>
<td>Domestic Hot Water Supply</td>
<td>Domestic Hot</td>
<td></td>
</tr>
<tr>
<td>Domestic Hot Water Recirculating</td>
<td>Water Supply</td>
<td></td>
</tr>
<tr>
<td>Domestic Hot Water Supply</td>
<td>Yellow</td>
<td></td>
</tr>
<tr>
<td>Fire Protection</td>
<td>Red</td>
<td></td>
</tr>
<tr>
<td>Automatic</td>
<td>Red</td>
<td></td>
</tr>
<tr>
<td>Sprinkler</td>
<td>Sprinkler</td>
<td></td>
</tr>
</tbody>
</table>

C. Pipe Painting:

1. All piping exposed to view shall be painted as indicated or as directed by the Architect in the field. Confirm all color selections with Architect prior to installation.

2. The entire fire protection piping system shall be painted red.

3. All piping located in mechanical rooms and exterior piping shall be painted as indicated below:

<table>
<thead>
<tr>
<th>System</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm Sewer</td>
<td>White</td>
</tr>
<tr>
<td>Sanitary Sewer Waste and Vent</td>
<td>Light Gray</td>
</tr>
<tr>
<td>Domestic Cold Water</td>
<td>Dark Blue</td>
</tr>
<tr>
<td>Domestic Hot Water Supply and Return</td>
<td>Orange</td>
</tr>
</tbody>
</table>

PART 3 - EXECUTION

3.1 All labeling equipment shall be installed as per manufacturers printed installation instructions.
3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Contractor's price shall include all items required as per manufacturers' requirements.

3.3 All piping shall be cleaned of rust, dirt, oil and all other contaminants prior to painting. Install primer and a quality latex paint over all surfaces of pipe.

END OF SECTION 22 05 53
SECTION 22 07 16 – PLUMBING EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

B. Work specified elsewhere.
   1. Basic materials and methods.
   2. Piping systems.
   3. Air distribution equipment.

1.3 WARRANTY

A. Warrant the Work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:
   1. Mildewing.
   2. Peeling, cracking, and blistering.
   3. Condensation on exterior surfaces.

1.4 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

1.5 DELIVERY AND STORAGE

A. DELIVERY: Deliver undamaged materials in the manufacturer's unopened containers clearly labeled with flame and smoke ratings.

PART 2 - PRODUCTS
2.1 It is the intent of these specifications to secure superior quality workmanship resulting in an absolutely satisfactory installation of insulation from the standpoint of both function and appearance. Particular attention shall be given to valves, fittings, pumps, etc., requiring low temperature insulation to insure full thickness of insulation and proper application of the vapor seal. All flaps of vapor barrier jackets and/or canvas covering must be neatly and securely smoothed and sealed down.

2.2 The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and approved before any insulation is installed.

2.3 A sample quantity of each type insulation and each type application shall be installed and approval secured prior to proceeding with the main body of the work. Condensation caused by improper installation of insulation shall be corrected by Installing Contractor. Any damage caused by condensation shall be made good at no cost to the Owner or Architect/Engineer.

2.4 Glass fiber materials as manufactured by Owens/Corning, PPG, CSG, or Johns Manville will be acceptable, if they comply with the specifications.

2.5 All insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) fire and smoke hazard as tested by Procedure ASTM E084, NFPA 255 and UL 723 not exceeding:

<table>
<thead>
<tr>
<th>Flame Spread</th>
<th>Smoke Developed</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>50</td>
</tr>
</tbody>
</table>

2.6 Accessories, such as adhesives, mastics and cements shall have the same component ratings as listed above.

2.7 All products or their shipping cartons shall have a label affixed, indicating flame and smoke ratings do not exceed the above requirements.

PART 3 - EXECUTION

3.1 All insulation shall be installed in accordance with the manufacturers recommendations and printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturers requirements.

END OF SECTION 22 07 16
SECTION 22 07 19 – PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

B. Furnish and install piping insulation to:

1. Interior domestic hot water and hot water return piping.
2. Interior domestic cold-water piping.
3. Exterior domestic cold-water piping.
4. Drain bodies and associated piping.
5. Condensate drainage piping.
6. All pipes subject to freezing conditions shall be insulated.

C. Work specified elsewhere.

1. Painting.
2. Pipe hangers and supports.

D. For insulation purposes, piping is defined as the complete piping system including supplies and returns, pipes, valves, automatic control valve bodies, fittings, flanges, strainers, thermometer wells, unions, pressure reducing stations, and orifice assemblies.

1.3 WARRANTY

A. Warrant the Work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.

B. Defects shall include, but not be limited to, the following:

1. Mildewing.
2. Peeling, cracking, and blistering.
3. Condensation on exterior surfaces.

1.4 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, project variations, and accessories.

1.5 DELIVERY AND STORAGE

A. DELIVERY: Deliver undamaged materials in the manufacturer's unopened containers. Containers shall be clearly labeled with the insulation's flame and smoke ratings.

PART 2 - PRODUCTS

2.1 It is the intent of these specifications to secure superior quality workmanship resulting in an absolutely satisfactory installation of insulation from the standpoint of both function and appearance. Particular attention shall be given to valves, fittings, pumps, etc., requiring low temperature insulation to insure full thickness of insulation and proper application of the vapor seal. All flaps of vapor barrier jackets and/or canvas covering must be neatly and securely smoothed and sealed down.

2.2 The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and approved prior to installation.

2.3 A sample quantity of each type of insulation and each type application shall be installed and approval secured prior to proceeding with the main body of the work. Condensation caused by improper installation of insulation shall be corrected by Installing Contractor. Any damage caused by condensation shall be made good at no cost to the Owner or Architect/Engineer.

2.4 All insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) fire and smoke hazard as tested by Procedure ASTM E084, NFPA 255 and UL 723 not exceeding:

Flame Spread 25
Smoke Developed 50

2.5 Accessories, such as adhesives, mastics and cements shall have the same component ratings as listed above.

2.6 All products or their shipping cartons shall have a label affixed, indicating flame and smoke ratings do not exceed the above requirements.

2.7 APPROVED MANUFACTURERS

A. Calcium silicate materials shall be as manufactured by Johns Manville.

B. Glass fiber materials shall be as manufactured by Johns Manville or Owens-Corning and
shall have the same thermal properties, density, fire rating, vapor barrier, etc., as the types specified herein, subject to review by the Engineer.

C. Adhesives shall be as manufactured by Childers, Foster, HB Fuller or Armstrong, and shall have the same adhesive properties, fire rating, vapor seal, etc., as the types specified herein, subject to review by the Engineer.

D. Armaflex elastomeric cellular thermal insulation by Armstrong.

E. Phenolic foam insulation shall be as manufactured by Kooltherm Insulation (Koolphen).

F. Metal jacketing and fitting covers shall be as manufactured by Childers or RPR Products, Inc.

2.8 MATERIALS

A. INTERIOR DOMESTIC WATER PIPE: provide fiberglass pipe insulation with all service jackets with self-sealing lap joint.

B. EXTERIOR DOMESTIC WATER PIPE: Provide elastomeric cellular thermal, or preformed phenolic foam pipe insulation with secured aluminum jacketing.

C. DRAIN BODIES AND DOWNSPOUTS: Insulate underside of roof and overflow drain bodies, associated horizontal piping, including first turn down to vertical conductor. Insulate chilled water waste lines from drinking fountain to junction with main waste stacks. Insulate branch lines including traps and exposed underside of floor drains receiving cooling coil condensate, same as water piping where exposed to building occupant view. When concealed, insulation may be same as specified for external duct wrap.

D. CONDENSATE DRAINAGE PIPING: Fire resistant fiberglass insulation; insulation not required when piping is exposed on roof.

E. ALUMINUM OR STAINLESS-STEEL JACKETING: Utilize strap-on type jacketing, banding, and accessories. Provide pre-formed fitting covers for all elbows and tees.

PART 3 - EXECUTION

3.1 All insulation shall be installed in accordance with the manufacturers’ recommendations and printed installation instructions, including high density inserts at all hangers and pipe supports to prevent compression of insulation.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturers requirements.

3.3 Pipes located outdoors or in tunnels shall be insulated same as concealed piping; and in addition, shall have a jacket of 0.016-inch-thick, smooth aluminum with longitudinal modified Pittsburg Z-Lock seam and 2-inch overlap. Jacketing shall be easily removed and replaced without damage. All butt joints shall be sealed with gray silicone. Galvanized banding is not acceptable.

3.4 All insulated piping located over driveways shall have an aluminum shield permanently banded over insulation to protect it from damage from car antennas.
3.5 WATER PIPE INSULATION INSTALLATION

A. The insulation shall be applied to clean, dry pipes with all joints firmly butted together. Where piping is interrupted by fittings, flanges, valves or hangers and at intervals not to exceed 25 feet on straight runs, an isolating seal shall be formed between the vapor barrier jacket and the bare pipe. The seal shall be by the applications of adhesive to the exposed insulation joint faces, carried continuously down to and along 4 inches of pipe and up to and along 2 inches of jacket.

B. Pipe fittings and valves shall be insulated with pre-molded or shop fabricated glass fiber covers finished with two brush coats of vapor barrier mastic reinforced with glass fabric.

C. All under lap surfaces shall be clean and free of dust, etc. before the SSL is sealed. These laps shall be firmly rubbed to insure a positive seal. A brush coat of vapor retarder shall be applied to all edges of the vapor barrier jacket.

D. At hangers and supports, provide a high-density foam insulation insert that extends 2” beyond the shield on each side and a protective shield/saddle to prevent compression/damage. Secure shield/saddle to insulation using mastic or strapping tape.

3.6 FIRE RATED INSULATION

A. All pipe penetrations through walls and concrete floors shall be fire rated by applying USG Thermafiber in the space between the concrete and the pipe.

B. The fire rating shall be additionally sealed by using 3M brand model CP 25 or 303 fire barrier caulk and putty.

C. All fire rating material shall be insulated in accordance with manufacturer's printed instructions.

PART 4 - SCHEDULES

4.1 LOW TEMPERATURE SURFACES MINIMUM INSULATION THICKNESS BASED ON FIBERGLASS

A. Exposed exterior domestic water pipe: 1-1/2 inch

B. Interior domestic cold-water pipe: 1 inch

C. Condensate drain lines: 3/4 inch

D. Drains receiving condensate: 1 inch

E. Concealed piping from roof drains: 1-1/2-inch blanket wrap

F. Exposed piping from roof drains: 1-inch thick rigid with all service jacket

4.2 HIGH TEMPERATURE SURFACES MINIMUM INSULATION THICKNESS
A. Domestic Hot Water and Domestic Hot Water Return Piping

1. Pipe sizes 1-1/4 inch and smaller with Operating temperatures of 140°F or less 1 inch

2. Pipe sizes 1-1/2 inch and larger with Operating temperatures of 140°F or less 1-1/2 inch

3. Pipe sizes 1-1/4 inch and smaller with Operating temperatures greater than 140°F 1-1/2 inch

4. Pipe sizes 1-1/2 inch and larger with Operating temperatures greater than 140°F 2 inch

END OF SECTION 22 07 19
SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract Documents, including General and Supplementary Conditions and Division 01 Specifications, apply to this section.

   B. Related SECTIONS:
      1. SECTION 01 91 00 - GENERAL COMMISSIONING REQUIREMENTS
      2. SECTION 23 09 63 - ENERGY MANAGEMENT AND CONTROL SYSTEMS.

1.2 SUMMARY
   A. The commissioning of the plumbing system and associated controls shall be performed by an impartial technical firm hired by the owner. The commissioning provider shall be certified under one or more of the following certifications:
      1. CxA – Certified Commissioning Authority – ACG
      2. CBCP – Certified Building Commissioning Professional – AEE
      3. CCP – Certified Commissioning Professional – BCA
      4. CPMP – Certified Process Management Professional – ASHRAE
      5. BSC – Building System Commissioning Certification – NEBB

   B. The commissioning provider (Commissioning authority) shall be responsible for leading the entire construction team through the commissioning process including, but not limited to, conducting the commissioning kick-off meeting, preparing the commissioning plan, preparing pre-functional checklists, preparing functional test scripts, participation in functional testing and preparation of required documentation and reports.

1.3 RESPONSIBILITIES
   A. Contractor: Responsibilities of the Contractor as related to the Commissioning Process include, but are not limited to the following:
      1. Facilitate coordination of Commissioning work by Commissioning authority.
      2. Attend Commissioning meetings or other meetings called by Commissioning authority to facilitate the Commissioning Process.
      3. Review Functional Performance Test procedures for feasibility, safety, and impact on warranty, and provide Commissioning authority with written comment on same.
      4. Provide all documentation relating to manufacturer’s recommended performance testing of equipment and systems.
5. Provide Operations & Maintenance data to Commissioning authority for preparation of checklists and training manuals.

6. Provide As-built drawings and documentation to facilitate Testing.

7. Assure and facilitate participation and cooperation of Sub Contractors and equipment suppliers as required for the Commissioning Process.

8. Certify to Commissioning authority that installation work listed in Pre-Functional Checklists has been completed.

9. Install systems and equipment in strict conformance with project specifications, manufacturer’s recommended installation procedures, and Pre-Functional Checklists.

10. Provide data concerning performance, installation, and start-up of systems.

11. Provide copy of manufacturers filled-out start-up forms for equipment and systems.

12. Ensure systems have been started and fully checked for proper operation prior to arranging for Testing with Commissioning authority. Prepare and submit to Commissioning authority written certification that each piece of equipment and/or system has been started according to manufacturer’s recommended procedure, and that system has been tested for compliance with operational requirements.
   a. Contractor shall carry out manufacturer’s recommended start-up and testing procedures, regardless of whether or not they are specifically listed in Pre-Functional Checklists.
   b. Contractor is not relieved of obligation for systems/equipment demonstration where performance testing is required by specifications, but a Functional Performance Test is not specifically designated by Commissioning authority.

13. Coordinate with Commissioning authority to determine mutually acceptable date of Functional Performance Tests.

14. Provide qualified personnel to assist and participate in Commissioning.

15. Provide test instruments and communications devices, as prescribed by Commissioning authority, required for carrying out Testing of systems.

16. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process. Proprietary test equipment shall become the property of the Owner upon completion of commissioning.

17. Ensure deficiencies found in the Commissioning Issues Log are corrected within the time schedule shown in the Commissioning Plan.

18. Provide Commissioning authority with all submittals, start-up instructions manuals,
operating parameters, and other pertinent information related to Commissioning Process. This information shall be routed through Architect.

19. Prepare and submit to Commissioning authority proposed Training Program outline for each system.

20. Coordinate and provide training of Owner’s personnel.

21. Prepare Operation & Maintenance Manuals and As-Built drawings in accordance with specifications; submit copy to Commissioning authority in addition to other contractually required submissions. Revise and resubmit manuals in accordance with Design Professionals and Commissioning authority comments.

22. Commissioning requires participation of this Division Subcontractors to ensure that systems are operating in manner consistent with Contract Documents. All costs associated with the participation of Contractor, Sub-Contractors, Design Professionals, and Equipment Vendors in the Commissioning Process shall be included as part of the Construction Contract.

B. Subcontractors and vendors shall prepare and submit to Commissioning authority proposed Startup procedures to demonstrate proper installation of systems, according to these specifications and checklists prepared by Commissioning authority

1.4 COMMISSIONING PLAN

A. Commissioning Process tasks and activities:

1. Commissioning kick-off meeting: Conducted by commissioning authority and attended by construction team and design team.

2. Pre-functional checklists: Prepared by the commissioning authority and filled out by subcontractors performing the work that is applicable.

3. Site visits to review installation of applicable systems and progress of checklist documentation performed and reported by commissioning authority.

4. Functional testing: Commissioning authority shall conduct functional testing with assistance of applicable subcontractors and document successful results as well as deficiencies (issues). Functional performance testing shall demonstrate the installation and operation of components, systems, and system-to-system interfacing in accordance with plans and specifications. Testing shall include all modes and sequence of operation, including under full-load, part-load and emergency conditions (including all alarms). Controls system shall be tested to document that control devices, components, equipment and systems are calibrated and adjusted and operate in accordance with the plans and specifications. Sequences shall be functionally tested to document they operate in accordance with plans and specifications.

5. Preliminary commissioning report: Commissioning authority shall issue a preliminary commissioning report to the owner that has results of the first round of functional testing including deficiencies discovered.

6. Systems manual: Commissioning authority shall compile the systems manual using
submittal data provided by the general contractor and applicable subcontractors.

7. Final commissioning report: Commissioning authority shall issue final commissioning report documenting the entire process and final results of functional testing. Report shall include final testing and balancing report.

B. Equipment to be tested

1. Energy Management and Control System interface with applicable plumbing system equipment.

2. Service water heating systems (100%).

3. Service water circulation equipment (100%).

4. Domestic water booster pumps (100%).

C. Testing functions and conditions

1. Verify shutdown of systems when scheduled.

2. Calibration of sensors

3. Confirm functionality of all specified sequences of operations.

4. Verify the functionality of all alarms.

D. Performance criteria

1. Water temperatures shall be within tolerances specified in the contract documents.

2. Water heating system “recovery” rates shall be within specified time frame.

3. Booster pump shall maintain system pressure within specified tolerance.

PART 2 – PRODUCTS

2.1 NO PRODUCTS SUPPLIED

PART 3 – EXECUTION

3.1 GENERAL

A. This Division has startup responsibilities and are required to complete sub-systems so COMPLETE SYSTEMS are fully functional. Insuring they meet design requirements of Contract Documents. Commissioning procedures and testing do not relieve or lessen this responsibility or shift this responsibility, in whole or in part, to Commissioning Agent or Owner.
B. Coordinate with other Sub-Contractors and equipment vendors to set aside adequate time to address Pre-Functional Checklists, Functional Performance Tests, Operations & Maintenance Manual creation, Owner Training, and associated coordination meetings.

C. Commissioning authority will also conduct site inspections at critical times and issue Cx Field Reports with observations on installation deficiencies so that they may be issued by Architect as deemed appropriate.

3.2 WORK PRIOR TO COMMISSIONING

A. Complete all phases of the work so the systems can be started, adjusted, balanced, tested, and otherwise tested.

B. See pertinent specification sections in this Division, which outline responsibilities for start-up of equipment with obligations to complete systems, including all sub-systems so that they are fully functional.

C. Assist commissioning authority with all information pertaining to actual equipment and installation as required complete the full commissioning scope.

D. Contractor shall prepare startup procedures to demonstrate compliance with pre-functional checklists, and coordinate scheduling for completion of these checklists.

E. A minimum of 7 days prior to date of system startup, submit to Commissioning authority for review, detailed description of equipment start-up procedures which contractor proposes to perform to demonstrate conformance of systems to specifications and Checklists.

3.3 PARTICIPATION IN COMMISSIONING

A. Attend meetings related to the Commissioning Process; arrange for attendance by personnel and vendors directly involved in the project, prior to testing of their systems.

B. Provide skilled technicians to startup and test all systems, and place systems in complete and fully functioning service in accordance with Contract Documents.

C. Provide skilled technicians, experienced and familiar with systems being commissioned, to assist Commissioning authority in commissioning process.

3.4 WORK TO RESOLVE DEFICIENCIES

A. Complete corrective work in a timely manner to allow expeditious completion of Commissioning Process. If deadlines pass without resolution of identified problems, Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs thus incurred will be Contractor’s responsibility.

3.5 PRE-FUNCTIONAL CHECKLISTS (PFC)

A. Contractor shall complete Pre-Functional Checklists to validate compliance with Contract Documents installation and start-up requirements, for this Division’s systems.
B. Refer to commissioning plan for detailed list of equipment to be commissioned.

3.6 FUNCTIONAL PERFORMANCE TESTING (FPT)

A. Contractor, in cooperation with Commissioning Agent, shall conduct Functional Performance Testing to validate compliance with Contract Documents.

B. Refer to commissioning plan for detailed list of equipment to be commissioned.

C. Assist Commissioning authority in Functional Testing by removing equipment covers, opening access panels, etc. Furnish ladders, flashlights, meters, gauges, or other inspection equipment as necessary.

3.7 TRAINING

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specifications manual.

B. Contractor shall be responsible for training coordination and scheduling, and ultimately to ensure that training is completed.

C. The training agenda (plan) shall include, at a minimum, the following elements:
   1. Purpose of equipment.
   2. Principle of how the equipment works.
   3. Important parts and assemblies.
   4. How the equipment achieves its purpose and necessary operating conditions.
   5. Most likely failure modes, causes and corrections.
   6. On site demonstration.

D. Commissioning authority shall be responsible for overseeing and approving content and adequacy of training of Owner personnel for all installed systems. Provide Commissioning authority with training plan two weeks before planned training.

3.8 OPERATIONS & MAINTENANCE MANUALS

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specifications manual.

B. Sub-Contractor shall compile and prepare documentation for equipment and systems specified in this Division and shall deliver documentation to Contractor for inclusion in Operation & Maintenance Manuals, in accordance with requirements of Division 01, prior to training Owner personnel.

C. Provide Commissioning authority with a single, electronic copy of Operation & Maintenance Manuals for review. Commissioning authority copy of O&M manuals shall be
submitted through Architect.

D. Operation and maintenance manuals shall include, service agency contact information, maintenance requirements, controls system settings and a narrative of how each system is intended to operate, including set points.

3.9 DOCUMENTATION

A. Commissioning authority shall provide documentation of process as follows:

1. Preliminary commissioning report including test procedures, results of testing, itemization of deficiencies, deferred tests and climatic conditions required for performance of deferred tests. Preliminary commissioning report shall be issued to owner to demonstrate the first pass of testing has occurred and to demonstrate compliance with applicable codes.

2. Final commissioning report shall include the final test and balance report, final results of functional testing, disposition of deficiencies discovered during testing, including the details of corrective measures used and functional testing procedures used for repeatability of testing in the future.

END OF SECTION 22 08 00
SECTION 22 10 00 - PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and pipe fittings.
B. Valves.
C. Sanitary sewer piping system.
D. Storm water piping system.
E. Domestic water piping system.
F. Compressed air piping system.
G. Excavation and backfill.

1.2 RELATED SECTIONS

A. Section 22 05 29 – Hangers and Support for Plumbing Piping and Equipment.
B. Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping.
C. Section 22 05 53 – Identification for Plumbing Piping and Equipment.
D. Section 22 07 19 – Plumbing Piping Insulation.
E. Section 22 11 19 - Plumbing Specialties.
F. Section 22 30 00 - Plumbing Equipment.
G. Section 22 40 00 - Plumbing Fixtures.

1.3 REFERENCES

A. ANSI B31.1 - Power Piping.
B. ANSI B31.9 - Building Service Piping.
C. ASME - Boiler and Pressure Vessel Code.
D. ASME Sec. 9 - Welding and Brazing Qualifications.
E. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
F. ASME B16.3 - Malleable Iron Threaded Fittings.
G. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and 250.
H. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings
I. ASTM A47 - Ferritic Malleable Iron Castings.
J. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
K. ASTM A74 - Cast Iron Soil Pipe and Fittings.
L. ASTM B32 - Solder Metal.
M. ASTM B42 - Seamless Copper Pipe.
N. ASTM B306 - Copper Drainage Tube (DWV).
O. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120.
S. ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
W. AWWA C651 - Disinfecting Water Mains.
Z. ASSE 1003 Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems.

1.4 SUBMITTALS

A. Submit under provisions of Division One.
B. Product Data: Provide data on pipe materials, Pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
1.5 PROJECT RECORD DOCUMENTS
   A. Submit under provisions of Division One.
   B. Record actual locations of valves.

1.6 OPERATION AND MAINTENANCE DATA
   A. Submit under provisions of Division One.
   B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7 QUALITY ASSURANCE
   A. Valves: Manufacturer's name and pressure rating cast or marked on valve body.
   B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
   C. Welders Certification: In accordance with ASME Sec 9.
   D. Foreign pipe, fittings or valves are unacceptable. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be listed by NSF International.
   E. Piping shall be labeled along entire length indicating size, class, material specification, manufacturers name and country of origin.

1.8 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience and must be a domestic manufacturer.
   B. Installer: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.9 REGULATORY REQUIREMENTS
   A. Perform Work in accordance with plumbing and building codes having jurisdiction.
   B. Conform to applicable codes for the provision and installation of all required backflow prevention devices.
   C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.
   D. No PVC pipe or fittings will be allowed for any areas where pipe is to penetrate a fire rated assembly or to be installed in a return air plenum unless the entire length of all such piping is encased within a minimum 2-hour fire rated enclosure.
E. Provide a pressure regulating valve assembly at the service entry where incoming water supply pressure is greater than 70 psi.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division One.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Tape will not be allowed as an acceptable end cover.

1.11 EXTRA MATERIALS

A. Furnish under provisions of Division One.

B. Provide two repacking kits for each size valve.

PART 2 - PRODUCTS

2.1 SANITARY SOIL, WASTE AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING, BELOW GRADE

A. PVC Pipe: ASTM D 1785/D 2665 schedule 40

1. Fittings: PVC, ASTM D 3311/D 2665 drainage pattern, with bell and spigot ends to be furnished by the same manufacturer as pipe or approved equal.

2. Joints: solvent weld with ASTM D 2564 solvent cement, clear, medium bodied, for sizes 3" and smaller and gray, heavy bodied, for sizes 4" and larger, mating surfaces shall be prepared with ASTM F 656 purple primer immediately prior to cement application.

2.2 SANITARY SOIL, WASTE AND VENT PIPING, WITHIN BUILDING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301 or ASTM A 888, hubless, service weight.

1. Fittings: Cast iron, CISPI 301 or ASTM A 888 drainage pattern.

2. Joints: No hub, ASTM C 564 neoprene gaskets with ASTM C1540 wide bodied stainless steel clamp and solid shield assembly constructed of type 300 series stainless steel. Couplings shall have four clamps for pipe sizes up to and including 4” and shall have six clamps for pipe sizes over 4” through 10”. Clamp
assemblies shall conform to FM 1680 where required by the administrative authority.

B. Copper Tubing: ASTM B 306, DWV, sizes 2" and smaller.
   2. Joints: ASTM B 32, solder, Grade 50B.

C. Brass Pipe: ASTM B 43, chrome plated.
   2. Joints: ASTM B 32, solder, Grade 50B.

2.3 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING, BELOW GRADE
   A. Pipe and fittings shall be same as specified for sanitary soil, waste and vent piping system.

2.4 STORM WATER PIPING, WITHIN BUILDING, ABOVE GRADE
   A. Pipe and fittings shall be same as specified for sanitary soil, waste and vent piping system.

2.5 DOMESTIC WATER PIPE, BURIED WITHIN 5 FEET OF BUILDING, BELOW GRADE
   A. Copper Tubing: ASTM B 88, Type K, soft annealed.
      2. Joints: Sweat solder or flared. Note: No joints will be permitted in pressure water pipe below slab on grade. All such piping must be brought up above finished floor line a minimum of 12" before joining. Exception may be taken when pipe is fully enclosed in pressure rated sleeve and pre-approved by the Architect and Engineer.

   1. Fittings: Ductile or gray cast iron, standard thickness.
   2. Joints: ANSI/AWWA C111, rubber gasket with 3/4 inch diameter rods. Note: No joints are to be permitted in pressure water pipe below slab on grade except at exterior wall pipe entry from below floor.

2.6 DOMESTIC WATER PIPING, WITHIN BUILDING, ABOVE GRADE
   A. Copper Tubing: ASTM B 88, Type L, hard drawn.

2.7 COMPRESSED AIR PIPING SYSTEM

A. Steel Pipe: ASTM A 53, Schedule 40, galvanized.
   1. Fittings: ANSI B 16.3 Malleable iron, 150 lb. galvanized.
   2. Joints: Screwed for sizes less than 4", flanged or mechanical cut grooved couplings for sizes 4" and larger.

2.8 EXCAVATION, BEDDING AND BACKFILL

A. This section shall govern for all excavation and soil testing for the construction and laying of all sewers.

B. Excavation:
   1. Excavate trenches for underground piping to the required depth to ensure 2-foot minimum coverage over piping unless noted otherwise.
   2. The bottom of the trench or excavation shall be cut to a uniform grade.
   3. Should rock be encountered, excavate 6 inches below grade, fill with bedding material and tamp to existing density.
   4. Coordinate alignment of pipe trenches to avoid obstructions. Assure that proposed routing of pipe will not interfere with building foundation before any trenching has begun. Should conflicts occur, contact Architect/Engineer before proceeding.

C. Bedding and Backfill:
   1. Backfill shall not be placed until the work has been inspected, tested and approved. Complete backfill to the surface of natural ground or to the lines and grades indicated on drawings. Provide 6-inch stabilized sand bed with 4-inch stabilized sand cover around each pipe. Provide select fill up to finished surface or grade, unless stated otherwise by project geotechnical report or specified otherwise in Division 02.
   2. Compacting Backfill: Place material in uniform layers of 8 inches maximum, loose measure and compact to not less than 95% of maximum soil density as determined by ASTM D-698 Standard Proctor.
   3. Restoration: Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks and similar areas, to a condition equal to the adjacent undisturbed earth and restore surface of the area to the condition existing prior to trenching or excavating operation.
4. A clay fill “trench plug” extending 3 feet inside the building line and 5 feet outside the building line shall be placed to completely surround utility lines passing beneath the foundation and grade beam. The materials shall consist of on-site soils with a plasticity index (PI) between 30 and 40 percent compacted to at least 95 percent of the Standard Proctor and maximum dry density as determined by ASTM D-698.

2.9 FLANGES, UNIONS AND COUPLINGS

A. Pipe size 2 inches and under:
   2. Copper tube and pipe: 150 psig bronze unions with soldered ends.
   3. Ferrous pipe: ANSI B16.5, 150 psig forged steel flanges; screwed neck, 1/16" thick preformed neoprene gaskets.

B. Pipe size 2-1/2 inches and larger:
   1. Ferrous pipe: 150 psig forged steel slip-on flanges; weld neck, 1/16" thick preformed neoprene gaskets.
   2. Copper tube and pipe: 150 psig slip-on bronze flanges; 1/16" thick preformed neoprene gaskets.

C. Dielectric Connections:
   1. Pipe size 2 inches and under: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
   2. Pipe size 2-1/2 inch and larger: flange, connection as above, with water impervious isolation barrier.
   3. Pipe sizes 1 inch to 8 inches: Dielectric waterway grooved, plain end, or thread end. ASTM-53 carbon steel or ASTM-536 ductile iron body, zinc electroplated, with LTHS high temperature stabilized polyolefin polymer linear Victulic style 47.

D. Mechanical Couplings:
   1. Grooved mechanical pipe couplings, fittings, valves and other grooved components may be used as an option to soldered or braised methods. Fittings shall be cast of bronze for copper tubing systems. All grooved components shall be of one domestic manufacturer and conform to local code approval and/or as listed by ANSI-B-31, B-31.3M B-31.9, ASME, UL/ULC, FM, IAPMO OR BOCA. Grooved end manufacturer to be ISO-9001 certified. Grooved couplings shall meet the requirements of ASTM F-1476. Manufacturer shall be Victaulic or approved equal.

2.10 BALL VALVES
A. Manufacturers:

1. Nibco No. T-585-66-LF

2. Other acceptable manufacturers offering equivalent products.
   a. Crane No. 9303-B
   b. Stockham Model S-216BR-1R-T
   c. Milwaukee valve UPBA-400S

B. Up to and including 2 Inches: Bronze – (ASTM B584 C8933), two 600 PSI piece body full port, stainless steel ball and stem, Teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.

C. Ball valves used for balancing shall have memory stops.

2.11 SWING CHECK VALVES

A. Manufacturers:

1. Nibco No. T-413-B up to 2-1/2"; F-918 3" and over.

2. Other acceptable manufacturers offering equivalent products.
   a. Crane No. 37 up to 2-1/2"; 372 3" and over.
   b. Stockham No. B-319; up to 2-1/2"; G931 3" and over.
   c. Victualic (for grooved systems only).
   d. Milwaukee valve UP509 up to 2", F-2974A 2½" and over.

B. Up to and including 2-1/2 Inches: Bronze body ASTM B584 C89833, Bronze swing disc, screwed ends.

C. Over 2-1/2 Inches: Iron body, bronze trim, swing disc, renewable disc and seat, flanged ends. Include outside lever and adjustable weight where required for quiet operation.

2.12 SPRING LOADED (SILENT) CHECK VALVES

A. Manufacturers:

1. Nibco No. W-910

2. Other acceptable manufacturers offering equivalent products.
   a. Grinnell No. 402

3. Victualic (for grooved systems only).

4. Milwaukee valve 1400 LF.

B. Iron body, bronze trim, stainless steel spring, renewable composition disc, screwed, wafer, grooved, or flanged ends.
2.13 REGULATING VALVES

A. Manufacturers:

1. Watts No. 223-S up to 2-1/2” size valve.


3. Other acceptable manufacturers offering equivalent products.

B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

C. Provide and install pressure regulating valves with inlet strainer and union fittings individually or as integral components of regulator.

D. Install pressure regulating valve within building immediately downstream of building shut-off valve and prior to any building service branch connection. Each building service PRV installation shall include an integral permanent bypass assembly with a normally closed bypass throttling globe or ball valve.

2.14 SOLDER

A. 95.5% tin, 4% copper, 0.5% silver.

B. Lead free, antimony free, zinc-free.

C. Silvabrite 100, by Engelhard Corporation or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Coordinate and verify excavations under provisions of Division Two.

B. Verify that all excavations are to the required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale, oil and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Install all materials in accordance with manufacturer's published instructions.
B. All exposed sewer and water pipe in toilet rooms or other finished areas of the building shall be chromium plated.

C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

D. Route piping in orderly manner, parallel and perpendicular to building column grid lines, unless indicated otherwise on drawings, and maintain gradients.

E. Install piping to conserve building space and not conflict with other trades or interfere with intended use of space.

F. Group piping whenever practical at common elevations.

G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

H. Provide clearance for installation of insulation and access to valves and fittings. Valves installed beyond reasonable reach shall be provided with chain operator.

I. Provide access doors where valves and operable fittings are not exposed. Access doors shall be of approved types set in locations pre-approved by submittal to the Architect.

J. Establish elevations of buried piping outside the building to ensure not less than 2 feet of cover, or maximum depth of frost penetration, whichever is the greater.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

L. Provide encasement for and support of utility meters in accordance with requirements of utility companies.

M. Gate valves installed below grade shall be covered with an adjustable cast iron roadway box extended to grade. Cover shall be cast iron with 'water' cast on top and set flush to finished paving or 2" above finished earthen grade. Box shall be supported from undisturbed soil or concrete base and shall not introduce any stress to piping under all traffic conditions.

N. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting.

O. Excavate in accordance with Division 22.

P. Backfill in accordance with Division 22.

Q. Install bell and spigot pipe with bell end upstream.

R. Maintain uniformity in the installation of piping materials and joining methods. Do not mix materials types.

S. Install valves with stems upright or horizontal, not inverted.
T. Solder joints shall be wiped clean at each joint, remove excess metal while molten and flux residue when cooled.

U. No PVC pipe or fittings will be allowed for any areas where pipe is installed in return air plenum unless the entire length of all such piping is encased within a minimum 2-hour fire rated enclosure.

V. Provide minimum 18-gauge copper tracer wire laid six inches directly above all underground non-metallic pipe.

W. Installations of thermoplastic piping systems shall be in strict conformity to the manufacturers published instructions. Underground drainage pipe installations shall be in conformity to ASTM D 2321.

X. Installation of solvent cement joints for PVC piping shall be in strict conformity to the requirements outlined in ASTM D 2855.

Y. Waste nipple from wall to tapped tee shall be schedule 40 threaded galvanized steel pipe or brass or copper with threaded adapter.

Z. Provide approved PVC slip by cast iron no hub adaptor at each transition from underground PVC piping to above ground cast iron pipe using heavy duty wide bodied no hub couplings as specified elsewhere in this section. Transition shall be made as close as possible to floor for sanitary DWV piping systems and at test tee “minimum 12 in. A.F.F.” for storm drainage piping. Support vertical cast iron pipe from floor anchors using riser clamp and galvanized all thread rod as specified in section 15140.

AA. Provide bracing to prevent axial movement for all storm drainage piping above ground floor. Provide restraints for all drainage piping at all changes in direction and at all diameter changes greater than two pipe sizes. Braces blocks, rodding and other permanent methods as prescribed by cast iron soil pipe institute.

BB. All grooved components (couplings, fittings, valves, gaskets and specialties) shall be of one domestic manufacturer.

CC. Grooved manufacturer shall provide on-site training for contractor’s field personnel by a factory trained representative in the proper use of grooving tools, application of groove, and product installation. Factory trained representative shall periodically visit the job site and inspect installation. Contractor shall remove and replace any improperly installed products.

3.4 APPLICATION

A. Install union downstream of all valves at equipment or apparatus connections.

B. Install male adapters each side of threaded valves in copper piped system. Sweat solder adapters to tube prior to make-up of threaded connections.

C. Install ball valves for shut-off and to isolate all equipment items, distinct parts of systems, or vertical risers.
D. Each plumbing fixture shall have a shut-off valve on each hot water and cold water supply line.

E. Each plumbing water rough-in stub out shall be fitted with a shut off valve.

F. Install globe, ball or butterfly valves for throttling, bypass, or balancing (manual flow control) services.

G. Ball valves installed in insulated piping shall be fitted with extended lever operators of sufficient length to raise handle above the insulation jacket material. Where valve is used for throttling service valve handle shall be equipped with adjustable memory stop device.

H. Provide spring loaded, non-slam, check valves on discharge of water pumps.

3.5 ERECTION TOLERANCES

A. All drainage lines in the building shall have 1/4 inch to the foot fall where possible and not less than 1/8 inch to the foot fall toward the main sewer. Pipe must be so laid that the slope will be uniform and continuous. Permission shall be secured from the Architect and Engineer before proceeding with any Work where existing conditions prevent the installation at minimum grade specified.

B. Slope all water piping and arrange to drain at low points. Provide loose key operated, polished chrome, sill cock flush to wall where fixture stop will not suffice for this requirement.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, all domestic water systems shall be complete, thoroughly flushed clean and free of all foreign matter or erection residue.

B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. On building side of the main shut off valve, provide a 3/4" connection through which chlorine can be introduced into the water piping.

D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, in sufficient quantity to obtain 50 to 80 mg/L residual free chlorine solution throughout the entire domestic water piping systems.

E. Bleed water from outlets as required to ensure complete distribution and test for disinfectant residual at a minimum 15 percent of total outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
I. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.7 SERVICE CONNECTIONS

A. Provide new sanitary and storm sewer services connecting to existing building services or utility lines as shown on the drawings.

B. Before commencing work, field verify invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover as required.

C. Provide new domestic water service connecting to existing building services or utility lines as shown on plans. Assure connections are in compliance with requirements of the jurisdiction having authority.

D. Extension of services to the building shall be fabricated from the same materials as the utility service lines or those materials specified herein.

E. Should points of connection vary from those indicated on the drawings contractor shall properly allow for this in the actual connections field fabricated.

3.8 RODDING SEWERS

A. All sanitary soil and waste lines, both in the building and out, shall be rodded out after completion of the installation.

B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned.

3.9 TESTING OF PLUMBING PIPING SYSTEMS

A. During the progress of the work and upon completion, tests shall be made as specified herein and as required by Authorities Having Jurisdiction, including Inspectors, Owner or Architect. The Architect or duly authorized Construction Inspector shall be notified in writing at least 2 working days prior to each test or other Specification requirement which requires action on the part of the Construction Inspector.

B. Tests shall be conducted as part of this work and shall include all necessary instruments, equipment, apparatus, and service as required to perform the tests with qualified personnel. Submit proposed test procedures, recording forms, and test equipment for approval prior to the execution of testing.

C. Tests shall be performed before piping of various systems have been covered or furred-in. For insulated piping systems testing shall be accomplished prior to the application of insulation.

D. All piping systems shall be tested and proved absolutely tight for a period of not less than 24 hours. Tests shall be witnessed by the Architect or an authorized representative and pronounced satisfactory before pressure is removed or any water drawn off.
E. Leaks, damage or defects discovered or resulting from test shall be repaired or replaced to a like new condition. Leaking pipe joints, or defective pipe, shall be removed and replaced with acceptable materials. Test shall be repeated after repairs are completed and shall continue until such time as the entire test period expires without the discovery of any leaks.

F. Wherever conditions permit, each piping system shall thereafter be subjected to its normal operating pressure and temperature for a period of no less than five 5 days. During that period, it shall be kept under the most careful observation. The piping systems must demonstrate the propriety of their installation by remaining absolutely tight during this period.

G. Domestic Water:

1. Pressure test at one and one-half times the normal working pressure or 125 psig, whichever is the greater, for 24 hours.

H. Sanitary Soil, Waste and Vents and Storm Sewer:

1. After the rough-in soil, waste and vent and other parts of the sanitary sewer including branch laterals have been set from the lowest level, at point of connection to existing utility lines, to above the floor line, all outlets shall be temporarily plugged or capped, except as are required for testing as described herein. Ground work shall not permit the backfill of trenches to cover any joints until the completion of testing. Back fill shall be limited to mid sections of full joints of piping only. For pipe in ground the piping shall be readied as described herein and filled with water to a verifiable and visible level to 10' above the lowest portions of the system being tested.

2. On multi-level buildings only one floor level shall be tested at a time. Each floor shall be tested from a level below the structure of the floor, or the outlet of the building in the case of the lowest level, to a level of 12 inches above the floor immediately above the floor being tested, or the top of the highest vent in the case of the highest building level. The pipes for the level being tested shall be filled with water to a verifiable and visible level as described above and be allowed to remain so for 24 hours. If after 24 hours the level of the water has been lowered by leakage, the leaks must be found and stopped, and the water level shall again be raised to the level described, and the test repeated until, after a 24-hour retention period, there shall be no perceptible lowering of the water level in the system being tested.

3. Should the completion of these tests leave any reasonable question or doubt of the integrity of the installation, additional tests including peppermint smoke, or other measures shall be performed to demonstrate the reliability of these systems to the complete satisfaction of the Owner's duly authorized representative. Such tests shall be conducted and completed before any joints in plumbing are concealed or made inaccessible.

3.10 COMPLETE FUNCTIONING OF WORK
A. All work fairly implied as essential to the complete functioning of the systems shown on the Drawings and Specification shall be completed as part of the work of this Division unless specifically stated otherwise. It is the intention of the Drawings and Specification to establish the type and function of systems but not to set forth each item essential to the functioning of any system. In case of doubt as to the work intended or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for Supplementary Instructions and Drawings, etc.

END OF SECTION 22 10 00
SECTION 22 11 19 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the specialties covered by this Section, with all appurtenances, ready for the Owner’s use.

B. Include the following work in addition to items normally part of this Section:

   1. Hose Bibbs and Hydrants
   2. Backflow Preventers
   3. Water Hammer Arresters
   4. Strainers and Filters
   5. Thermostatic Mixing Valves
   6. Floor Drains and Floor Sinks
   7. Cleanouts
   8. Trap Primers
   9. Roof Drains and Overflow Nozzles

1.3 RELATED WORK

A. Section 22 05 29 – Hangers and Support for Plumbing Piping and Equipment

B. Section 22 10 00 – Plumbing Piping

C. Section 22 30 00 – Plumbing Equipment

D. Section 22 40 00 – Plumbing Fixtures

1.4 REFERENCES

A. ANSI/ASSE 1010 – Performance Requirements for Water Hammer Arresters

B. ANSI/ASSE 1011 – Performance Requirements for Hose Connection Vacuum Breakers
C. ANSI/ASSE 1012 – Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent
D. ANSI/ASSE 1013 – Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers
E. ANSI/ASSE 1015 – Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
F. ANSI/ASSE 1019 – Performance Requirements for Wall Hydrants with Backflow Protection and Freeze Resistance
G. ANSI/ASSE 1057 – Performance Requirements for Freeze Resistant Sanitary Yard Hydrants with Backflow Protection
H. ASME A112.6.3 – Floor Drains and Trench Drains
I. ASME A112.6.7 – Sanitary Floor Sinks
J. ASME A112.6.4 – Roof, Deck, and Balcony Drains
K. ASME A112.14.1 – Backwater Valves
L. ASME A112.14.3 – Grease Interceptors
M. ASME/ANSI A112.26.1 – Water Hammer Arresters
N. PDI WH-201 Water Hammer Arresters
O. AWWA C506 – Standard for Backflow Prevention Devices – Reduced Pressure Principle and Double Check Valve Types
P. AWWA C510 – Standard for Double Check Valve Backflow Prevention Assembly
Q. ASSE 1069 – Performance Requirements for Automatic Temperature Control Mixing Valves
R. ASSE 1070 – Performance Requirements for Water Temperature Limiting Devices
S. PDI G-101 – Testing and Rating Procedure for Hydro Mechanical Grease Interceptors

1.5 QUALITY ASSURANCE
A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

1.6 SUBMITTALS
A. Submit under provisions of Division One.
B. Submit shop drawings and product data under provisions of Division One.
C. Include component sizes, rough-in requirements, service sizes, and finishes.
D. Manufacturer's Installation Instructions: Indicate assembly and support requirements.
1.7 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Division One.
B. Record actual locations of equipment and backflow preventers.

1.8 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Division One.
B. Operation Data: Indicate frequency of treatment required for interceptors and separators.
C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.9 DELIVERY, STORAGE, AND HANDLING
A. DELIVERY: Deliver clearly labeled specialties to; and store, protect and handle products on site in accordance with the provisions of Division One.
B. TIMING AND COORDINATION: Arrange for delivery of materials to allow for minimum storage time at the project site. Coordinate with the scheduled time of installation.
C. ACCEPTANCE: Accept specialties on site in original factory packaging. Inspect for damage. Damaged specialties shall not be acceptable.
D. STORAGE: Store materials in a clean, dry location, protected from weather and damage.

1.10 EXTRA MATERIALS
A. Furnish under provisions of Division One.
B. Provide two loose keys for hose bibbs and hydrants and spare hose end vacuum breakers.

1.11 REGULATORY REQUIREMENTS
A. Conform to applicable codes for the provision and installation of all required backflow prevention devices.
B. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.
C. Provide backflow prevention assembly test and maintenance report for all devices. A printed and signed form by the licensed tester that performed the work shall be provided both to the Owner and to the Public Water System in accordance with TCEQ (Texas Commission on Environmental Quality) requirements.

PART 2 - PRODUCTS

2.1 HOSE BIBBS/HYDRANTS
A. Hose Bibb: ANSI/ASSE 1011; bronze or brass construction, replaceable hexagonal disc, hose thread spout, chrome plated where exposed, with lockshield and removable key, integral vacuum breaker.

B. Wall Hydrant: ANSI/ASSE 1019; non-freeze, self-draining type with chrome plated lockable recessed box hose thread spout, lockshield and removable key, and vacuum breaker.

C. Floor Hydrant: ANSI/ASSE 1019; chrome plated lockable recessed box, hose thread spout, lockshield and removable key, and vacuum breaker.

D. Roof/Post Hydrant; ANSI/ASSE 1057; bronze non-freeze post hydrant with cast iron casing guard, vacuum breaker, and removable tee handle key.

E. ACCEPTABLE MANUFACTURERS:

1. J.R. Smith
2. Zurn
3. Mifab
4. Watts
5. Wade
6. Josam
7. Chicago
8. Woodford

2.2 RECESSED VALVE BOX

A. Washing Machine: Pre-formed galvanized or stainless steel rough-in box with brass long shank valves with wheel handles, threaded drain fitting for waste, and matching secured faceplate.

B. Refrigerator: Pre-formed galvanized or stainless steel rough-in box with brass long shank valve with wheel or quarter-turn handle and matching secured faceplate.

C. ACCEPTABLE MANUFACTURERS:

1. Guy Gray
2. Mifab
3. Sioux Chief
4. Oatey

2.3 BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventers: ANSI/ASSE 1013; Bronze or FDA approved epoxy coated cast iron body with corrosion resistant internal parts and stainless-steel springs; two independently operating, spring loaded check valves;
intermediate internal pressure intermediate relief valve with water outlet; test cocks and isolation valves.

B. Double Check Valve Assemblies: ANSI/ASSE 1015; Cast copper alloy or FDA approved epoxy coated cast iron body with corrosion resistant internal parts and stainless-steel springs; two independently operating check valves, test cocks and isolation valves.

C. Dual Check Valve with Intermediate Atmospheric Vent: ANSI/ASSE 1012; Brass body with corrosion resistant internal parts and stainless-steel springs; two independently operating check valves with intermediate atmospheric vent.

D. ACCEPTABLE MANUFACTURERS:
   1. Watts
   2. Wilkins
   3. Ames
   4. Febco
   5. Beeco
   6. Conbraco

2.4 WATER HAMMER ARRESTERS

A. ASSE 1010; sized and located in accordance with PDI WH-201; pre-charged, approved mechanical devices suitable for operation in temperature range -100 to 300 degrees F (-73 to 149 degrees C) and maximum 250 psig (1700 kPa) working pressure.

B. ACCEPTABLE MANUFACTURERS:
   1. J.R. Smith
   2. Zurn
   3. Mifab
   4. Watts
   5. Wade
   6. Josam
   7. P.P.P.
   8. Sioux Chief

2.5 THERMOSTATIC MIXING VALVES

A. Provide thermostatic mixing valves in accordance with manufacturer’s recommendations and as indicated and scheduled on Drawings.
1. Unless scheduled otherwise, all units other than under-counter point of use units shall be provided complete in lockable cabinet of 16 gage (1.5 mm) prime coated steel when located in finished areas.

2. All under-counter point of use units shall be provided complete with integral checks and dual stainless-steel strainers on inlets for protection against fouling.

B. ACCEPTABLE MANUFACTURERS:
   1. Bradley
   2. Powers
   3. Symmons
   4. Acorn

2.6 FLOOR DRAINS AND FLOOR SINKS

A. Provide floor drains and floor sinks in accordance with manufacturer’s recommendations, as appropriate for floor construction, and as indicated and scheduled on Drawings.

B. Provide clamping devices for all drains in membrane floor areas.

C. ACCEPTABLE MANUFACTURERS:
   1. J.R. Smith
   2. Zurn
   3. Mifab
   4. Watts
   5. Wade
   6. Josam

D. Provide drains of suitable and compatible material for specialized piping systems conveying acid waste.

2.7 CLEANOUTS

A. General: Provide cleanouts as indicated and scheduled on Drawings and also as required by the prevailing code, whether shown on the Drawings or not.

B. Construction: All cleanouts shall have tapered bronze plugs.

C. Provide clamping devices for all cleanouts in membrane floor areas.

D. Provide cleanouts of suitable and compatible material for specialized piping systems conveying acid waste.

E. Types:
1. Finished floor cleanouts: Provide cast iron body, with adjustable floor level assembly, and round nickel bronze scoriated top.

2. Resilient or tile finished floor cleanouts: Provide cast iron body, with adjustable floor level assembly, and round nickel-bronze top with gasketed water tight cover and depressed top to receive flooring finish material.

3. Interior finished wall cleanouts: Provide cast iron tee body or cleanout ferrule as required for wall construction and provide counter-sunk bronze plug with stainless steel access cover and securing screw(s).

4. Interior unfinished accessible cleanouts: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

F. ACCEPTABLE MANUFACTURERS:

1. J.R. Smith
2. Zurn
3. Mifab
4. Watts
5. Wade
6. Josam

2.8 TRAP PRIMERS

A. General: Provide trap primers as indicated and scheduled on Drawings and in accordance with manufacturer’s recommendations.

B. ACCEPTABLE MANUFACTURERS:

1. J.R. Smith
2. Zurn
3. Mifab
4. Watts
5. Wade
6. Josam
7. P.P.P.
8. Sioux Chief

2.9 BACKWATER VALVES
A. ASME A112.14.1; Lacquered cast iron body and cover, brass valve, access cover, extension sleeve as required and cover at finished elevation.

B. ACCEPTABLE MANUFACTURERS:

1. J.R. Smith
2. Zurn
3. Mifab
4. Watts
5. Wade
6. Josam

2.10 ROOF DRAINS, PLANTER DRAINS, AND OVERFLOW NOZZLES

A. Roof drains (RD): ASME A112.6.4; Lacquered cast iron body with sump, removable aluminum dome strainer, membrane flange and clamp with integral gravel stop, adjustable underdeck clamp, roof sump receiver, waterproofing anchor flange, adjustable extension as required for insulation, perforated or slotted ballast guard extension for inverted roof.

B. Roof overflow drains (OD): Lacquered cast iron body and features similar to roof drain, with 2-inch external water dam or pipe extended to 2 inches above flood elevation.

C. Planter drains: Lacquered cast iron body with flange, integral clamping collar, seepage openings and either adjustable perforated standpipe (length as necessary) with secured dome or dome with secured stainless-steel screen.

D. ACCEPTABLE MANUFACTURERS:

1. J.R. Smith
2. Zurn
3. Mifab
4. Watts
5. Wade
6. Josam

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

A. Install specialties in accordance with manufacturer's instructions to provide intended performance.

B. The contractor shall provide water hammer arresters as shown on Drawings and also in accordance with PDI Standard WH-201, whether shown on Drawings or not. Water hammer arresters shall be
PDI certified and sized and placed as recommended by manufacturer. Provide above ceiling or otherwise accessible location complete with isolation valve to facilitate replacement.

C. The use of air chambers for the control of water hammer shock shall not be acceptable.

D. Provide strainers at all backflow preventers.

E. Contractor shall certify all newly installed backflow preventers and provide proof of certification to the Owner.

F. Pipe relief line from backflow preventer via manufacturer’s air gap assembly, full size to nearest drain. Such routing shall not pose a trip hazard.

G. All backflow preventers shall be securely supported with wall supports and/or pipe stands as appropriate for the size and weight of the unit and shall be installed with sufficient access and clearance for testing and maintenance. Unless specifically noted otherwise on Drawings, all backflow preventers shall be installed at 48”-60” above finished floor.

H. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanouts for rodding of drainage system.

I. All cleanouts outside of building on grade shall be set in an 18” x 18” x 4” thick concrete pad, flush with final grade/paving.

J. All cleanouts shall be the same nominal size as the pipe they serve, up to 4 inches. For pipes larger than 4 inches, provide a 4-inch cleanout.

K. Coordinate with casework to ensure that all interceptors are readily accessible and removable for servicing and cleaning.

L. Coordinate with casework to ensure that all point of use interceptors do not interfere with required accessibility requirements. Provide offset(s) as required and in accordance with code.

M. Provide approved sampling well downstream of centralized interceptors and separators.

END OF SECTION 22 11 19
SECTION 22 11 21 - NATURAL GAS PIPING SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing, complete installation and testing of the gas piping system, with all metering, valves, piping and auxiliaries, ready for owner's use.

B. Coordinate with the gas company and pay all fees and permits required for a complete and operating gas service to the project.

PART 2 - PRODUCTS

2.1 All gas piping above ground shall be Schedule 40 black steel as manufactured by National Tube, Republic, Youngstown, or approved equal domestic manufacturer.

2.2 All gas piping larger than 2" shall be of welded construction. Screwed fittings will only be permitted for size 2" and smaller. Unions and valves will not be permitted above furred ceiling areas or in walls or chases.

2.3 All pipe fittings shall be of materials as follows:

A. All welding fittings shall be factory-made and shall be full line size, for each tee, branch, elbow, etc., with reducers after fittings, if required.

B. All screwed fittings shall be Crane, or approved equal, Class 150 malleable iron. Screw joints shall be made up with graphite and oil or Teflon tape. Screwed threads shall be in accordance with American Pipe Thread Standards.

C. All piping and fittings shall be from a domestic manufacturer.

2.4 All underground gas piping with 5 pound working pressure or less shall be as follows:

A. The pipe shall be yellow polyethylene with socket heat fusion joints and fittings. Pipe sizes 1-1/2" and 2" shall be SDR 11, (PE 2406) and pipe sizes 3" and 4" shall be SDR 11.5 (PE 2406).

B. All socket heat fusion fittings shall be D.O.T. approved and meet ASTM D-2513 and ANSI B31.8 codes.

C. All gas valves shall be polyethylene ball type, doubled union, rated for natural gas use. All valves shall be placed in a cast-iron valve box of an adequate size for accessibility and maintenance.
D. All transition meter risers shall be D.O.T. approved anode-less service type, fusion coupled and PE 2406 rated.

E. The contractor shall take thermal expansion under consideration during installation. The contractor shall follow all requirements set by the manufacturer to protect the system from damage due to thermal expansion.

F. The contractor shall provide detector tape approximately 12" above all gas piping.

G. Wrap pipe with 18 gauge minimum copper tracer wire.

2.5 Gas piping installed in unventilated spaces shall be routed in properly vented continuous sleeve where required by the building code.

2.6 Gas valves shall be U.L. listed as follows:
   A. Ball Valves: Nibco T585-70-UL for ¼” to 1” and T580-70-UL for 1-¼” to 3”.
   B. Plug Valves: DeZurick Series 425 or 435 Eccentric valves with RS 49 plug seals.

2.7 Gas pressure regulators shall be capable of reducing 75 psi pressure gas to 0.5 psi gas at capacities required by Gas Demand. Install per A.G.A. Bulletin 90. Regulators shall be as manufactured by Rockwell, Fisher-Governor or approved equal.

2.8 All gas regulators located inside the building shall be vented to atmosphere with schedule 40 black steel pipe. This includes all regulators provided with mechanical and plumbing equipment and all other regulators provided under this contract. Vent piping shall be the full size of regulatory port opening, or as recommended by regulator manufacturer, and shall run independent of any other regulator vent through to point of termination.

PART 3 - EXECUTION

3.1 All piping shall be installed in accordance with the manufacturer’s recommendations and printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer’s requirements.

3.3 All underground gas piping shall be laid on 6" of wet compact banksand approximately 24" below grade. Backfill trench with wet compacted banksand to 6" above pipe. The remainder of backfill shall be selected backfill and shall meet all compaction requirements set forth by the general trenching and backfill requirements.

3.4 Provide lever handle gas valve, drip leg and union to each piece of equipment and where indicated.

3.5 All gas lines entering building shall be valved on the exterior of the building above grade.

PART 4 - TESTING

4.1 TESTING OF GAS PIPING SYSTEMS
A. All gas system testing shall be in compliance with local codes or as required in NFPA 54 National Fuel Gas Code whichever is the more stringent requirement.

B. All work shall be performed by a Journeyman Plumber holding current State and local licenses.

C. All tests shall be accomplished during normal working hours and after having given due notification to building owner, construction manager or designee, of tests to be performed. All tests shall be performed in the presence of and witnessed by the building owners representative or designee.

D. All gas system piping shall be subjected to a pneumatic test pressure of 60 psig for not less than 2 hours upon completion of all rough-in work and prior to covering. While the systems are subjected to this air pressure test, all joints shall have a soapy water solution applied and shall be observed for leaks. During test period there shall be no perceptible drop in test gage pressure.

E. A final test shall be performed after all portions of the piping system are completely installed and covered. The entire system shall be tested, with all system outlets plugged or capped, before any equipment or appliances are connected to the piping.

1. Final test shall be with mercury, measured with a manometer or slope gage. Test pressures shall in no case be less than one and one half times the normal operating pressure or as listed below; which ever is the greater:
   a. 10.5 inches mercury (5 psig) for 4 ounce system.
   b. 21.0 inches mercury (10 psig) for 8 ounce system.

2. Tests shall be for a period of not less than 30 minutes and shall prove absolutely tight, showing no perceptible drop, for the entire test period.

F. Purge air from test piping before connecting equipment or appliances. Purge air to outdoors or to ventilated space of sufficient volume to prevent accumulation of flammable mixtures.

END OF SECTION 22 11 21
SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water Heaters.
B. In-line circulator pumps.
C. Sump Pumps

1.2 RELATED SECTIONS

A. Section 22 05 29 – Hangers and Support for Plumbing Piping and Equipment.
B. Section 22 05 48 – Vibration and Seismic Controls for Plumbing Equipment.
C. Section 22 10 00 - Plumbing Piping.
D. Section 22 11 19 - Plumbing Specialties.
E. Section 26 05 19 - Wire, Cable, and Related Materials.

1.3 REFERENCES

B. ASME Section VIII-D - Pressure Vessels; Boiler and Pressure Vessel Codes.

1.4 SUBMITTALS

A. Submit under provisions of Division One.
B. Shop Drawings:
   1. Include water heater dimensions, size of tappings, and performance data.
   2. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
C. Product Data:
   1. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
2. Indicate pump type, capacity, power requirements, and affected adjacent construction.

3. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

4. Provide electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 22.

B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with authorities having jurisdiction.

B. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

C. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. American Gas Association (AGA).

2. National Sanitation Foundation (NSF).

3. American Society of Mechanical Engineers (ASME).

4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).


6. Underwriters Laboratories (UL).

7. American Society of Plumbing Engineers (ASPE)

D. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.7 REGULATORY REQUIREMENTS

A. Conform to AGA NSF ANSI/NFPA 54 ANSI/NFPA 70 ANSI/UL 1453 requirements for water heaters.

B. Conform to ASME Section VIIIID for manufacture of pressure vessels for heat exchangers.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, protect and handle products to site under provisions of Section Division One.

B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.9 WARRANTY

A. Provide five-year warranty under provisions of Division One.

B. Warranty: Include coverage of domestic water heaters, water storage tanks, and packaged water heating systems.

1.10 EXTRA MATERIALS

A. Furnish under provisions of Division One.

B. Provide two sets of electric heater elements.

1.11 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.

2. Principle of how the equipment works

3. Important parts and assemblies

4. How the equipment achieves its purpose and necessary operating conditions

5. Most likely failure modes, causes and corrections

6. On site demonstration

PART 2 - PRODUCTS

2.1 COMMERCIAL ELECTRIC WATER HEATERS

A. Manufacturers:

1. A.O. Smith

2. Other acceptable manufacturers offering equivalent products.
   a. State
   b. Rheem.
   d. Bock.

B. Type: Factory-assembled and wired, electric, vertical storage.
C. Tank: Glass lined welded steel; 4-inch diameter inspection port (when applicable), thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.

D. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F (16 to 82 degrees C), flanged or screw-in nichrome elements, high temperature limit thermostat.

E. Accessories: Brass water connections and dip tube, drain valve, high-density magnesium anode, and ASME rated temperature and pressure relief valve.

F. Provide training per 1.11.

2.2 DOMESTIC HOT WATER STORAGE TANKS

A. Manufacturers:

1. AO Smith

2. Other acceptable manufacturers offering equivalent products.
   a. Lochinvar
   b. Rheem
   c. PVI

B. Tank: Welded steel, ASME labeled for working pressure of 125 psig, steel support saddles, tappings for accessories, threaded connections of stainless steel, access manhole.

C. Lining: 0.015 inches epoxy, continued into flanged connections.

D. Openings: Up to 3 inches, copper-silicone threaded; over 4 inches, flanged.

E. Accessories: Tank drain, water inlet and outlet, thermometer range of 40 to 200 degrees F (4 to 93 degrees C), ASME pressure relief valve suitable for maximum working pressure.

F. Provide training per 1.11.

2.3 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Manufacturer:

1. Taco.

2. Other acceptable manufacturers offering equivalent products.
   a. Watts.
   b. Bell and Gossett.

B. Construction: Welded steel, tested and stamped in accordance with Section 8D of ASME Code; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

C. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to 12 psig.

2.4 IN-LINE CIRCULATOR PUMPS
A. Manufacturers:

1. Bell & Gossett.

2. Other acceptable manufacturers offering equivalent products.
   a. TACO.
   b. Grundfos.

B. Casing: Bronze, rated for 125 psig working pressure.

C. Impeller: Bronze.

D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.

E. Seal: Carbon rotating against a stationary ceramic seat.

F. Drive: Flexible coupling.

2.5 SUBMERSIBLE SUMP PUMPS

A. Manufacturers:

1. Weil.

2. Other acceptable manufacturers offering equivalent products.
   a. Aurora.
   b. Chicago
   c. Myers

B. Type: Completely submersible vertical centrifugal.

C. Casing: Cast iron pump body and oil filled motor chamber totally enclosed.

D. Impeller: Bronze; closed, stainless steel shaft.

E. Bearings: Ball bearings.

F. Accessories: Oil resistant 6-foot cord and plug with three-prong connector for connection to electric wiring system including grounding connector. Gas tight steel cover with openings for discharge piping, float rods, conduit and an accessible manhole cover.

G. Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks. Design shall permit removal of motor-shaft-impeller assembly without disconnecting piping or removing pump casing from the basin.

H. Motor control panel containing across-the-line electric motor starters with ambient compensated quick trip overloads in each phase with manual trip button and reset button, circuit breaker, control transformer, electro mechanical alternator, hand-off-automatic selector switches, pilot lights, high water alarm pilot light, reset button and alarm horn. Provide an auxiliary set of contacts for connection or remote alarm circuit. Provide mercury switch liquid level controls, steel shell switch encased in polyurethane foam with cast iron weight for pump on (each pump), pump off (common), and alarm.

1. Provide relay outputs to EMCS for pump alarm and high-water level.
I. Provide training per 1.11.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install water heaters in accordance with manufacturer's instructions and to AGA NSF ANSI/NFPA 54 UL requirements.

B. Coordinate with plumbing piping and related work to achieve operating system.

3.2 DOMESTIC HOT WATER STORAGE TANK INSTALLATION

A. Install tanks in accordance with manufacturer's instructions.

B. Provide steel pipe support for tanks, independent of building structural framing members.

C. Clean and flush tank after installation. Seal until pipe connections are made.

3.3 PUMP INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Ensure shaft length allows sump pumps to be located minimum 24 inches below lowest invert into sump pit and minimum 6 inches clearance from bottom of sump pit.

C. Provide air cock and drain connection on horizontal pump casings.

D. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.

E. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.

F. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

G. Align and verify alignment of base mounted pumps prior to start-up. Provide alignment certificate to engineer prior to start-up.

END OF SECTION 22 30 00
SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the fixtures covered by this Section, with all appurtenances, ready for the Owner’s use.

B. Include the following work in addition to items normally part of this Section:

   1. Plumbing Fixtures
   2. Fixture Carriers
   3. Faucets, Supplies, and Trim
   4. Flushometers

1.3 RELATED WORK

A. Section 22 05 29 – Hangers and Support for Plumbing Piping and Equipment

B. Section 22 10 00 – Plumbing Piping

C. Section 22 11 19 – Plumbing Specialties

D. Section 22 30 00 – Plumbing Equipment

1.4 REFERENCES

A. ASME A112.4.3 – Plastic Fittings for Connecting Water Closets to the Sanitary Drainage System

B. ASME A112.6.1M – Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use

C. ASME A112.18.1 – Plumbing Supply Fittings

D. ASME A112.18.2 – Plumbing Waste Fittings

E. ASME A112.18.9 – Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures

F. ASME A112.19.1 – Enameled Cast Iron and Enameled Steel Plumbing Fixtures
G. ASME A112.19.2 – Ceramic Plumbing Fixtures

H. ASME A112.19.3 – Stainless Steel Plumbing Fixtures

I. ASME A112.19.7 – Hydromassage Bathtub Systems

J. NSF/ANSI 61 – Drinking Water System Components – Health Effects

K. ANSI Z358.1 – Emergency Eyewash and Shower Equipment

L. ASSE 1016 – Performance Requirements for Individual Thermostatic, Pressure Balancing, and Combination Pressure Balancing and Thermostatic Control Valves for Individual Fixture Fittings.

M. ASSE 1037 – Performance Requirements for Pressurized Flushing Devices for Plumbing Fixtures

N. ADA (Americans with Disabilities Act)

O. TAS (Texas Accessibility Standards)

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

B. Warranty: Warrant the work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from defective or non-conforming materials and workmanship.

C. Defects shall include, but not necessarily be limited to, the following:

   1. Noisy operation.
   2. Noticeable deterioration of finish.
   3. Leakage of water.

1.6 SUBMITTALS

A. Submit under provisions of Division One.

B. Submit product data under provisions of Division One.

C. Include component sizes, rough-in requirements, service sizes, finishes, materials, dimensions, performance information, and accessories.

D. Manufacturer’s Installation Instructions: Indicate assembly and support requirements.

1.7 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Division One.

B. Provide pre-printed operating and maintenance instructions for each item specified. Instruct and demonstrate the proper operation and maintenance to the Owner's designated representative.

1.8 DELIVERY, STORAGE, AND HANDLING

A. DELIVERY: Deliver clearly labeled specialties to; and store, protect and handle products on site in accordance with the provisions of Division One.

B. TIMING AND COORDINATION: Arrange for delivery of materials to allow for minimum storage time at the project site. Coordinate with the scheduled time of installation.

C. ACCEPTANCE: Accept specialties on site in original factory packaging. Inspect for damage. Damaged specialties shall not be acceptable.

D. STORAGE: Store materials in a clean, dry location, protected from weather and damage.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on the Contract Documents.

B. Confirm and field coordinate that millwork is constructed with adequate provisions for the installation of countertop lavatories and sinks.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. GENERAL: Provide plumbing fixtures in accordance with manufacturer’s recommendations and as indicated and scheduled on Drawings. Acceptable manufacturers of each fixture type are as indicated below.

1. Provide floor-affixed fixture carriers as appropriate for all wall-hung plumbing fixtures unless specifically noted otherwise.

2. Fixture drilling shall match faucet spread and match any related trim and accessories.

B. WATER CLOSETS, URINALS, LAVATORIES (Vitreous China)

1. American Standard

2. Zurn

3. Sloan

4. Toto

C. WATER CLOSETS, URINALS, LAVATORIES, COMBINATION UNITS (Stainless Steel, Security Fixtures)
1. Acorn
2. Willoughby

D. SINKS – COUNTER MOUNTED (Stainless Steel)
1. Elkay
2. Just
3. Moen Commercial

E. MOP SINKS
1. Stern-Williams
2. Fiat
3. E.L. Mustee & Sons

F. EMERGENCY SAFETY FIXTURES
1. Bradley
2. Guardian
3. Chicago
4. Haws

G. DRINKING FOUNTAINS AND WATER COOLERS
1. Halsey Taylor
2. Elkay
3. Haws
4. Oasis

2.2 FAUCETS, SUPPLIES, AND TRIM

A. GENERAL: Provide faucets, supplies, and trim in accordance with manufacturer’s recommendations, as appropriate for fixtures to be served, and as indicated and scheduled on Drawings. Acceptable manufacturers for each type of appurtenance are as indicated below.

1. Flushometer flush rate shall match gallon-per-flush criteria of fixtures served.

2. Strainers shall be heavy cast brass chrome plated with matching grid type strainer, with or without overflow as required, 17-gauge seamless brass tailpiece of length determined by installation requirements. Provide complete with washers and brass locknut.
3. P-traps shall be 17-gauge seamless chrome plated brass, adjustable type. Provide complete with cleanout plug, chrome plated brass slip nuts, wall bend, and wrought brass escutcheon of depth determined by installation requirements.

4. Angle stops shall be lead-free commercial pattern chrome plated brass, quarter turn ball type with loose key handles. Provide complete with chrome plated copper supply risers and wrought brass escutcheon of depth determined by installation requirements.

5. Toilet seats shall be commercial grade and provided complete with stainless steel posts and self-sustaining check hinges.

6. Pipe trim insulation shall be compliant, white molded vinyl, fade/discoloration-resistant, bacteria/fungal-resistant insulation.

B. FAUCETS

1. Chicago
2. T&S Brass
3. Zurn
4. Moen Commercial
5. Delta Commercial
6. American Standard
7. Symmons Commercial

C. SHOWER VALVES

1. Acorn
2. Bradley
3. Symmons Commercial
4. Chicago
5. Powers
6. Zurn

D. FLUSHOMETERS

1. Sloan
2. Zurn
3. Moen Commercial
4. Delta Commercial
5. American Standard
6. Toto

E. SUPPLY STOPS
1. McGuire
2. Zurn
3. Chicago

F. CHROME PLATED TUBULAR BRASS
1. McGuire
2. Zurn

G. TOILET SEATS
1. Church
2. Bemis
3. American Standard
4. Zurn
5. Toto

H. PIPE TRIM INSULATION
1. Truebro
2. McGuire
3. Plumberex

2.3 FIXTURE CARRIERS

A. GENERAL: ANSI/ ASME A112.6.1M; Provide floor-affixed fixture carriers as appropriate for all wall-hung plumbing fixtures unless specifically noted otherwise. Fixture carrier foot supports shall be securely anchored to the floor with 1/2” bolts and anchors at all locations.

1. Chair type carriers shall be adjustable, with coated cast iron body with integral no hub waste and vent connections, complete with gasketed adjustable faceplate assembly, adjustable nipple with test cap, neoprene bowl gasket, lugs for floor and wall attachment, threaded fixture studs, and hardware. Provide single or double type of vertical or horizontal configuration as required and with auxiliary inlet as required.
2. Lavatory carriers shall be adjustable, with steel uprights and welded base feet, coated cast iron support brackets, cast or ductile iron concealed support arms, alignment rod, complete with leveling and support hardware. Provide single or back to back configuration as required.

3. Drinking fountain and urinal carriers shall be adjustable, with steel uprights and welded base feet, upper and lower bearing plates, threaded rods, and mounting hardware. Provide single or side-by-side configuration as required

B. ACCEPTABLE MANUFACTURERS

1. J.R. Smith
2. Zurn
3. Mifab
4. Watts
5. Wade
6. Josam

PART 3 - EXECUTION

3.1 PREPARATION

A. EXAMINATION OF CONDITIONS: Examine conditions affecting this work. Report unsatisfactory factory conditions to the proper authority and do not proceed until those conditions have been corrected. Commencing work implies acceptance of existing conditions as satisfactory to the outcome of this work.

B. Coordinate cutting, forming of roof or floor construction to receive drains to required invert elevations.

3.2 INSTALLATION

A. Install fixtures in locations and heights as shown on Drawings and as directed by the Architect.

B. Install materials plumb, level, securely, and in accordance with manufacturer's recommendations.

C. All rough-in pipe openings for final connections with supply, waste, vent, and storm systems shall be closed with caps or plugs during early stages of construction and installation. Tape shall not be considered sufficient protection.

D. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

E. Provide ball valves in piping serving batteries of fixtures. Label stops "Hot" and "Cold." Valves shall be located above accessible ceilings. If ceilings are not accessible, provide access panels of
adequate size to ensure valves are fully accessible and can be fully operated.

F. Provide lockable ball valves in piping serving emergency safety fixtures and clearly label such valves as to the fixtures served.

G. Plumbing fixtures shall be supported by a concealed carrier where required to properly support the fixture specified. All carriers to be securely mounted, bolted and checked prior to concealment.

H. Caulk around fixtures with best grade white silicone caulking. Do not use grout.

I. All handles on supply and drainage fittings or other brass items shall be properly lined up and adjusted. Fittings shall not be left in any haphazard manner.

J. All fixtures shall have individual chrome plated heavy pattern loose key quarter-turn cutoff stops on supply lines, complete with escutcheons. Where same are not specified as a part of the fixture trim, they shall be installed as close to fixtures as possible in the hot and cold water supply.

K. Install each fixture with trap, easily removable for servicing and cleaning.

L. All showers and similar installations shall be installed with type “L” copper pipe between shower valve and shower head rough-in. The termination point shall have a brass drop ear elbow for shower head arm connection. Contractor shall provide proper anchoring support.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

B. Review architectural drawings. Confirm configuration and orientation of shower controls and trim prior to rough-in and installation.

3.4 ADJUSTING

A. Adjust work under provisions of Division One.

B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.5 CLEANING

A. Clean work under provisions of Division One.

B. At completion clean plumbing fixtures and appurtenances.

3.6 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Division One.

B. Do not permit use of fixtures.

3.7 ADA ACCESSIBLE FIXTURES
A. At all locations required to be accessible, such fixtures, controls, and final installations shall comply with the requirements of ADA and any applicable state accessibility standards. Install fixtures to heights, indicated on architectural drawings.

B. All exposed water supply and drain pipes under accessible lavatories and sinks shall be insulated with securely fastened pipe trim insulation kits of the proper model for the fixtures specified.

C. Wall mounted drinking fountains and coolers which protrude into passages or corridor space, whether single or paired with an adjacent accessible fixture, shall be supplied with a matching skirt or apron to lower the underside clearance of the non-accessible fixture equal to that required for accessible fixture.

END OF SECTION 22 40 00
SECTION 23 02 00 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings is deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted to the Architect/Engineer for review as soon as practicable. No such departures shall be made without the prior written approval of the Architect/Engineer.

C. Notwithstanding any reference in the Specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, such reference shall not be construed as limiting competition; and the Contractor, in such cases, may at his option use any article, device, product, material, fixture, form or type of construction which in the judgment of the Architect/Engineer, expressed in writing, is the equivalent of that specified.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form complete and functioning systems in all of their various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The Contractor shall review all pertinent drawings, including those of other contracts, prior to commencement of Work.

B. This Division requires the furnishing and installing of all items as specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Mechanical (HVAC) items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.
D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

E. All discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to bidding. Where this cannot be done at least 7 working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning heating, ventilating and air conditioning system shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. The Contractor shall participate in the commissioning process as required; including, but not limited to, meeting attendance, completion of checklists, and participation in functional testing.

1.3 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The Contract Documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the reviewed shop drawings.

B. All duct or pipe or equipment locations as indicated on the documents do not indicate every transition, offset, or exact location. All transitions, offsets, clearances and exact locations shall be established by actual field measurements, coordination with the structural, architectural and reflected ceiling plans, and other trades. Submit shop drawings for review.

C. All transitions, offsets and relocations as required by actual field conditions shall be performed by the Contractor at no additional cost to the Owner.

D. Additional coordination with electrical contractor may be required to allow adequate clearances of electrical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.
1.4 SITE VISIT AND FAMILIARIZATION

A. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

B. Understand the existing utilities from which services will be supplied; verify locations of utility services and determine requirements for connections.

C. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.5 WORK SPECIFIED IN OTHER SECTIONS

A. Finish painting is specified. Prime and protective painting are included in the work of this Division.

B. Owner and General Contractor furnished equipment shall be properly connected to Mechanical (HVAC) systems.

C. Furnishing and installing all required Mechanical (HVAC) equipment control relays and electrical interlock devices, conduit, wire and J-boxes are included in the Work of this Division.

1.6 PERMITS, TESTS, INSPECTIONS

A. Arrange and pay for all permits, fees, tests, and all inspections as required by governmental authorities.

1.7 DATE OF FINAL ACCEPTANCE

A. The date of final acceptance shall be the date of Owner occupancy, or the date all punch list items have been completed, or the date final payment has been received. Refer to Division One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the Architect, Owner and Contractor.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct - properly protected from incidental damage and weather damage.
C. Damaged equipment, duct or pipe shall be promptly removed from the site and new, undamaged equipment, pipe or duct shall be installed in its place promptly with no additional charge to the Owner.

1.9 NOISE AND VIBRATION

A. The heating, ventilating and air conditioning systems, and the component parts thereof, shall be guaranteed to operate without objectionable noise and vibration.

B. Provide foundations, supports and isolators as specified or indicated, properly adjusted to prevent transmission of vibration to the building structure, piping and other items.

C. Carefully fabricate ductwork and fittings with smooth interior finish to prevent turbulence and generation or regeneration of noise.

D. All equipment shall be selected to operate with minimum of noise and vibration. If, in the opinion of the Architect, objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of the Work, the Contractor shall rectify such conditions without extra cost to the Owner.

1.10 APPLICABLE CODES

A. Obtain all required permits and inspections for all work required by the Contract Documents and pay all required fees in connection thereof.

B. Arrange with the serving utility companies for the connection of all required utilities and pay all charges, meter charges, connection fees and inspection fees, if required.

C. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations and the applicable requirements which includes and is not limited to the following nationally accepted codes and standards:

1. Air Moving & Conditioning Association, AMCA.

2. American Standards Association, ASA.


4. American Society of Mechanical Engineers, ASME.

5. American Society of Plumbing Engineers, ASPE.

6. American Society of Testing Materials, ASTM.

7. American Water Works Association, AWWA.

8. National Bureau of Standards, NBS.


10. Sheet Metal & Air Conditioning Contractors' National Association, SMACNA.
11. Underwriters' Laboratories, Inc., UL.


D. Where differences existing between the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the nationally accepted codes and standards, the more stringent or costly application shall govern. Promptly notify the Engineer in writing of all differences.

E. When directed in writing by the Engineer, remove all work installed that does not comply with the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, correct the deficiencies, and complete the work at no additional cost to the Owner.

1.11 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 01.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean
supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor, or its Subcontractor or Sub-subcontractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor or, when so noted, by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances) or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by the latest ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.12 DRAWINGS AND SPECIFICATIONS

A. These Specifications are intended to supplement the Drawings and it will not be the province
of the Specifications to mention any part of the Work which the Drawings are competent to fully explain in every particular and such omission is not to relieve the Contractor from carrying out portions indicated on the Drawings only.

B. Should items be required by these Specifications and not indicated on the Drawings, they are to be supplied even if of such nature that they could have been indicated thereon. In case of disagreement between Drawings and Specifications, or within either Drawings or Specifications, the better quality or greater quantity of work shall be estimated, and the matter referred to the Architect or Engineer for review with a request for information and clarification at least 7 working days prior to bid opening date for issuance of an addendum.

C. The listing of product manufacturers, materials and methods in the various sections of the Specifications, and indicated on the Drawings, is intended to establish a standard of quality only. It is not the intention of the Owner or Engineer to discriminate against any product, material or method that is the equivalent of the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturer’s standard product will meet the requirements of the project design, Drawings, Specifications and space constraints.

D. The Architect or Engineer and Owner shall be the sole judge of quality and equivalence of equipment, materials and methods.

E. Products by other reliable manufacturers, other materials, and other methods, will be accepted as outlined, provided they have equivalent capacity, construction, and performance. However, under no circumstances shall any substitution be made without the written permission of the Architect or Engineer and Owner. Request for prior approval must be made in writing 10 days prior to the bid date without fail.

F. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method is the only one that shall be used without prior approval.

G. Wherever a definite material or manufacturer's product is specified and the Specification states that products of similar design and equivalent construction from the specified list of manufacturers may be substituted, it is the intention of the Owner or Engineer that products of manufacturers that are specified are the only products that will be acceptable and that products of other manufacturers will not be considered for substitution without approval.

H. Wherever a definite product, material or method is specified and there is a statement that "OR EQUIVALENT" product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method or an "OR EQUIVALENT" product, material or method may be used if it complies with the Specifications and is submitted for review to the Engineer as outline herein.
I. Where permission to use substituted or alternative equipment on the project is granted by the Owner or Engineer in writing, it shall be the responsibility of the Contractor or Subcontractor involved to verify that the equipment will fit in the space available which includes allowances for all required Code and maintenance clearances, and to coordinate all equipment structural support, plumbing and electrical requirements and provisions with the Mechanical (HVAC) Design Documents and all other trades, including Division 26.

J. Changes in architectural, structural, electrical, mechanical, and plumbing requirements for the substitution shall be the responsibility of the bidder wishing to make the substitution. This shall include the cost of redesign by the affected designer(s). Any additional cost incurred by affected Subcontractors shall be the responsibility of this bidder and not the Owner.

K. If any request for a substitution of product, material or method is rejected, the Contractor will automatically be required to furnish the product, material or method named in the Specifications. Repetitive requests for substitutions will not be considered.

L. The Owner or Engineer will investigate all requests for substitutions when submitted in accordance with the requirements listed above; and if accepted, will issue a letter allowing the substitutions.

M. Where equipment other than that used in the design as specified or shown on the Drawings is substituted (either from an approved manufacturers list or by submittal review), it shall be the responsibility of the substituting Contractor to coordinate space requirements, building provisions and connection requirements with his trades and all other trades; and to pay all additional costs to other trades, the Owner, the Architect or Engineer, if any, due to the substitutions.

1.13 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty-day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

1. A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.

2. An index page with a listing of all data included in the Submittal.
3. A list of variations page with a listing of all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.

4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.

5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.

6. Identification of each item of material or equipment matching that indicated on the Drawings.

7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.

8. Additional information as required in other Sections of this Division.

9. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 00 and Division 01 for additional information on shop drawings and submittals.

C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.
E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

1. REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.

2. REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.

3. NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not approved. The Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or Drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.

4. REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit. The Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.

5. CONTRACTOR’S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor’s stamp is required stating that the submittal meets all conditions of the Contract Documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.

6. MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified. The Contractor will automatically be required to furnish the product, material or method named in the Specifications. Contractor shall not order equipment when submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without submittal review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.
H. Submittals are required for, but not limited to, the following items subject to project requirements:

1. Coordination Drawings
2. Common Motor Requirements for HVAC Equipment
3. Expansion Fittings and Loops for HVAC Piping
4. Variable Frequency Motor Speed Control for HVAC Equipment
5. Hangers and Support for Piping and Equipment HVAC
6. Vibration and Seismic Controls for HVAC Piping and Equipment
7. Testing, Adjusting, and Balancing
8. Duct Insulation
9. HVAC Equipment Insulation
10. HVAC Piping Insulation
11. Energy Management and Control System
12. Above Ground Hydronic Piping
13. Hydronic Specialties
14. Hydronic Pumps
15. Refrigerant Piping
16. Metal Ductwork
17. Ductwork Accessories
18. HVAC Fans
19. Series Fan Powered Terminal Units
20. Single Duct VAV Terminal Box
21. Air Distribution Devices
22. Air Filters
23. Air Cooled Condensing Units
24. Air Cooled Water Chiller
25. Modular Indoor Central Station Air Handling Units
26. Fan Coil Unit

I. Refer to other Division 23 sections for additional submittal requirements. Provide samples of actual materials and/or equipment to be used on the Project upon request of the Owner or Engineer.

1.14 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access, and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:
   a. Wall and type locations.
   b. Clearances for installing and maintaining insulation.
   c. Locations of light fixtures and sprinkler heads.
   d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
   e. Equipment connections and support details.
   f. Exterior wall and foundation penetrations.
   g. Routing of storm and sanitary sewer piping.
   h. Fire-rated wall and floor penetrations.
   i. Sizes and location of required concrete pads and bases.
   j. Valve stem movement.
   k. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.
C. By submitting coordination drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 RECORD DOCUMENTS

A. Prepare Record Documents in accordance with the requirements in Special Project Requirements, in addition to the requirements specified in Division 23, indicate the following installed conditions:

1. Duct mains and branches, size and location, for both exterior and interior; locations of dampers, fire dampers, duct access panels, and other control devices; filters, fuel fired heaters, fan coils, condensing units, and roof-top A/C units requiring periodic maintenance or repair.

2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.

3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.


5. Contract Modifications, actual equipment and materials installed.

B. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.

C. The Contractor shall maintain a set of clearly marked black line record "AS-BUILT" prints on the job site on which he shall mark all work details, alterations to meet site conditions and changes made by "Change Order" notices. These shall be kept available for inspection by the Owner, Architect or Engineer at all times.

D. Refer to Division 00 and Division 01 for additional requirements concerning Record Drawings. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect. Mark the drawings with a colored pencil. Delivery of as-built prints and re-producibles is a condition of substantial completion.

E. The record prints shall be updated on a daily basis and shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents which are required for coordination. All dimensions shall include at least two dimensions to permanent structure points.

F. Submit three prints of the tracings for review. Make corrections to tracings as directed and deliver "Auto Positive Tracings" to the Architect. "As-Built" drawings shall be furnished in
addition to submittals.

G. When the option described in paragraph F above is not exercised, then upon completion of the Work, the Contractor shall transfer all marks from the tracings and submit a set of clear concise reproducible record "AS-BUILT" drawings and shall submit the reproducible drawings with corrections made by a competent draftsman and three (3) sets of black line prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the Work. The reproducible record "AS-BUILT" drawings shall have the Engineer’s Name and Seal removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS

DATE:

(NAME OF GENERAL CONTRACTOR)

BY: ____________________________
(SIGNATURE)

(NAME OF SUBCONTRACTOR)

BY: ____________________________
(SIGNATURE)

1.16 OPERATING AND MAINTENANCE MANUALS

A. Prepare operating and maintenance manuals in accordance with Division 00 and Division 01 and, in addition to the requirements specified in those Divisions, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

1.17 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and scheduled date for each test. This detailed completion and test schedule shall be submitted at least 90 days before the projected substantial completion date.
B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of substantial completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to, those items outlined in Section 23 02 00.

1.18 OPERATING AND MAINTENANCE MANUALS

A. Coordinate with Division 00 and Division 01 for operating and maintenance manual requirements. Unless noted otherwise, bind together in “D ring type” binders (National model no. 79-883 or equal). Binders shall be large enough to allow ¼” of spare capacity. Three (3) sets of all reviewed submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under these Specifications. All sections shall be typed and indexed into sections and labeled for easy reference and shall utilize the individual specification section numbers shown in the Mechanical Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 23 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

B. Prepare maintenance manuals in accordance with Special Project Conditions. In addition to the requirements specified in Division 23, include the following information for equipment items:

1. Identifying names, name tag designations and locations for all equipment.

2. Valve tag lists with valve number, type, color coding, location and function.

3. Reviewed submittals with exceptions noted compliance letter.

4. Fabrication drawings.

5. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable (i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts).

6. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

7. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.

8. Equipment and motor name plate data.
10. Exploded parts views and parts lists for all equipment and devices.
11. Color coding charts for all painted equipment and piping.
12. Location and listing of all spare parts and special keys and tools furnished to the Owner.
13. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

C. Refer to Division 00 and Division 01 for additional information on Operating and Maintenance Manuals.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer for review a minimum of 14 working days prior to the beginning of the operator training period.

1.19 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include a minimum of 12 hours of onsite training in three 4-hour shifts.

B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period, obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

C. Refer to other Division 23 Sections for additional Operator Training requirements.

1.20 FINAL COMPLETION

A. At the completion of the Work, all equipment and systems shall be tested, and faulty equipment and material shall be repaired or replaced. Refer to Sections of Division 23 for additional requirements.

B. Clean and adjust all air distribution devices and replace all air filters immediately prior to Substantial Completion.

C. Touch up and/or refinish all scratched equipment and devices immediately prior to Substantial Completion.

1.21 CONTRACTOR'S GUARANTEE

A. Use of the HVAC systems to provide temporary service during construction period will not be allowed without permission from the Owner in writing; and, if granted, shall not cause the warranty period to start, except as defined below.
B. Contractor shall guarantee to keep the entire installation in repair and perfect working order for a period of one year after the date of the Substantial Completion, and shall furnish (free of additional cost to the Owner) all materials and labor necessary to comply with the above guarantee throughout the year beginning from the date of Substantial Completion, Beneficial Occupancy by the Owner, or the Certificate of Final Payment as agreed upon by all parties.

C. This guarantee shall not include cleaning or changing filters except as required by testing, adjusting and balancing.

D. All air conditioning compressors shall have parts and labor guarantees for a period of not less than 5 years beyond the date of Substantial Completion.

E. Refer to Sections in Division 23 for additional guarantee or warranty requirements.

1.22 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner’s risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney’s fees arising out of or resulting thereof.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently, or otherwise, without authorization of the data’s creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long-term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be at the Contractor’s sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect’s written consent.

1. It is agreed that “MEP” hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The Contract Documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.

2. If the client, Architect/Owner, or developer of the project requires electronic media for “record purposes”, then an AutoCAD based compact disc (“CD”) will be prepared.
The “CD” will be submitted with all title block references intact and will be formatted in a “plot” format to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

F. At the Architect/Owner’s request, Engineer will prepare one “CD” of electronic media to assist the Contractor in the preparation of submittals. The Engineer will prepare and submit the “CD” to the Architect/Owner for distribution to the Contractor.

1. The “CD” will be prepared, and all title blocks, names and dates will be removed. The “CD” will be prepared in a “.dwg” format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide materials and equipment manufactured by a domestic United States manufacturer and assembled in the United States for all local and Federal Government projects. These materials and equipment shall comply with “Buy American Act.”

B. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts and other apparatus where concealed. Access doors shall have concealed hinges and screw driver cam locks.

C. All access doors located in wet areas such as restrooms, locker rooms, shower rooms, kitchen and any other wet areas shall be constructed of stainless steel.

D. Access Doors: shall be as follows:

1. Plaster Surfaces: Milcor Style K.

2. Ceramic Tile Surface: Milcor Style M.

3. Drywall Surfaces: Milcor Style DW.

4. Install doors only in locations approved by the Architect.

2.2 EQUIPMENT PADS (See 2.04 in Section 26 02 00)

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected via reviewed submittals.

B. Refer to equipment specifications in Divisions 2 through 48 for additional rough-in requirements.
3.2 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.

2. Verify all dimensions by field measurements.

3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.

4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

8. Install systems, materials, and equipment to conform with architectural action markings on submittal, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, resolve conflicts and submit proposed solution to the Architect for review.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as possible, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location and label.

11. Install access doors where units are concealed behind finished surfaces. Refer to paragraph 2.01 in this section and architect for access doors specifications and location.

12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

13. Provide roof curbs for all roof mounted equipment. Coordinate with roof construction for pitched roof. Provide roof curbs which match the roof slope and provides a level top for equipment installation. Refer to Architectural drawings and details.
14. The equipment to be furnished under these Specifications shall be essentially the standard product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the product of the same manufacturer.

15. The Architectural and Structural features of the building and the space limitations shall be considered in selection of all equipment. No equipment shall be furnished which will not suit the arrangement and space limitations indicated.

16. Lubrication: Prior to start-up, check and properly lubricate all bearings as recommended by the manufacturer.

17. Where the word "Concealed" is used in these Specifications in connection with insulating, painting, piping, ducts, etc., it shall be understood to mean hidden from sight as in chases, furred spaces or suspended ceilings. "Exposed" shall be understood to mean the opposite of concealed.

18. Identification of Mechanical Equipment:
   a. Mechanical equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic or etched metal. Submittals shall include dimensions and lettering format for approval. Attachment shall be with escutcheon pins, self-tapping screws, or machine screws.
   b. Tags shall be attached to all valves, including control valves, with nonferrous chain. Tags shall be brass and at least 1-1/2 inches in diameter. Nameplate and tag symbols shall correspond to the identification symbols on the temperature control submittal and the "as-built" drawings.

19. Provide construction filters for all air handling units, fain coil unit, UAV boxes, and all other air handling equipment during the entire construction period.

3.3 CUTTING AND PATCHING

A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
   1. Uncover Work to provide for installation of ill-timed Work.
   2. Remove and replace defective Work.
   3. Remove and replace Work not conforming to requirements of the Contract Documents.
   4. Remove samples of installed Work as specified for testing.
   5. Install equipment and materials in existing structures.
   6. Upon written instructions from the Engineer, uncover and restore Work to provide for
Engineer/Owner's observation of concealed Work, without additional cost to the Owner.

7. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers; refer to the materials and methods required for the surface and building components being patched; Refer to Paragraph 1.11 I for definition of "Installer."

C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, mechanical ducts and HVAC units, and other mechanical items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.4 WORK SEQUENCE, TIMING, COORDINATION WITH OWNER, ARCHITECT AND ENGINEER

A. The Owner will cooperate with the Contractor; however, the following provisions must be observed:

1. A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Sub-Contractors and the Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.

2. During the construction of this project, normal facility activities will continue in existing buildings until renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems shall be maintained in service within the occupied spaces of the existing building.

3. Contractor shall not start-up any of the HVAC equipment unless the Owner, Architect and Engineer are signed off.

4. Start-up for major HVAC equipment such as chillers, cooling towers, variable frequency drives and hot water boilers shall be performed by a factory technician. The start-up shall include a written report signed off by Contractor, Engineer and Owner.

3.5 DEMOLITION AND WORK WITHIN EXISTING BUILDINGS

A. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to, the existing piping, duct, equipment and other apparatus related to this phase of the Work. However, this Contractor shall be responsible for verifying all of the above information. This Contractor shall visit the existing site to inspect the facilities and related areas. This Contractor shall inspect and verify all details and requirements of all
the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by the contractor, who shall produce drawings that shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be a part of this Contract.

B. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify its working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.

C. All equipment and/or systems noted on the Drawings "To Be Removed" shall be removed including, associated pipe and duct, pipe and duct hangers and/or line supports. Where duct or pipe is to be capped for future or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric motor or connection, the Electrical Contractor shall disconnect motor or connection, remove wiring to a safe point and this Contractor shall remove or relocate motor or connection along with the equipment.

D. During construction and remodeling, portions of the Project shall remain in service. Construction equipment, material, tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility; or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades, other separations in corridors and other spaces where work is conducted.

E. Certain work during the demolition and construction phases may require overtime or night time shifts or temporary evacuation of the occupants. Coordinate and schedule all proposed down time with the Owner at least seventy-two (72) hours in advance in writing.

F. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.

G. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.

H. Make every effort to minimize damage to the existing building and the Owner's property. Repair, patch or replace as required any damage that occurs as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.

I. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the Drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, and ventilation services for the existing areas with a minimum of interruption.

J. All existing pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.
K. Pipe, duct, equipment and controls serving mechanical and other Owner's equipment, etc., which is to remain but is served by pipe, duct, equipment and controls that are disturbed by the remodeling work, shall be reconnected in such a manner as to leave this equipment in proper operating condition.

L. No portion of the fire protection systems shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner’s representative in order to protect systems that shall remain in service.

M. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.

N. Refer to Architectural Demolition and/or Alteration plans for actual location of walls, ceilings, etc., being removed and/or remodeled.

END OF SECTION
SECTION 23 02 01 - COORDINATION DRAWINGS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions 013100 and Supplementary Conditions apply to all Work herein.

1.2 COORDINATION DRAWINGS

A. The Mechanical Contractor shall take the lead in coordinating the Mechanical, Electrical, Plumbing, and Fire Protection systems within the building.

B. The Mechanical Contractor shall coordinate a three-dimensional (3D) model of the building which includes the Mechanical, Electrical, Plumbing, and Fire Protection systems. The Electrical, Plumbing, and Fire Protection Contractors shall prepare their work and generate 3D models which will be given to the Mechanical Contractor for coordination. The Contractor will be provided with the REVIT model that was used to generate the contract documents, this file may be used as the background file. The Contractor shall replace the systems drawn with the actual shop drawing models. The Contractor is not limited to using REVIT but may use any 3-D software in generating and combining the coordination model.

C. Submitting the contract drawings as coordination drawings will not be acceptable.

D. The model shall include detailed and accurate representations of all equipment to be installed based upon the reviewed equipment submittals.

E. The Mechanical Contractor shall hold a 3-D coordination meeting with all subcontractors present to review the model and discuss coordination of the installation of the building systems.

F. Upon completion of the coordination meeting, the Contractor shall submit the 3-D model and 1/4” scale drawings for review.

G. The model shall detail major elements, components, and systems in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:
   a. Wall and type locations.
   b. Clearances for installing and maintaining insulation.
c. Locations of light fixtures and sprinkler heads.
d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
e. Equipment connections and support details.
f. Exterior wall and foundation penetrations.
g. Routing of storm and sanitary sewer piping.
h. Fire-rated wall and floor penetrations.
i. Sizes and location of required concrete pads and bases.
j. Valve stem movement.
k. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

H. Sequence of Coordination

Below is hierarchy of model elements and the sequencing by which the models will be coordinated.

1. Structural and Architectural model
2. Miscellaneous steel
3. Perform preliminary space allocation
4. Identify hard constraints (locations of access panels, lights, A/V space requirements, etc.)
5. Main and medium pressure ducts from the shaft out
6. Main graded plumbing lines and vents
7. Sprinkler mains and branches
8. Cold and hot water mains and branches
9. Lighting fixtures and plumbing fixtures
10. Smaller sized ducts and flex ducts

11. Smaller size cold water and hot water piping, flex ducts, etc.

I. The Contractor and Sub-Contractors shall not install any item until the coordination has been completed and reviewed by the Construction Manager, Owner, and A/E team.

J. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

K. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

END OF SECTION 23 02 01
SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 23 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

B. WORK SPECIFIED ELSEWHERE:

1. Painting
2. Automatic temperature controls.
3. Power control wiring to motors and equipment.

1.3 WARRANTY

Warrant the Work specified herein for one year and motors for five years beginning on the date of substantial completion against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

1.4 SUBMITTALS

A. SHOP DRAWINGS: Indicate size material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures variations, and accessories.

C. MOTOR NAMEPLATE INFORMATION: Manufacturer's name, address, utility and operating data.

D. Refer to Division One for additional information.

1.5 DELIVERY AND STORAGE

A. DELIVERY: Deliver clearly labeled, undamaged materials in the manufacturers' unopened containers.

B. TIME AND COORDINATION: Deliver materials to allow for minimum storage time at the project site. Coordinate delivery with the scheduled time of installation.
C. STORAGE: Store materials in a clean, dry location, protected from weather and abuse.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

A. APPROVED MANUFACTURERS: Provide motors by a single manufacturer as much as possible.

1. Baldor
2. Marathon
3. Siemens-Allis
4. General Electric
5. U.S. Motor

B. TEMPERATURE RATING: Provide insulation as follows:

1. CLASS B: 40 degrees C maximum.
2. CLASS F:
   a. Between 40 degrees C and 65 degrees C maximum.
   b. Totally enclosed motors.

C. STARTING CAPABILITY: As required for service indicated five starts minimum per hour.

D. PHASES AND CURRENT: Verify electrical service compatibility with motors to be used.

1. UP TO 1/2 HP: Provide permanent split, capacitor-start single phase with inherent overload protection.
2. 3/4 HP AND LARGER: Provide squirrel-cage induction polyphone.
3. Provide two separate windings on 2-speed polyphone motors.
4. Name plate voltage shall be the same as the circuit's normal voltage, serving the motor.

E. SERVICE FACTOR: 1.15 for polyphase; 1.35 for single phase.

F. FRAMES: U-frames 1.5 hp. and larger.

G. BEARINGS: Provide sealed re-greaseable ball bearings; with top mounted zerc lubrication fittings and bottom side drains minimum average life 100,000 hours typically, and others as follows:

6. Design for thrust where applicable.
7. PERMANENTLY SEALED: Where not accessible for greasing.

8. SLEEVE-TYPE WITH OIL CUPS: Light duty fractional hp. motors or polyphase requiring minimum noise level.

H. ENCLOSURE TYPE: Provide enclosures as follows:

a. CONCEALED INDOOR: ODP (Open Drip Proof).

b. EXPOSED INDOOR: Guard Protected.

c. OUTDOOR TYPICAL: Type II. TEFC.

d. OUTDOOR WEATHER PROTECTED: Type I. WPI.

EXPLOSION PROOF, XP: For use in hazardous locations.

I. OVERLOAD PROTECTION: Built-in sensing device for stopping motor in all phase legs and signaling where indicated for fractional horse power motors.

J. NOISE RATING: "Quiet" except where otherwise indicated.

K. EFFICIENCY: Minimum full load efficiency listed in the following table, when tested in accordance with IEEE Test Procedure 112A, Method B, including stray load loss measure.

<table>
<thead>
<tr>
<th>NEMA Efficiency</th>
<th>Motor Horsepower</th>
<th>INDEX Letter</th>
<th>Minimum Efficiency %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1800 RPM Synchronous Speed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-5</td>
<td>G</td>
<td>89.5</td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>G</td>
<td>91.0</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>91.7</td>
<td></td>
</tr>
<tr>
<td>15-20</td>
<td>E</td>
<td>93.0</td>
<td></td>
</tr>
<tr>
<td>25-30</td>
<td>E</td>
<td>93.6</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>D</td>
<td>94.1</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>C</td>
<td>94.5</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>C</td>
<td>95.0</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>C</td>
<td>95.0</td>
<td></td>
</tr>
<tr>
<td>100-125</td>
<td>B</td>
<td>95.4</td>
<td></td>
</tr>
<tr>
<td>150-200</td>
<td>B</td>
<td>95.8</td>
<td></td>
</tr>
</tbody>
</table>

2.2 MOTOR CONTROLLERS (STARTERS)

A. All motor controllers (for equipment furnished under Division 23) shall be furnished under Division 23 and installed under Division 26 unless otherwise noted on the plans.

Starters shall be provided for 3 phase motors 3/4 horsepower and greater.

B. Motor starters shall be furnished as follows.

GENERAL: Motor starters shall be Square D Company Class 8536 across-the-line magnetic type, full-voltage, non-reversing (FAVOR) starter. All starters shall be constructed and...
tested in accordance with the latest NEMA standards, sizes and horsepower. ICE sizes are not acceptable. Starters shall be mounted in a general-purpose dead front, painted steel enclosure and surface-mounted. Provide size and number of poles as shown and required by equipment served. Provide two speed, two winding or two speed, single winding motor starter as required for two speed motors.

a. CONTACTS: Magnetic starter contacts shall be double break solid silver alloy. All contacts shall be replaceable without removing power wiring or removing starter from panel. The starter shall have straight-through wiring.

b. OPERATING COILS: Operating coils shall be 120 volts and shall be of molded construction. When the coil fails, the starter shall open and shall not lock in the closed position.

c. OVERLOAD RELAYS: Provide manual reset, trip-free Class 20 overload relays in each phase conductor in of all starters. Overload relays shall be melting alloy type with visual trip indication. All 3 phase and single-phase starters shall have one overload relay in each underground conductor. Relay shall not be field adjustable from manual to automatic reset. Provide 6 overload relays for two speed motor starters.

d. PILOT LIGHTS: Provide a red running pilot light for all motor starters. Pilot lights shall be mounted in the starter enclosure cover. Pilot lights shall be operated from an interlock on the motor starter and shall not be wired across the operating coil.

e. CONTROLS: Provide starters with HAND-OFF-AUTOMATIC switches. Coordinate additional motor starter controls with the requirements of Division 23. Motor starter controls shall be mounted in the starter enclosure cover.

f. CONTROL POWER TRANSFORMER: Provide a single-phase 480-volt control power transformer with each starter for 120 volt control power. Connect the primary side to the line side of the motor starter. The primary side shall be protected by a fuse for each conductor. The secondary side shall have one leg fused and one leg grounded. Arrange transformer terminals so that wiring to terminals will not be located above the transformer.

g. AUXILIARY CONTACTS: Each starter shall have one normally open and one normally closed convertible auxiliary contact in addition to the number of contacts required for the "holding interlock", remote monitoring, and control wiring. In addition, it shall be possible to field-install three more additional auxiliary contacts without removing existing wiring or removing the starter from its enclosure.

h. UNIT WIRING: Unit shall be completely pre-wired to terminals to eliminate any interior field wiring except for line and load power wiring and HVAC control wiring.

i. ENCLOSURES: All motor starter enclosures shall be NEMA 1, general purpose enclosures or NEMA-3R if mounted exposed to high moisture conditions. Provide NEMA 4X when located by cooling towers.

j. POWER MONITOR: Provide a square "D" 8430 MPS phase failure and under-voltage relay, base and wiring required for starters serving all 3 phase motors. Set the under-voltage setting according to minimum voltage required for the motor to operate within its range.

C. APPROVED MANUFACTURERS: Controller numbers are based on first named manufacturer. Provide one of the following manufacturer's.
1. Siemens.

2. Square D.


4. Eaton.

2.3 COMBINATION MOTOR STARTERS

A. GENERAL: Combination motor starters shall consist of a magnetic starter and a fusible or non-fusible disconnect switch in a dead front, painted steel NEMA 1 enclosure unless otherwise noted and shall be surface-mounted. Size and number of poles shall as shown and required by equipment served. Combination motor starters shall be as specified for motor starters in Paragraph 2.01/B, except as modified herein.

B. DISCONNECT SWITCH: Disconnect switches shall be as specified in Section 26 28 16.

C. APPROVED MANUFACTURERS: Controller numbers are based on first named manufacturer. Provide one of the following manufacturer's.

1. Siemens.

2. Square D.


PART 3 - EXECUTION

3.1 All equipment shall be installed in accordance with the manufacturers’ recommendations and printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Contractors’ price shall include all items required as per manufacturers’ requirements.

3.3 INSTALLATION

A. GENERAL: Install in a professional manner. Any part or parts not meeting this requirement shall be replaced or rebuilt without extra expense to Owner.

B. Install rotating equipment in static and dynamic balance.

C. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building.

D. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.

END OF SECTION 23 05 13
SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 – Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Flexible pipe connections.

B. Expansion joints and compensators

C. Pipe loops, offsets, and swing joints.

1.3 RELATED WORK

A. Section 23 05 29 - Hangers and Supports for Piping and Equipment - HVAC

B. Section 23 21 13 - Above Ground Hydronic Piping

C. Section 23 23 00 - Refrigerant Piping.

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

B. Expansion Calculations:

1. Installation Temperature: 50 degrees F (10 degrees C).


3. Domestic Hot Water: 140 degrees F (60 degrees C).

4. Safety Factor: 30 percent.

C. Pipe sizes indicated are to establish a minimum quality of compensator. Refer to manufacturer’s literature for model series for different pipe sizes.

1.5 SUBMITTALS

A. Submit shop drawings under provisions of Division One.
B. Product Data:
   1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
   2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Design Data: Indicate selection calculations.

D. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

1.6 PROJECT RECORD DOCUMENTS
   A. Submit under provisions of Division One.
   B. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.7 OPERATION AND MAINTENANCE DATA
   A. Submit under provisions of Division One.
   B. Maintenance Data: Include adjustment instructions.

1.8 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
   B. Design expansion compensation system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the state where the project is located.

1.9 DELIVERY, STORAGE, AND HANDLING
   A. Deliver, store, protect and handle products under provisions of Division One.
   B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
   C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.10 WARRANTY
   A. Provide five-year warranty under provisions of Division One.
   B. Warranty: Include coverage for leak free performance of packed expansion joints.

1.11 EXTRA MATERIALS
   A. Furnish under provisions of Division One.
2.1 FLEXIBLE PIPE CONNECTORS

A. Steel Piping (Based on 2” Pipe):

1. Manufacturers:
   a. Amber/Booth Metal-Flex, Model Type SS-PM or FW
   b. Triplex, Model Flexonics Series 400M
   c. Mercer Rubber Company, Model BSS-EM (Mason Industries)

2. Inner Hose: Type 321, stainless steel, corrugated metal.


4. Pressure Rating: 350 psig WOG and 70 degrees F. For 4-inch pipe - 200 psig WOG and 70 degrees F.

5. Joint: Schedule 40 steel, threaded with male nipple and hex boss each end and union. Flanged joints for pipe sizes 2½ inch and larger.


7. Maximum offset: 1/2 inch on each side of installed center line.

8. Application: Air handling unit cooling and heating coils.

B. Copper Piping (Based on 2” Pipe):

1. Manufacturers:
   a. Amber/Booth Metal-Flex, Model Type BR-SM
   b. Triplex, Model Flexonics Series 300
   c. Mercer Rubber Company, Type BFF (Mason Industries)

2. Inner Hose: Corrugated Bronze


4. Pressure Rating: 250 psig WOG and 70 degrees F.

5. Joint: Threaded with male nipple and hex boss each end with union. Flanged joints for pipe sizes 2½ inch and larger.


7. Maximum offset: 1/2 inch on each side of installed center line.

8. Application: Air handling unit cooling and heating coils.

2.2 EXPANSION JOINTS
A. Bellows Type (Based on 4" Pipe):

1. Manufacturers:
   a. Amber/Booth, Style EB
   b. Triplex, Model Resistoflex R6905
   c. Mercer Rubber Company, Style 803 or 805 (Mason Industries)

2. Body: Monel wire reinforced molded TFE teflon bellows, multiple arch.

3. Pressure Rating: 70 psig WSP and 250 degrees F (66 degrees C).

4. Maximum Compression: 1 inch.

5. Maximum Extension: 1 inch.


8. Size: Use pipe sized units.

9. Accessories: Control rod limit bolts.

10. Application: Steel piping 8 inch and under.

2.3 ACCESSORIES

A. Pipe Alignment Guides to Direct Axial Movement:

1. Manufacturers:
   a. Triplex, Model Flexonics
   b. Metraflex, Style II

2. Two-piece welded steel with shop paint, and bolted to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Construct spool pieces to exact size of flexible connection for future insertion.

C. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provided line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
E. Provide miscellaneous metals to rigidly anchor pipe to building structure. Provide pipe guides so that movement takes place along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Division One.

B. Provide inspection services by flexible pipe manufacturer's representative for final installing and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION 23 05 16
SECTION 23 05 26 - VARIABLE FREQUENCY MOTOR SPEED CONTROL FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Section 1.01 A in Section 23 05 13

B. Section 1.01 B in Section 23 05 13

C. Furnish and install a complete adjustable frequency motor speed control for the following items:
   1. Variable volume air handling units.
   2. Chilled water pumps
   3. Condenser water pumps
   4. Hot water pumps
   5. Cooling tower fans.

1.2 RELATED SECTIONS

A. Section 23 02 00 – Basic Materials and Methods

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment

C. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment

D. Section 23 05 93 – Testing, Adjusting and Balancing

E. Section 23 09 00 – Energy Management and Controls System

F. Section 23 21 23 – Hydronic Pumps

G. Section 23 73 13 – Modular Indoor Central Station Air Handling Units

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Certified noise data shall be submitted by drive manufacturer. Noise generated by variable frequency motor speed control drive shall not exceed preferred “RC” as listed in 1995 ASHRAE HVAC Applications, Chapter 43 Sound and Vibration Control, Table 2 Criteria for Acceptable HVAC Noise in Unoccupied Rooms.

1.4 WARRANTY
A. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. There shall be 365/24 support available via a toll free phone number.

1.5 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be stored and handled per manufacturer’s instructions.

1.6 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes causes and corrections.
6. On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Yaskawa/Magnetek
B. ABB
C. Danfoss

2.2 ADJUSTABLE FREQUENCY INVERTER

A. The AFD package as specified herein shall be enclosed in a NEMA 12 enclosure for interior applications, a NEMA 4R enclosure for exterior locations and a NEMA 4X enclosure where located in a cooling tower yard or within 20 feet from cooling tower. All enclosures shall be completely assembled and tested by the manufacturer in an ISO9001 facility. The AFD shall operate from a line of +30% over nominal and the under-voltage trip level shall be 35% under the nominal voltage as a minimum.

B. The fused input shall utilize fast acting current limiting type per manufacturer recommendations.
C. The variable frequency power and logic unit shall be completely solid state. The unit shall transform 480 Volt or 208 Volt (as indicated on plans), 3 phase, 60 hertz input power into frequency and voltage controlled, 3 phase output power suitable to provide positive speed and torque control to the fan motor. The speed control shall be step-less throughout the speed range under variable torque load on a continuous basis. The adjustable frequency control shall be of a pulse width modulated type utilizing a full wave diode bridge rectifier; and shall have a power factor of 0.95 or better at all motor loads.

D. All AFD’s shall have the same customer interface, including a backlit LCD two line digital display, and keypad, regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable, capable of remote mounting, and shall have its own non-volatile memory. The keypad shall allow for uploading and downloading of parameter settings as an aid for the start-up of multiple AFD’s. The keypad shall include Hand-Off-Auto membrane selections. When in “Hand”, the AFD will be started and the speed will be controlled from the up/down arrows. When in “Off”, the AFD will be stopped. When in “Auto”, the AFD will start via an external contact closure and the AFD speed will be controlled via an external speed reference.

E. The adjustable frequency inverter shall conduct no radio frequency interference (RFI) back to the input power line.

F. The AFD shall have an integral 5% impedance line reactor to reduce the harmonics to the power line and to add protection from AC line transients. The inverter/reactor shall be a single wiring point.

2.3 SELF PROTECTION

A. The following features for self-protection shall be included:

1. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes. The minimum FLA rating shall meet or exceed the values in the NEC/UL Table 430-150 for 4-pole motors.

2. Limit the output current in under 50 microseconds due to phase to phase short circuits or severe overload conditions.

3. Protect the inverter due to non-momentary power or phase loss. The undervoltage trip shall activate automatically when the line voltage drops 15% below rated input voltage.

4. Protect the inverter due to voltage levels in excess of its rating. The overvoltage trip shall activate automatically when the DC bus in the controller exceeds 1000 VDC.

5. Protect the inverter from elevated temperatures in excess of its rating. An indicating light that begins flashing within 10 degrees C of the trip shall be provided to alert the operator to the increasing temperature condition. When the over temperature trip point is reached, this light shall be continuously illuminated.

6. The inverter shall be equipped such that a trip condition resulting from overcurrent, undervoltage, overvoltage or overtemperature shall be automatically reset, and the
inverter shall be automatically reset, and the inverter shall automatically restart upon removal, or correction of the faulty condition.

7. Status lights for indication of conditions described above shall be provided. A SPDT contact for remote indication shall be provided. Additionally, status lights to show power on, zero speed, and drive enabled shall be provided. All status lights shall be self-contained in the front panel of the unit and shall be duplicated for ease of troubleshooting on the inside of the unit.

8. Current and voltage signals shall be isolated from logic circuitry.

9. Drive logic shall be microprocessor based.

10. In the event of a sustained power loss, the control shall shut down safely without component failure. Upon return of power, the system shall automatically return to normal operation if the start is in the “On” condition.

11. In the event of a momentary power loss, the control shall be shut down safely without component failure. Upon return of power, the system shall automatically return to normal operation (if the start is in the “On” position) being able to restart into a rotating motor regaining positive speed control without shutdown or component failure.

12. In the event of a phase to phase short circuit, the control shall shut down safely without component failure.

13. In the event that an input power contactor is opened or closed while the control is activated, no damage shall result.

14. To facilitate startup and troubleshooting, the control shall operate without a motor or any other equipment connected to the inverter output.

2.4 ELECTRICAL CONSTANT SPEED BYPASS

A. Provide all components and circuitry necessary to provide manual full bypass of the inverter. The bypass package shall be mounted in a cabinet common with the inverter and shall be constructed in such a manner that the inverter can be removed for repair while still operating the motor in the “bypass” mode. Fast-acting semi-conductor with a fuse block shall be provided to isolate the drive for service. Bypass designs that have no such fuses must have a lockable disconnect that isolates the drive while running in bypass mode. The Contractor device shall be NEC approved. A common start/stop signal shall be used for both the variable frequency drive mode and bypass mode. Manual bypass shall contain the following:

1. Two contactors mechanically interlocked via a three position through the door selector switch or keypad to provide the following controls:
   “Inverter” mode connects the motor to the output of the inverter.
   “Bypass” mode connects the motor to the input since wave power. Transfer must occur with input disconnect open. Motor is protected via electronic overload.
   “Off” mode disconnects motor from all input power.
   A molded case circuit breaker with door interlocked handle (lock out type) that interrupts input power to both the bypass circuitry and the drive.
Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is Hand, Auto, or Bypass mode. The remote start/stop contact shall operate in AFD and bypass modes. An electronic overload selectable for class 20 or 30 shall provide protection of the motor in Bypass mode.

2. The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.
   a. Power on
   b. External fault
   c. Drive mode selected
   d. Bypass mode selected
   e. Drive running
   f. Bypass running
   g. Drive fault
   h. Bypass fault
   i. Bypass-H-O-A mode
   j. Automatic transfer to bypass selected

3. The following relay (form C) outputs from the bypass shall be provided:
   a. System started
   b. System running
   c. Bypass override enabled
   d. Drive fault
   e. Bypass fault (motor overload or underload (broken belt))
   f. Bypass H-O-A position

4. The AFD shall include a “run permissive circuit” that will provide a normally open contact any time a run command is provided (local or remote start command in AFD or bypass mode). The AFD system (AFD or bypass) shall not operate the motor until it receives a dry contact closure from a damper or valve end-switch). When the AFD systems safety interlock (fire detector, freeze stat, high static pressure switch, etc.) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve.

5. There shall be an internal switch to select manual or automatic bypass.

6. There shall be an adjustable current sensing circuit for the bypass to provide loss of load indication when in the bypass mode.

7. The bypass mode must include an undervoltage and phase loss relay to protect the motor from single phase power and undervoltage conditions.
   a. Bypass shall be UL listed.
   b. Bypass shall carry a UL 508 label.

2.5 FEATURES AND SPECIFICATIONS

B. Output frequency shall neither vary with load nor with any input frequency variations. Output frequency shall not vary within +/-10% input voltage changes. Output frequency shall not vary with temperature changes within the ambient specification.
C. No auxiliary equipment shall be required. The output frequency shall be adjusted in proportion to 4-20 mA signal.
D. A 0 to 10 Volt DC signal shall be provided for remote indication. These 0 to 10 Volt DC signals shall vary in direct proportion to the controller speed.
E. The controller shall be started or stopped by a contact closure or through serial communications.
F. A single pole, double throw contact shall be provided for remote indication. Contact will change state when any trip condition has occurred. (contact rated for 12-250 VAC-2 AMPS).
G. A second single pole, double throw contact shall be provided for remote indication. Contact will state when the VFD receives a run command (contact rated for 12-250 VAC-24 AMPS).
H. PID Setpoint controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the AFD, using the microprocessor in the AFD for the closed loop control. The AFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID setpoint shall be adjustable from the AFD keypad, analog inputs, or over the communications bus.
I. Unit to operate from a 4 to 20 mA input signal and shall have hand-off-auto switch and door mounted potentiometer controls for manual speed selection.
J. Acceleration and deceleration times shall be adjustable from 30 to 300 seconds.
K. The drive shall have the ability to invert the speed signal input, as well as having offset and gain controls for speed signal conditioning.
L. Minimum and maximum speeds shall be adjustable in automatic and manual modes.
M. Hazard inputs shall be provided, capable of up to two inputs (fire, freeze). These shall each be capable of safely shutting down the inverter and illuminating a front panel hazard light depicting that a hazard condition turned the inverter off.
N. The inverter shall be a starter, containing a door interlocked input disconnect switch and manual reset motor electronic overloads, with accessible reset on front door, when a bypass is not specified.
O. Solid state ground fault interrupt circuit.
P. The LED display shall monitor and display four parameters on a single display (i.e. frequency command, output frequency, output current, and torque).
Q. A N.O. auxiliary run-time contact shall be provided for control signaling to auxiliary equipment. Contact shall close when the pump is brought on line and open when the pump is taken off line. Contact shall be rated 20 amps at 120 volts.
R. Inverter shall be UL listed.
S. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the Owner, and a copy kept on file at the manufacturer.

T. Factory trained application engineering and service personnel that are thoroughly familiar with the AFD products offered shall be locally available at both the specifying and installation locations. A 24/365 technical support line shall be available on a toll-free line.

U. A computer-based training CD or 8-hour professionally generated video (VCR format) shall be provided to the Owner at the time of Substantial Completion. The training shall include installation, programming and operation of the AFD, bypass and serial communication.

V. Provide a motor end surge control voltage suppressive filter if the VFD manufacturer cannot limit their voltage surges to under 1000 volt at 100 feet.

W. Provide a motor acoustic noise reduction filter capable of approximately 12 dBA attenuation, if the VFD raises the dBa level above 3 dBa at a distance of 3 feet from the motor.

X. Provide each unit with a 3% reactor which is mounted on both the positive and negative DC bus. The reactor shall be a single wiring point and mounted internally to the drive.

Y. Adjustable frequency inverters shall have native BACnet protocol for integration with EMCS. If the inverter does not have native BACnet protocol, a BACnet interface card shall be provided.

PART 3 - INSTALLATION

3.1 Install units in accordance with manufacturer’s published installation instructions. Variable frequency speed control shall be located so that wiring to motor does not exceed 100 feet.

END OF SECTION 23 05 26
SECTION 23 05 29 – HANGERS AND SUPPORTS FOR PIPING AND EQUIPMENT – HVAC

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Pipe, and equipment hangers, supports and associated anchors.

B. Sleeves and seals

C. Flashing and sealing equipment and pipe stacks.

1.3 RELATED WORK

A. Section 21 00 00 – Fire Suppression.

B. Section 22 10 00 – Plumbing Piping and Pumps.

C. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

D. Section 23 07 16 – HVAC Equipment Insulation.

E. Section 23 07 19 – HVAC Piping Insulation.

F. Section 23 21 13 – Above Ground Hydronic Piping.

G. Section 23 21 16 – Underground Hydronic Piping.

1.4 REFERENCES


C. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

1.5 QUALITY ASSURANCE

A. Supports for Sprinkler Piping: In conformance with NFPA 13.

B. Supports for Standpipes: In conformance with NFPA 14.

1.6 SUBMITTALS
A. Submit shop drawings and product data under provisions of Division One.
B. Indicate hanger and support framing and attachment methods.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipes Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
B. Hangers for Pipes Sizes 2 to 4 Inch: Carbon steel, adjustable clevis.
C. Hangers for Pipes Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roller, double hanger.
D. Multiple or Trapeze Hangers: Steel channels with welded spacers, pre-formed manufactured saddles and hanger rods; cast iron roller 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 roller.
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 roller 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.
   1. For pipes 2-1/2” and smaller – Type PP10 with roller
   2. For pipes 3” through 8” – Type PS
   3. For multiple pipes – Type PSE – Custom
L. Shields for Vertical Copper Pipe Risers: Sheet lead.
M. Pipe Rough-In Supports in Walls/Chases: Provide preformed plastic pipe supports, Sioux Chief “Pipe Titan” 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 with 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.

   B. For metal roof construction, roof curbs shall be made of aluminum or stainless steel. Coordinate with Architectural Drawings and details.

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

A. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Coordinate with Structural Engineer for placement of 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>
</tr>
<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>
</tbody>
</table>

| (Copper Pipe)     |                     |                 |
| 1/2 to 1-1/4 inch | 5'-0"               | 3/8"            |
| 1-1/2 to 2-1/2 inch | 8'-0"       | 3/8"            |
| 3 to 4 inch       | 10'-0"              | 3/8"            |
| 6 to 8 inch       | 10'-0"              | 1/2"            |

| (Cast Iron)       |                     |                 |
| 2 to 3 inch       | 5'-0"               | 3/8"            |
4 to 6 inch 10'-0" 1/2"
8 to 10 inch 10'-0" 5/8"
12 to 14 inch 10'-0" 3/4"
15 inch and over 10'-0" 7/8"
(PVC Pipe)
1-1/2 to 4 inch 4'-0" 3/8"
6 to 8 inch 4'-0" 1/2"
10 and over 4'-0" 5/8"

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 to 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 manufacturer’s 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. Secure the full contact area of the saddle to the pipe insulation with 1/8" thick coat of mastic.

C. Shields: Install protective shields MSS Type 40 on cold and chilled water piping that has vapor barrier. Secure the full contact area of the shield to the pipe insulation with 1/8” thick coat of mastic.

D. 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</td>
<td>12</td>
<td>0.048</td>
</tr>
<tr>
<td>3-1/2</td>
<td></td>
<td></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 14</td>
<td>24</td>
<td>0.075</td>
</tr>
<tr>
<td>16 THROUGH 24</td>
<td>24</td>
<td>0.105</td>
</tr>
</tbody>
</table>

E. Piping 2” and larger: provide galvanized sheet metal shields with calcium silicate insulation at hangers/supports.

F. Insert material shall be at least as long as the protective shield.

G. 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. Provide 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 thermafiber 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 air tight. 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 23 05 29
SECTION 23 05 48 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. This Section and Section 23 02 00 – Basic Materials and Methods are part of each Division 23 Section which references the vibration control products specified herein.

1.2 WORK INCLUDED

A. Vibration and sound control products.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of vibration control products of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.

C. Unless otherwise indicated, sound and vibration control products shall be provided by a single manufacturer.

1.4 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Amber/Booth Company, Inc.

B. Mason Industries, Inc.

C. Noise Control, Inc.
2.2 GENERAL

A. Provide vibration isolation supports for equipment, piping and ductwork, to prevent transmission of vibration and noise to the building structure that may cause discomfort to the occupants.

B. Model numbers of Amber/Booth products are included for identification. Products of the additional manufacturers will be acceptable provided they comply with all of the requirements of this specification.

2.3 FLOOR MOUNTED AIR HANDLING UNITS

A. Provide Amber/Booth XLW-2, style C aluminum housed isolators sized for 2” static deflection. Cast iron or steel housings may be used provided they are hot-dip galvanized after fabrication.

B. If floor mounted air handling units are furnished with internal vibration isolation option, provide 2” thick Amber/Booth type NRC ribbed neoprene pads to address high frequency breakout and afford additional unit elevation for condensate drains. Ribbed neoprene pads shall be located in accordance with the air handling unit manufacturer’s recommendations.

2.4 SUSPENDED AIR HANDLING UNITS

A. Provide Amber/Booth type BSWR-2 combination spring and rubber-in-shear isolation hanger sized for 2” static deflection.

B. If suspended air handling units are furnished with internal vibration isolation option, furnish Amber/Booth type BRD rubber-in-shear or NR AMPAD 3/8” thick neoprene pad isolation hangers sized for approximately 1/8” deflection to address high frequency break-out.

2.5 SUSPENDED FANS AND FAN COIL UNITS

A. Provide Amber/Booth type BSS spring hangers sized for 1” static deflection.

2.6 BASE MOUNTED PUMPS AND CHILLERS

A. Amber/Booth type SP-NR style E flexplate pad isolators consisting of two layers of 3/8” thick alternate ribbed neoprene pad bonded to a 16-gage galvanized steel separator plate.

B. Pads shall be sized for approximately 40 PSI loading and 1/8” deflection.

2.7 PIPING

A. Provide spring and rubber-in-shear hangers, Amber/Booth type BSR in mechanical equipment rooms, for a minimum distance of 50 feet from isolated equipment for all chilled water and hot water piping 1-1/2” diameter and larger. Springs shall be sized for 1” deflection.

B. Floor supported piping is required to be isolated with Amber/Booth type SW-1 open springs sized for 1” deflection.

C. All condenser water piping shall be supported with Amber/Booth type SW – 1 with 1” deflection for floor or roof mounted piping and Amber/Booth BSR isolators with 1” deflectors.
for suspended piping.

D. Furnish line size flexible connectors at supply and return of pumps, Amber/Booth style 2800 single sphere EPDM construction, connector shall include 150 lb. cadmium plated carbon steel floating flanges.

2.9 CORROSION PROTECTION

A. All vibration isolators shall be designed and treated for resistance to corrosion.

B. Steel components: PVC coated or phosphated and painted with industrial grade enamel. Nuts, bolts, and washers: zinc-electroplated.

PART 3 - EXECUTION

3.1 All equipment shall be installed in accordance with the manufacturer’s recommendations and printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer’s requirements.

3.3 If internal isolation option is used on air handling units, the mechanical contractor shall verify proper adjustment and operation of isolators prior to start-up. All shipping brackets and temporary restraint devices shall be removed.

3.4 The vibration isolation supplier shall certify in writing that he has inspected the installation and that all external isolation materials and devices are installed correctly and functioning properly.

END OF SECTION 23 05 48
SECTION 23 05 53 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 – Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

1.3 Refer to Architectural Sections for additional requirements.

PART 2 - PRODUCTS

2.1 VALVE AND PIPE IDENTIFICATION

A. Valves:

1. All valves shall be identified with a 1-1/2" diameter brass disc wired onto the handle. The disc shall be stamped with 1/2" high depressed black filled identifying numbers. These numbers shall be numerically sequenced for all valves on the job.

2. The number and description indicating make, size, model number and service of each valve shall be listed in proper operational sequence, properly typewritten. Three copies to be turned over to Owner at completion.

3. Tags shall be fastened with approved meter seal and 4 ply 0.018 smooth copper wire. Tags and fastenings shall be manufactured by the Seton Name Plate Company or approved equal.

4. All valves shall be numbered serially with all valves of any one system and/or trade grouped together.

B. Pipe Marking:

1. All interior visible piping located in accessible spaces such as above accessible ceilings, equipment rooms, attic space, under floor spaces, etc., shall be identified with all temperature pipe markers as manufactured by W.H. Brady Company, 431 West Rock Ave., New Haven, Connecticut, or approved equal.

2. All exterior visible piping shall be identified with UV and acid resistant outdoor grade acrylic plastic markers as manufactured by Set Mark distributed by Seton (Name plate Company Factory location 20 Thompson Road, Branford, Connecticut) or approved equal.

3. Generally, markers shall be located on each side of each and every partition, on each side of every tee, on each side of every valve and/or valve group, on each side of every piece of equipment, and, for straight runs, at equally spaced intervals not to exceed 75 feet. In
congested area, marks shall be placed on each pipe at the points where it enters and leaves the area and at the point of connection of each piece of equipment and automatic control valve. All markers shall have directional arrows.

4. Markers shall be installed after final painting of all piping and equipment and in such a manner that they are visible from the normal maintenance position. Manufacturer's installation instructions shall be closely followed.

5. Markers shall be colored as indicated below per ANSI/OSHA Standards:

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>COLOR</th>
<th>LEGEND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled Water</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>Chilled Water Return</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C. Pipe Painting:

1. All piping exposed to view shall be painted as indicated or as directed by the Architect in the field. Confirm all color selections with Architect prior to installation.

2. All piping located in mechanical rooms and exterior piping shall be painted as indicated below:

<table>
<thead>
<tr>
<th>System</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled Water Supply and Return</td>
<td>Light Blue</td>
</tr>
</tbody>
</table>

PART 3 - EXECUTION

3.1 All labeling equipment shall be installed as per manufacturer’s printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Contractors price shall include all items required as per manufacturer’s requirements.

3.3 All piping shall be cleaned of rust, dirt, oil and all other contaminants prior to painting. Refer to Division 9 for Architect’s required paint system(s).

END OF SECTION 23 05 53
SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 – Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 RELATED DOCUMENTS

Approved submittal date on equipment installed, to accomplish the test procedures, outlined under paragraph 3.01 of this Section, will be provided by the Contractor.

1.3 DESCRIPTION

A. The TAB of the air conditioning systems shall be performed by an impartial technical firm whose operations are limited only to the field of professional TAB. The TAB work will be done under the direct supervision of a qualified engineer employed by the TAB firm.

B. The TAB firm will be responsible for inspecting, adjusting, balancing, and logging the date on the performance of fans, dampers in the duct system, and air distribution devices. The Contractor and the various Subcontractors of the equipment installed shall cooperate with the TAB firm to furnish necessary data on the design and proper applications of the system components and provide labor and material required to eliminate deficiencies or malperformance.

1.4 QUALITY ASSURANCE

A. QUALIFICATIONS OF CONTRACTOR PERSONNEL: Submit evidence to show that the personnel who shall be in charge of correcting deficiencies for balancing the systems are qualified. The Owner and Engineer reserve the right to require that the originally approved personnel be replaced with other qualified personnel if, in the Owner and Engineer's opinion, the original personnel are not qualified to properly place the system in condition for balancing.

B. QUALIFICATIONS OF TAB FIRM PERSONNEL:

1. A minimum of one registered Professional Engineer licensed in the State, is required to be in permanent employment of the firm.

2. Personnel used on the jobsite shall be either Professional Engineers or technicians, who shall have been permanent, full time employees of the firm for a minimum of six months prior to the start of Work for that specified project.

3. Evidence shall be submitted to show that the personnel who actually balance the systems are qualified. Evidence showing that the personnel have passed the tests required by the Associated Air Balance Council (AABC) shall be required.

C. CALIBRATION LIST: Submit to the Engineer for approval, a list of the gauges, thermometers, velocimeter, and other balancing devices to be used in balancing the system. Submit evidence to show that the balancing devices are properly calibrated before proceeding with system balancing.
PART 3 - EXECUTION

3.1 SERVICES OF THE CONTRACTOR

A. The Drawings and Specifications have indicated valves, dampers, and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions. Install these devices in a manner that leaves them accessible, and provide access as requested by the TAB firm.

B. Have systems complete and in operational readiness prior to notifying the TAB firm that the project is ready for their services and certify in writing to the Architect and Owner that such a condition exists.

C. As a part of the Work of this Section, make changes in the sheaves, belts, and dampers or the addition of dampers required for correct balance of the new work as required by the TAB firm, at no additional cost to the Owner.

D. Fully examine the existing system to be balanced, to determine whether or not sufficient volume dampers, balancing valves, thermometers, gauges, pressure and temperature taps, means of reading static pressure and total pressure in duct systems, means of determining water flow, and other means of taking data needed for proper water and air balancing are existing. Submit to the Engineer in writing a listing of omitted items considered necessary to balance existing systems. Submit the list and proposal as a cost add item.

E. Verify that fresh air louvers are free of blockage, coils are clean and fresh air ducts to each air handling unit have individually adjustable volume regulating dampers.

F. Provide, correct, repair, or replace deficient items or conditions found during the testing, adjusting, and balancing period.

G. In order that systems may be properly tested, balanced, and adjusted as specified, operate the systems at no expense to the Owner for the length of time necessary to properly verify their completion and readiness for TAB period.

H. Project construction schedules shall provide time to permit the successful completion of TAB services prior to Substantial Completion. Complete, operational readiness, prior to commencement of TAB services, shall include the following services of the Contractor:

1. Construction status of building shall permit the closing of doors, windows, ceilings installed and penetrations complete, to obtain project operating conditions.

2. AIR DISTRIBUTION SYSTEMS:
   a. Verify installation for conformity to design. Supply, return, and exhaust ducts terminated, and pressure tested for leakage as specified.
   b. Volume and fire dampers properly located and functional. Dampers serving requirements of minimum and maximum outside air, return and relief shall provide tight closure and full opening, smooth and free operation.
   c. Supply, return, exhaust and transfer grilles, registers and diffusers shall be installed.
   d. Air handling systems, units and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc., shall be blanked and sealed to eliminate excessive bypass or leakage of air.
   e. Fans (supply and exhaust) operating and verified for freedom from vibrations, proper
fan rotation and belt tension; overload heater elements shall be of proper size and rating; record motor amperage and voltage and verify that these functions do not exceed nameplate ratings.

f. Furnish or revise fan drives or motors as necessary to attain the specified air volumes.

3. WATER CIRCULATING SYSTEMS:
   a. Position valves pertinent to system design and require operation to permit full flow of water through system components. Operate hydronic systems under full flow conditions until circulating water is clean. Remove and clean strainers as required during this cycle of operation.
   b. For retrofit projects, record each existing pump motor amperage and voltage. Readings shall not exceed nameplate rating.
   c. Verify, on new equipment, electrical starter overload heater elements to be of proper size and rating.
   d. Ensure that water circulating systems shall be full of water and free of air; expansion tanks set for proper water level, and air vents installed at high points of systems and operating freely. Advise Engineer of deficiencies.
   e. Check and set operating temperatures of heat exchangers to design requirements.
   f. The various existing water circulating systems shall be cleaned, filled, purged of air, and put into operation before hydronic balancing.

4. AUTOMATIC CONTROLS:
   a. Verify that control components are installed in accordance with project documents and functional, electrical interlocks, damper sequences, air and water resets, fire and freeze stats.
   b. Controlling instruments shall be functional and set for design operating conditions. Factory precalibration of room thermostats and pneumatic equipment will not be acceptable.
   c. The temperature regulation shall be adjusted for proper relationship between the controlling instruments and calibrated by the TAB Contractor. Advise Engineer of deficiencies or malfunctions.

I. Contractor shall repair any insulation removed from piping system by TAB Contractor during water balancing.

3.2 SERVICES OF THE TAB FIRM

A. The TAB firm will act as liaison between the Owner, Engineer, and the Contractor and inspect the installation of mechanical piping system, sheet metal work, temperature controls and other component parts of the heating, air conditioning and ventilating systems being retrofitted, repaired, or added under this Contract. The reinspection of the Work will cover that part related to proper arrangement and adequate provision for the testing and balancing and will be done when the Work is 80 percent complete.

B. Upon completion of the installation and start-up of the mechanical equipment, to check, adjust, and balance system components to obtain optimum conditions in each conditioned space in the building. Prepare and submit to the Engineer complete reports on the balance and operations of the systems.

C. Measurements and recorded readings of air, water, and electricity that appear in the reports will be done by the permanently employed technicians or engineers of the TAB firm.

D. Make an inspection in the building during the opposite season from that in which the initial adjustments were made. At the time, make necessary modifications to the initial adjustments required to produce optimum operation of system components to affect the proper conditions as indicated on the Drawings. At time of opposite season check-out, the Owner's representative will be notified before readings or adjustments are made.
E. In fan systems, the air quantities indicated on the Drawings may be varied as required to secure a maximum temperature variation of two degrees within each separately controlled space, but the total air quantity indicated for each zone must be obtained. It shall be the obligation of the Contractor to furnish or revise fan drive and motors if necessary, without cost to the Owner, to attain the specified air volumes.

F. Contractor shall utilize ultrasonic flow meter to balance water flow of existing water system if the original pressure drop data is not available. Contractor shall remove insulation as necessary to use flow meter.

3.3 PROFESSIONAL REPORT

A. Before the final acceptance of the report is made, the TAB firm will furnish the Engineer the following data to be approved by the Owner and Engineer:

1. Summary of main supply return and exhaust duct pitot tube traverses and fan settings indicating minimum value required to achieve specified air volumes.

2. A listing of the measured air quantities at each outlet corresponding to the temperature tabulation as developed by the Engineer and TAB firm.

3. Air quantities at each return and exhaust air handling device.

4. Static pressure readings entering and leaving each supply fan, exhaust fan, filter, coil, balancing dampers and other components of the systems. Including the retrofit Work. These readings will be related to performance curves in terms of the CFM handled if available.

5. Motor current readings at each equipment motor on load side of capacitors. The voltages at the time of the reading shall be listed.

6. The final report shall certify test methods and instrumentation used, final velocity reading obtained, temperatures, pressure drops, RPM of equipment, amperage of motors, air balancing problems encountered, recommendations and uncompleted punch list items. The test results will be recorded on standard forms.

7. A summary of actual operating conditions shall be included with each system outlining normal and ventilation cycles of operation. The final report will act as a reference of actual operating conditions for the Owner's operating personnel.

3.4 BALANCING AIR CONDITIONING SYSTEM

A. GENERAL:

1. Place all equipment into full operation and continue operating during each working day of balancing and testing. If the air conditioning system is balanced during Off-Peak cooling season Contractor shall return to rebalance air side system as required to put system in proper balance at that season.

2. The Contractor shall submit detailed balancing and recording forms for approval. After approval by the Engineer, prepare complete set of forms for recording test data on each system. All Work shall be done under the supervision of a Registered Professional Engineer. All instruments used shall be accurately calibrated to within 1% of scale and maintained in good working order.
3. Upon completion of the balancing and testing, the TAB Contractor shall compile the test data in report forms, and forward five copies to the Engineer for evaluation.

4. The final report shall contain logged results of all tests, including such data as:
   a. Tabulation of air volume at each outlet.
   b. Outside dry bulb and wet bulb temperature.
   c. Inside dry bulb and wet bulb temperatures in each conditioned space room or area.
   d. Actual fan capacities and static pressures. Motor current and voltage readings at each fan.

B. AIR SYSTEMS: Perform the following operations as applicable to balance and test systems:

1. Check fan rotation.
2. Check filters (balancing shall be done with clean filters).
3. Test and adjust blower rpm to design requirements.
4. Test and record motor full load amperes.
5. Test and record system static pressures, suction and discharge.
6. Test and adjust system for design cfm, return air and outside air (±2%). Change-out fan sheaves as required to balance system.
7. Test and record entering air temperatures, db and wb.
8. Test and record leaving air temperatures, db and wb.
9. Adjust all zones to design cfm (±2%).
10. Test and adjust each diffuser, grille, and register to within 5% of design.

C. AIR DUCT LEAKAGE: (From SMACNA Duct Standards latest edition) Test all ductwork (designed to handle over 1000 CFM) as follows:

1. Test apparatus
   The test apparatus shall consist of:
   a. A source of high pressure air--a portable rotary blower or a tank type vacuum cleaner.
   b. A flow measuring device consisting of straightening vanes and an orifice plate mounted in a straight tube with properly located pressure taps. Each orifice assembly shall be accurately calibrated with its own calibration curve. Pressure and flow readings shall be taken with U-tube manometers.

2. Test Procedures
   a. Test for audible leaks as follows:
      1) Close off and seal all openings in the duct section to be tested. Connect the test apparatus to the duct by means of a section of flexible duct.
      2) Start the blower with its control damper closed.
      3) Gradually open the inlet damper until the duct pressure reaches 1.2 times the standard designed duct operating pressure.
      4) Survey all joints for audible leaks. Mark each leak and repair after shutting
down blower. Do not apply a retest until sealants have set.

b. After all audible leaks have been sealed, the remaining leakage should be measured with the orifice section of the test apparatus as follows:

1) Start blower and open damper until pressure in duct reaches 25% in excess of designed duct operating pressure.

2) Read the pressure differential across the orifice on manometer No. 2. If there is no leakage, the pressure differential will be zero.

3) Total allowable leakage shall not exceed one (1) percent of the total system design air flow rate. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.

4) Even though a system may pass the measured leakage test, a concentration of leakage at one point may result in a noisy leak which must be corrected.

D. DX SYSTEMS:

1. Test and record suction and discharge pressures at each compressor and record ambient air temperature entering the condensing coils.

2. Test and record unit full load amps and voltage.

3. Test and record staging and unloading of unit required by sequence of operation or drawing schedule.

E. Automatic temperature controls shall be calibrated; and all thermostats and dampers adjusted so that the control system is in proper operating condition, subject to the approval of the Engineer/Owner.

F. The TAB Contractor shall report to Engineer all air distribution devices or other equipment that operate noisily so that corrective measures may be implemented by the Contractor at no additional cost to the Owner or Architect/Engineer.

END OF SECTION 23 05 93
SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

C. Ductwork system insulation.

1.3 RELATED SECTIONS

A. Section 23 05 13 – Common Motor Requirements for HVAC Equipment

B. Section 23 05 53 – Identification for HVAC Piping and Equipment

1.4 QUALITY ASSURANCE

A. Installer’s Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

B. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

   1. Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.

C. Duct and plenum insulation shall comply with minimum R-value requirements of 2015 International Energy Conservation Code.

D. Adhesive and other material shall comply with NFPA and NBFU Standards No. 90A and 90B.

1.5 WARRANTY

A. Warrant the Work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective, or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:

   1. Mildewing.

   2. Peeling, cracking, and blistering.
3. Condensation on exterior surfaces.

1.6 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in unopened containers with manufacturer’s stamp, clearly labeled with flame and smoke rating, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water and chemical and mechanical damage. Do not install damaged or wet insulation; remove such from project site.

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

A. The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and approved before any insulation is installed.

B. A sample quantity of each type of insulation and each type of application shall be installed and approval secured prior to proceeding with the main body of the Work.

2.2 ACCEPTABLE MANUFACTURERS

A. Glass fiber materials shall be as manufactured by Knauf, Certain-Teed, Johns-Manville or Owens-Corning and shall have the same thermal properties, density, fire rating, vapor barrier, etc., as the types specified herein, subject to review by the Engineer.

B. Adhesives shall be as manufactured by Minnesota Mining, Arabol, Benjamin-Foster, Armstrong or Insulmastic, Inc., and shall have the same adhesive properties, fire rating, vapor seal, etc., as the types specified herein, subject to review by the Engineer.

C. Ceramic fiber materials shall be as manufactured by Primer Refractories, A.P. Green Refractories or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. All insulation shall be installed in accordance with the manufacturer's recommendations and
printed installation instructions.

B. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

3.2 EXTERNAL DUCT INSULATION

C. Fasten all longitudinal and circumferential laps with outward clinching staples 3” on center. On rectangular ducts over 24” wide apply as above and hold insulation in place on bottom side with mechanical pins and clips on 12” centers.

D. Seal all joints, fastener penetrations and other breaks in vapor barrier with 3-inch-wide strips of white glass fabric embedded between two coats of vapor barrier mastic, Childers CP-30 or approved equal.

E. All external duct insulation shall be Johns Manville Microlite EQ or Microlite XG fiberglass duct wrap insulation with reinforced aluminum facing or approved equal.

F. External duct wrap is required on all outside air ducts, supply and return air ducts that are not internally insulated. Duct wrap shall be provided as follows:

   1. 1½” thick, 1.0 PCF density minimum when ducts are located in conditioned spaces.
   2. 2” thick with a minimum installed R-value of 6 when ducts are located in unconditioned spaces, such as ceiling plenum space.

3.3 DUCT LINER

A. Duct liner shall be kept clean and dry during transportation, storage, installation, and throughout the construction process care should be taken to protect the liner from exposure to the elements or damage from mechanical abuse.

B. All portions of duct designed to receive duct liner shall be completely covered with liner as specified. The smooth, black, acrylic-coated surfaces with flexible glass cloth reinforcement shall face the airstream. All duct liner shall be cut to assure tight, overlapped corner joints. The top pieces shall be supported by the sidepieces. Duct liner shall be installed following the guidelines in the NAIMA “Duct Liner Installation Standard”.

C. The duct liner shall be tested according to erosion test method in UL 181 and shall be guaranteed to withstand velocities in the duct system up to 5000 fpm without surface erosion.

D. Duct liner shall be adhered to the sheet metal with full coverage of an approved adhesive that conforms to ASTM C 916, and all exposed leading edges and transverse joints shall be coated with Permacote factory-applied or field-applied edge coating and shall be neatly butted without gaps. Shop or field cuts shall be liberally coated with Johns Manville SuperSeal® duct butter and Edge Treatment or approved adhesive.

E. Metal nosings shall be securely installed over transversely oriented liner edges facing the airstream at forward discharge and at any point where lined duct is preceded by unlined duct.

F. When velocity exceeds 4000 fpm (20.3 m/sec), use metal nosing on every leading edge.
Nosing may be formed on duct or be channel or zee attached by screws, rivets or welds.

G. The liner shall further be secured with Graham welding pins and washers on not more than 18-inch centers both vertical and horizontal surfaces, and the pins and washers shall be pointed up with adhesive.

H. Duct liner shall be Johns Manville Linacoustic RC fiberglass duct liner with factory-applied edge coating and acrylic coating on the mat surface of airstream side or approved equal. The liner shall meet the Life Safety Standards as established by NFPA 90A and 90B, FHC 25/50 and Limited Combustibility and the air stream surface coating should contain an immobilized, EPA-registered, anti-microbial agent so it will not support microbial growth as tested in accordance with ASTM G21 and G22. The duct liner shall conform to the requirements of ASTM C 1071, with an NRC not less than .70 as tested per ASTM C 423 using a Type “A” mounting, and a thermal conductivity no higher than .25 BTU•in/(hr•ft²•°F) at 75°F mean temperature.

I. Line supply and return ductwork at connection of HVAC unit to a point of 15 feet upstream and downstream of the equipment and in return air boots. Attach with full cover coat of cement, duct dimensions up to 16 inches; provide stick clips or screws and cap for dimensions over 16 inches, spaced 16 inches o.c. maximum. Provide sheet metal liner cap over all leading edges of internal insulation exposed to air stream.

J. Duct liner shall be provided as follows:
   1. 1” Thick, 1.5 PCF density minimum when ducts are located in conditioned spaces.
   2. 1 ½” Thick with a minimum installed R-value of 6 when ducts are located in unconditioned spaces, such as ceiling plenum space.
   3. 2” Thick with a minimum installed R-value of 8 when ducts are located outdoors.

3.4 EXPOSED DUCTWORK LOCATED INDOORS
   A. Duct routed exposed in occupied spaces shall be double wall.
   B. Round and flat oval duct routed exposed shall be double wall with perforated inner liner and 1” thick layer of fiberglass insulation as manufactured by United McGill Company model no. Acousti-27 or approved equal. Insulation density shall be a minimum of 1.0 PCF.

3.5 EXPOSED DUCT LOCATED OUTDOORS
   A. All duct located outdoors shall be internally lined as specified and shall have a 2” thick, 6 lb. density rigid board external duct insulation, finished with aluminum jacketing.
   B. Paint non-insulated duct. Coordinate color with Architect.

3.6 AIR DEVICE AND MISCELLANEOUS DUCT INSULATION
   A. The backside of all supply air devices shall be insulated with taped and sealed 1½ inch thick external duct wrap.
   B. The contractor shall install an additional layer of 1½ inch thick external fiberglass duct wrap
on any portion of the supply air, return air, outside air, or exhaust air system that has condensation forming during any period of operation. The insulation shall be taped and sealed and located until all evidence of the condensation has been eliminated, at no additional cost to the Owner.

3.7 KITCHEN GREASE HOOD EXHAUST DUCT

A. All kitchen range hood exhaust duct shall be enclosed with 2-hour fire rated enclosure.

B. The duct enclosure shall be sealed around the duct at the points of penetration.

C. The enclosure shall be separated from the duct by at least 3 inches and not more than 12 inches.

D. Cleanout openings at exhaust duct with access openings at the fire rated enclosure and access doors shall be provided at each duct offset and as required for proper operation and maintenance.

E. As an alternate method, the contractor may use 2-hour fire rated enclosure such as “3M FireMaster Fastwrap” along with “3M Fire Barrier 1000 N/S Silicone Sealant”, Thermal Ceramics, fast wrap XL or approved equals in lieu of the fire rated enclosure, provided the product used meets UL requirements and is approved by the local authority have jurisdiction. This application shall follow the manufacturer’s strict installation instructions and guidelines.

F. Insulation and all other requirements shall be provided per local codes.

END OF SECTION 23 07 13
SECTION 23 07 16 - HVAC EQUIPMENT INSULATION

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 – Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for Owner's use.

B. Work specified elsewhere.
   1. Basic materials and methods.
   2. Piping systems.
   3. Air distribution equipment.

1.3 WARRANTY

A. Warrant the Work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:
   1. Mildewing.
   2. Peeling, cracking, and blistering.
   3. Condensation on exterior surfaces.

1.4 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

1.5 DELIVERY AND STORAGE

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in unopened containers with manufacturer's stamp, clearly labeled with flame and smoke rating, affixed showing fire hazard indexes of products.
B. Protect insulation against dirt, water and chemical and mechanical damage. Do not install damaged or wet insulation; remove such from project site.

PART 2 – PRODUCTS

2.1 It is the intent of these specifications to secure superior quality workmanship resulting in an absolutely satisfactory installation of insulation from the standpoint of both function and appearance. Particular attention shall be given to valves, fittings, pumps, etc., requiring low temperature insulation to insure full thickness of insulation and proper application of the vapor seal. All flaps of vapor barrier jackets and/or canvas covering must be neatly and securely smoothed and sealed down.

2.2 The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and reviewed before any insulation is installed.

2.3 A sample quantity of each type of insulation and each type application shall be installed and reviewed prior to proceeding with the main body of the work. Condensation caused by improper installation of insulation shall be corrected by Installing Contractor. Any damage caused by condensation shall be made good at no cost to the Owner or Architect/Engineer.

2.4 Glass fiber materials as manufactured by Owens/Corning, PPG, CSG, or Johns Manville will be acceptable, if they comply with the specifications.

2.5 All insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) fire and smoke hazard as tested by Procedure ASTM E084, NFPA 255 and UL 723 not exceeding:

   Flame Spread 25
   Smoke Developed 50

2.6 Accessories, such as adhesives, mastics and cements shall have the same component ratings as listed above.

2.7 All products or their shipping cartons shall have a label affixed, indicating flame and smoke ratings do not exceed the above requirements.

PART 3 – EXECUTION

3.1 All insulation shall be installed in accordance with the manufacturer’s recommendations and printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer’s requirements.

3.3 CHILLED WATER PUMPS

   A. Shall be insulated with Certain-Teed IB-600 rigid insulation board, 2" thick, cut and formed into a box and secured in place with 3/4" wide x .020 galvanized bands spaced on 9” centers. Bands shall be pulled snug over sheets of insulation board. All joints shall be well and neatly
fitted and so arranged that the assembly may be dismantled with ease permitting access to the pump. All voids on the interior of box shall be filled with glass fiber blanket insulation. Exterior shall be finished with a trowel coat of Foster's 30-35 vapor barrier mastic, a layer of 1" mesh galvanized wire, and a coat of J.M. #352 cement. Final finish shall be an eight-ounce canvas jacket, pasted and sealed in place with Foster's 30-36 Seafas.

B. Pipe insulation shall be extended over all cold parts of chilled water pumps not directly over drainage basin of pump base.

END OF SECTION 23 07 16
SECTION 23 07 19 – HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 – Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for Owner's use.

B. Furnish and install piping insulation to:
   1. Chilled water piping.
   2. Condensate drain piping.
   3. Refrigerant piping.
   4. All pipes subject to freezing conditions shall be insulated.

C. Work specified elsewhere.
   1. Painting.
   2. Pipe hangers and supports.

D. For insulation purpose piping is defined as the complete piping system including supplies and returns, pipes, valves, automatic control valve bodies, fittings, flanges, strainers, thermometer well, unions, reducing stations, and orifice assemblies.

1.3 WARRANTY

A. Warrant the Work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.

B. Defects shall include, but not be limited to, the following:
   1. Mildewing.
   2. Peeling, cracking, and blistering.
   3. Condensation on exterior surfaces.

1.4 SUBMITTALS
A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, project variations, and accessories.

1.5 DELIVERY AND STORAGE

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in unopened containers with manufacturer’s stamp, clearly labeled with flame and smoke rating, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water and chemical and mechanical damage. Do not install damaged or wet insulation; remove such from project site.

PART 2 - PRODUCTS

2.1 It is the intent of these specifications to secure superior quality workmanship resulting in an absolutely satisfactory installation of insulation from the standpoint of both function and appearance. Particular attention shall be given to valves, fittings, pumps, etc., requiring low temperature insulation to insure full thickness of insulation and proper application of the vapor seal. All flaps of vapor barrier jackets and/or canvas covering must be neatly and securely smoothed and sealed down.

2.2 The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and reviewed prior to installation.

2.3 A sample quantity of each type of insulation and each type application shall be installed and accepted prior to proceeding with the main body of the work. Condensation caused by improper installation of insulation shall be corrected by Installing Contractor. Any damage caused by condensation shall be made good at no cost to the Owner or Architect/Engineer.

2.4 All insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) fire and smoke hazard as tested by Procedure ASTM E084, NFPA 255 and UL 723 not exceeding:

   Flame Spread 25
   Smoke Developed 50

2.5 Accessories, such as adhesives, mastics and cements shall have the same component ratings as listed above.

2.6 All products or their shipping cartons shall have a label affixed, indicating flame and smoke ratings do not exceed the above requirements.
2.7  APPROVED MANUFACTURERS

A. Calcium silicate materials shall be as manufactured by Johns Manville.

B. Glass fiber materials shall be as manufactured by Johns Manville or Owens-Corning and shall have the same thermal properties, density, fire rating, vapor barrier, etc., as the types specified herein, subject to review by the Engineer.

C. Adhesives shall be as manufactured by Childers, Foster, HB Fuller or Armacell, and shall have the same adhesive properties, fire rating, vapor seal, etc., as the types specified herein, subject to review by the Engineer.

D. Flexible elastomeric cellular thermal insulation by Armacell.

E. Phenolic foam insulation shall be as manufactured by Kooltherm Insulation (Koolphen).

F. Metal jacketing and fitting covers shall be as manufactured by Childers or RPR Products.

2.8  MATERIALS

A. CHILLED WATER: Provide Phenolic foam with ASJ jacket and all joints sealed

B. CONDENSATE DRAINAGE PIPING: Fire resistant fiberglass insulation; insulation not required when piping is exposed on roof.

C. REFRIGERANT PIPING: Refrigerant pipe insulation shall be model "AP-2000", fire rated for use in environmental air plenums. Apply manufacturers recommended finish and sealant for exterior applications.


PART 3 - EXECUTION

3.1 All insulation shall be installed in accordance with the manufacturer’s recommendations and printed installation instructions, including high density inserts at all hangers and pipe supports to prevent compression of insulation.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer’s requirements.

3.3 Pipes located outdoors or in tunnels shall be insulated same as concealed piping and shall have a jacket of 0.016-inch-thick, smooth aluminum with longitudinal modified Pittsburg Z-Lock seam and 2 inch overlap. Jacketing shall be easily removed and replaced without damage. All insulation butt joints shall be sealed with gray silicone. Galvanized banding is not acceptable.

3.4 All insulated piping located over driveways shall have an aluminum shield permanently banded over insulation to protect it from damage from car antennas.

3.5 WATER PIPE INSULATION INSTALLATION
A. The insulation shall be applied to clean, dry pipes with all joints firmly butted together. Where piping is interrupted by fittings, flanges, valves or hangers and at intervals not to exceed 25 feet on straight runs, an isolating seal shall be formed between the vapor barrier jacket and the bare pipe. The seal shall be by the applications of adhesive to the exposed insulation joint faces, carried continuously down to and along 4 inches of pipe and up to and along 2 inches of jacket.

B. Pipe fittings and valves shall be insulated with pre-molded or shop fabricated glass fiber covers finished with two brush coats of vapor barrier mastic reinforced with glass fabric.

C. All under lap surfaces shall be clean and free of dust, etc. before the Joint is sealed. These laps shall be firmly rubbed to insure a positive seal. A brush coat of vapor retarder shall be applied to all edges of the vapor barrier jacket.

3.6 FIRE RATED INSULATION

A. All pipe penetrations through walls and concrete floors shall be fire rated by applying USG Thermafiber in the space between the concrete and the pipe.

B. The penetration shall be additionally sealed by using 3M brand model CP 25 or 303 fire barrier caulk and putty.

C. All fire rating material shall be insulated in accordance with manufacturer's printed instructions.

PART 4 - SCHEDULES

4.1 LOW TEMPERATURE SURFACES MINIMUM INSULATION THICKNESS

A. Condensate drain lines: ¾ inch

B. Chilled Water Piping:

1. Located outdoors: 2 inches

2. Located indoors:
   a. 4 inch and smaller: 1½ inch
   b. Larger than 4 inches: 2 inches

C. Refrigerant Piping

1. 1½" and smaller 1 inch

2. Larger than 1½ inch 1½ inch

END OF SECTION 23 07 19
SECTION 23 08 00 – COMMISSIONING OF HVAC SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract Documents, including General and Supplementary Conditions and Division 01 Specifications, apply to this section.

B. Related SECTIONS:

1. SECTION 01 91 00 - GENERAL COMMISSIONING REQUIREMENTS
2. SECTION 23 09 63 - ENERGY MANAGEMENT AND CONTROL SYSTEMS.

1.2 SUMMARY

A. The commissioning of the HVAC system and associated controls shall be performed by an impartial technical firm hired by the owner. The commissioning provider shall be certified under one or more of the following certifications:

1. CxA – Certified Commissioning Authority – ACG
2. CBCP – Certified Building Commissioning Professional – AEE
3. CCP – Certified Commissioning Professional – BCA
4. CPMP – Certified Process Management Professional – ASHRAE
5. BSC – Building System Commissioning Certification – NEBB

B. The commissioning provider (Commissioning authority) shall be responsible for leading the entire construction team through the commissioning process including, but not limited to, conducting the commissioning kick-off meeting, preparing the commissioning plan, preparing pre-functional checklists, preparing functional test scripts, participation in functional testing and preparation of required documentation and reports.

1.3 RESPONSIBILITIES

A. Contractor: Responsibilities of the Contractor as related to the Commissioning Process include, but are not limited to the following:

1. Facilitate coordination of Commissioning work by Commissioning authority.
2. Attend Commissioning meetings or other meetings called by Commissioning authority to facilitate the Commissioning Process.
3. Review Functional Performance Test procedures for feasibility, safety, and impact on warranty, and provide Commissioning authority with written comment on same.
4. Provide all documentation relating to manufacturer’s recommended performance testing of equipment and systems.

5. Provide Operations & Maintenance data to Commissioning authority for preparation of checklists and training manuals.


7. Provide As-built drawings and documentation to facilitate Testing.

8. Assure and facilitate participation and cooperation of Sub Contractors and equipment suppliers as required for the Commissioning Process.

9. Certify to Commissioning authority that installation work listed in Pre-Functional Checklists has been completed.

10. Install systems and equipment in strict conformance with project specifications, manufacturer’s recommended installation procedures, and Pre-Functional Checklists.

11. Provide data concerning performance, installation, and start-up of systems.

12. Provide copy of manufacturers filled-out start-up forms for equipment and systems.

13. Ensure systems have been started and fully checked for proper operation prior to arranging for Testing with Commissioning authority. Prepare and submit to Commissioning authority written certification that each piece of equipment and/or system has been started according to manufacturer’s recommended procedure, and that system has been tested for compliance with operational requirements.
   a. Contractor shall carry out manufacturer’s recommended start-up and testing procedures, regardless of whether or not they are specifically listed in Pre-Functional Checklists.
   b. Contractor is not relieved of obligation for systems/equipment demonstration where performance testing is required by specifications, but a Functional Performance Test is not specifically designated by Commissioning authority.

14. Coordinate with Commissioning authority to determine mutually acceptable date of Functional Performance Tests.

15. Provide qualified personnel to assist and participate in Commissioning.

16. Provide test instruments and communications devices, as prescribed by Commissioning authority, required for carrying out Testing of systems.

17. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Test Engineer in the commissioning process. Proprietary test equipment shall become the property of the Owner upon completion of commissioning.

18. Ensure deficiencies found in the Commissioning Issues Log are corrected within the
19. Provide Commissioning authority with all submittals, start-up instructions manuals, operating parameters, and other pertinent information related to Commissioning Process. This information shall be routed through Architect.

20. Prepare and submit to Commissioning authority proposed Training Program outline for each system.

21. Coordinate and provide training of Owner’s personnel.

22. Prepare Operation & Maintenance Manuals and As-Built drawings in accordance with specifications; submit copy to Commissioning authority in addition to other contractually required submissions. Revise and resubmit manuals in accordance with Design Professionals and Commissioning authority comments.

23. Commissioning requires participation of this Division Subcontractors to ensure that systems are operating in manner consistent with Contract Documents. All costs associated with the participation of Contractor, Sub-Contractors, Design Professionals, and Equipment Vendors in the Commissioning Process shall be included as part of the Construction Contract.

B. Subcontractors and vendors shall prepare and submit to Commissioning authority proposed Startup procedures to demonstrate proper installation of systems, according to these specifications and checklists prepared by Commissioning authority.

1.4 COMMISSIONING PLAN

A. Commissioning Process tasks and activities:

1. Commissioning kick-off meeting: Conducted by commissioning authority and attended by construction team and design team.

2. Pre-functional checklists: Prepared by the commissioning authority and filled out by subcontractors performing the work that is applicable.

3. Site visits to review installation of applicable systems and progress of checklist documentation performed and reported by commissioning authority.

4. Functional testing: Commissioning authority shall conduct functional testing with assistance of applicable subcontractors and document successful results as well as deficiencies (issues). Functional performance testing shall demonstrate the installation and operation of components, systems, and system-to-system interfacing in accordance with plans and specifications. Testing shall include all modes and sequence of operation, including under full-load, part-load and emergency conditions (including all alarms). Controls system shall be tested to document that control devices, components, equipment and systems are calibrated and adjusted and operate in accordance with the plans and specifications. Sequences shall be functionally tested to document they operate in accordance with plans and specifications.
5. Preliminary commissioning report: Commissioning authority shall issue a preliminary commissioning report to the owner that has results of the first round of functional testing including deficiencies discovered.

6. Air and hydronic system balancing: Air and water flow rates shall be measured and adjusted to deliver final flow rates within the tolerances provided in the contract documents. System balancing shall be performed by T.A.B. contractor as specified in the Testing, Adjusting and Balancing specification section 23 05 93.

7. Systems manual: Commissioning authority shall compile the systems manual using submittal data provided by the general contractor and applicable subcontractors.

8. Final commissioning report: Commissioning authority shall issue final commissioning report documenting the entire process and final results of functional testing. Report shall include final testing and balancing report.

B. Equipment to be tested

1. Energy Management and Control System:
   a. Graphical User Interface
   b. Automation Software
   c. Field Level Controllers
   d. Field Level Devices
   e. Control Sequences

2. Chilled Water Systems (All chillers and pumps)

3. Condenser Water Systems (All towers and pumps)

4. Heating Water Systems (All boilers and pumps)

5. Air Handling Systems (All AHU and 10% of terminal units)

6. Energy Recovery Systems (100%)

7. Water Treatment Systems (Verify vendors completion of scope)

8. Service water heating systems (100%)

C. Testing functions and conditions

1. Energy conservation programs (economizer, optimal start, etc)

2. Verify shutdown of systems when scheduled.

3. Calibration of sensors

4. Testing shall affirm winter and summer design conditions.

5. Test under full outside air conditions.
6. Confirm functionality of all specified sequences of operations.

7. Verify the functionality of all alarms.

D. Performance criteria

1. Air and water temperatures shall be within tolerances specified in the contract documents.

2. Space temperatures shall be maintained within 1 degree of specified set points.

3. Space humidity shall be maintained within 5% of specified levels.

PART 2 – PRODUCTS

2.1 NO PRODUCTS SUPPLIED

PART 3 – EXECUTION

3.1 GENERAL

A. This Division has startup responsibilities and are required to complete sub-systems so COMPLETE SYSTEMS are fully functional. Insuring they meet design requirements of Contract Documents. Commissioning procedures and testing do not relieve or lessen this responsibility or shift this responsibility, in whole or in part, to Commissioning Agent or Owner.

B. Coordinate with other Sub-Contractors and equipment vendors to set aside adequate time to address Pre-Functional Checklists, Functional Performance Tests, Operations & Maintenance Manual creation, Owner Training, and associated coordination meetings.

C. Commissioning authority will also conduct site inspections at critical times and issue Cx Field Reports with observations on installation deficiencies so that they may be issued by Architect as deemed appropriate.

3.2 WORK PRIOR TO COMMISSIONING

A. Complete all phases of the work so the systems can be started, adjusted, balanced, tested, and otherwise tested.

B. See pertinent specification sections in this Division, which outline responsibilities for start-up of equipment with obligations to complete systems, including all sub-systems so that they are fully functional.

C. Assist commissioning authority with all information pertaining to actual equipment and installation as required complete the full commissioning scope.
D. Contractor shall prepare startup procedures to demonstrate compliance with pre-functional checklists, and coordinate scheduling for completion of these checklists.

E. A minimum of 7 days prior to date of system startup, submit to Commissioning authority for review, detailed description of equipment start-up procedures which contractor proposes to perform to demonstrate conformance of systems to specifications and Checklists.

3.3 PARTICIPATION IN COMMISSIONING

A. Attend meetings related to the Commissioning Process; arrange for attendance by personnel and vendors directly involved in the project, prior to testing of their systems.

B. Provide skilled technicians to startup and test all systems, and place systems in complete and fully functioning service in accordance with Contract Documents.

C. Provide skilled technicians, experienced and familiar with systems being commissioned, to assist Commissioning authority in commissioning process.

3.4 WORK TO RESOLVE DEFICIENCIES

A. Complete corrective work in a timely manner to allow expeditious completion of Commissioning Process. If deadlines pass without resolution of identified problems, Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs thus incurred will be Contractor’s responsibility.

3.5 PRE-FUNCTIONAL CHECKLISTS (PFC)

A. Contractor shall complete Pre-Functional Checklists to validate compliance with Contract Documents installation and start-up requirements, for this Division’s systems.

B. Refer to commissioning plan for detailed list of equipment to be commissioned.

3.6 FUNCTIONAL PERFORMANCE TESTING (FPT)

A. Contractor, in cooperation with Commissioning Agent, shall conduct Functional Performance Testing to validate compliance with Contract Documents.

B. Refer to commissioning plan for detailed list of equipment to be commissioned.

C. Assist Commissioning authority in Functional Testing by removing equipment covers, opening access panels, etc. Furnish ladders, flashlights, meters, gauges, or other inspection equipment as necessary.

3.7 TRAINING

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specifications manual.

B. Contractor shall be responsible for training coordination and scheduling, and ultimately to ensure that training is completed.
C. The training agenda (plan) shall include, at a minimum, the following elements:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

D. Commissioning authority shall be responsible for overseeing and approving content and adequacy of training of Owner personnel for all installed systems. Provide Commissioning authority with training plan two weeks before planned training.

3.8 OPERATIONS & MAINTENANCE MANUALS

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specifications manual.

B. Sub-Contractor shall compile and prepare documentation for equipment and systems specified in this Division and shall deliver documentation to Contractor for inclusion in Operation & Maintenance Manuals, in accordance with requirements of Division 01, prior to training Owner personnel.


D. Operation and maintenance manuals shall include, service agency contact information, maintenance requirements, controls system settings and a narrative of how each system is intended to operate, including set points.

3.9 DOCUMENTATION

A. Commissioning authority shall provide documentation of process as follows:

1. Preliminary commissioning report including test procedures, results of testing, itemization of deficiencies, deferred tests and climatic conditions required for performance of deferred tests. Preliminary commissioning report shall be issued to owner to demonstrate the first pass of testing has occurred and to demonstrate compliance with applicable codes.

2. Final commissioning report shall include the final test and balance report, final results of functional testing, disposition of deficiencies discovered during testing, including the details of corrective measures used and functional testing procedures used for
repeatability of testing in the future.

END OF SECTION 23 08 00
SECTION 23 09 63 - ENERGY MANAGEMENT AND CONTROL SYSTEM (EMCS)

PART 1 - GENERAL

GENERAL

A. The Energy Management and Control System (EMCS) shall be comprised of a Local Area Network (LAN) infrastructure, Operator Workstations (OWS), Engineering Workstations (EWS), a Primary Network Server (PNS), Network Area Controllers (NAC), Application Specific Controllers (ASC), Unitary System Controllers (USC), and Field Devices installed within the facility.


C. If the EMCS contractor wishes to connect to the Owner’s Wide Area/Local Area Network as part of the control system network, the EMCS contractor shall acquire permission in writing and include the letter in the submittal. Any system that requires connection to the owner’s network for communication between NAC, ASC, USC and/or filed devices that is submitted without the written permission from the owner shall be rejected. The EMCS Contractor shall coordinate with the Owner and supply all required information.

D. Access to the system, either locally in the building, or remotely from a central site or sites, shall be accomplished through standard web browsers, via the Internet and/or a local area network.

E. All EMCS controllers and workstations shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135-2010, latest revision. Management level TCP/IP Ethernet network speeds shall be 1 Gbps minimum and the Automation Level MS/TP network speeds shall be 76.8 Kbps minimum.

F. The Server shall gather data from the system and generate HTML pages accessible through a conventional web browser from all personal computers (PCs) connected to the network. System shall include any and all software and hardware to support at least 50 simultaneous users. The EMCS shall be compatible with all common web browsers.

G. Facility Operators shall be able to view and configure systems through the standard web browser and all graphical/data representations shall appear identical, whether the user is on site or viewing via the Internet at a remote location. Standard operator functions such as control point manipulation, configuration and viewing of trends, schedules and alarms shall be performed through the standard browser. Each mechanical system and building floor plan shall be depicted on the operator workstation by point-and-click graphics.

H. The EMCS shall directly control HVAC equipment as specified in the Sequence of Operations. Furnish Energy Conservation features such as Optimal Start/Stop, Night Setback, Setpoint Reset logic, and Demand Control Ventilation.

I. The EMCS vendor shall provide the following additional services as part of this specification: warranty and service during the warranty period; submittals, samples and
record documentation; comprehensive startup and testing of the EMCS with
documentation; training services for the owner and facility operators; coordination with
other contractors and suppliers; operator and technician training program and shall
cooperate fully with the Project Commissioning Agent.

J. Products furnished under this specification but installed by other.

1. Mechanical devices installed under Division 23 by the mechanical contractor or
   other suppliers: temperature sensing thermowells; automatic control valves; pipe
taps for flowmeters; water pressure sensors and switches; automatic control
dampers not installed in air handling unit mixing boxes or louver schedules;
damper actuators for variable air volume (VAV) terminal units; mounting cost of
controller and actuator for VAV terminal units.

2. Electrical devices installed under Division 26 by the electrical contractor:
   a. 120 VAC power to controllers and control panels at locations indicated on
      the drawings. Review and verify that these locations are adequate for the
      proposed EMCS.
   b. Interlock wiring to duct mounted smoke detector or fire alarm shutdown
      relays to HVAC equipment motor starters and variable frequency drives
      (VFD).

K. Provide and install all interconnecting cables between all operator’s terminals and
   peripheral devices (such as printers, etc.) supplied under this section.

RELATED DOCUMENTS & REFERENCES

L. Drawings and general provisions of the contract documents apply to this section including:

   1. Division 01 for General Conditions and Supplementary Conditions.
   2. Division 21 for fire protection equipment.
   3. Division 22 for plumbing equipment and domestic water systems.
   4. Division 23 for mechanical equipment, ductwork, and piping systems.
   5. Division 26 for electrical equipment, lighting control, and fire alarm systems.

M. The latest edition of the following standards and codes in effect as approved by the
   authority having jurisdiction and amended as of supplier's proposal date, and any
   applicable subsections thereof, shall govern design and selection of equipment and material
   supplied:

   1. ANSI MC85.1 - Terminology for Automatic Control.
   2. American Society of Heating, Refrigerating and Air Conditioning Engineers
      (ASHRAE).
4. BTL Mark by the BACnet Testing Laboratories.

5. Uniform Building Code (UBC), including local amendments.

6. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.


8. FCC Part 15, Subpart J, Class A.


RELATED WORK IN OTHER SECTIONS

N. Refer to Division 00 and Division 01 for allowances and related contractual requirements.

O. Refer to Division 21 for General Fire Protection Provisions and fire suppression pump.

1. The EMCS contractor shall provide communications integration via BACnet/IP interface to each installed system listed above. BACnet MS/TP acceptable if IP interface is not available from equipment manufacturer.

2. The EMCS contractor shall coordinate with all vendors providing above systems to obtain communications requirements and points lists. Map all available points to EMCS.

P. Refer to Division 22 for General Plumbing Provisions, domestic water heating systems, domestic water pumping systems, and domestic water metering.

1. The EMCS contractor shall provide communications integration via BACnet/IP interface to each installed system listed above. BACnet MS/TP acceptable if IP interface is not available from equipment manufacturer.

2. The EMCS contractor shall coordinate with all vendors providing above systems to obtain communications requirements and points lists. Map all available points to EMCS.

Q. Refer to Division 23 for General Mechanical Provisions for equipment such as chillers, cooling towers, boilers, pumps, air-handling units, terminal units, ventilation fans, variable frequency drives, unitary AC units, etc.

1. The EMCS contractor shall provide communications integration via BACnet/IP interface to each installed system listed above. BACnet MS/TP acceptable if IP interface is not available from equipment manufacturer.

2. The EMCS contractor shall coordinate with all vendors providing above systems to obtain communications requirements and points lists. Map all available points
R. Refer to Section 26 for General Electrical Provisions for equipment such as electrical switchgear control, electrical power monitoring, emergency generators, lighting control system, etc.

1. The EMCS contractor shall provide communications integration via BACnet/IP interface to each installed system listed above. BACnet MS/TP acceptable if IP interface is not available from equipment manufacturer.

2. The EMCS contractor shall coordinate with all vendors providing above systems to obtain communications requirements and points lists. Map all available points to EMCS.

ELECTRICAL POWER PROVISIONS

S. Primary power will be provided under Division 26 by the electrical contractor to the panel locations indicated on the mechanical & electrical drawings. Provide step down transformers within panel enclosures. Provide all necessary fuses and circuit protection devices.

T. Power will be provided to the controllers serving fan powered terminal units with electric heat via the control transformer provided with the unit.

U. All components of the EMCS shall be powered from the sources above. Provide final terminations from the locations indicated on the Division 23 Drawings.

V. The EMCS Contractor shall provide any additional control power that is required as part of this contract and not indicated by other. This shall include all conduit, cabling, circuit breakers, etc.

CONTRACTOR QUALIFICATIONS

W. The EMCS Contractor shall:

1. Have a local staff of trained personnel capable of giving instructions and providing routine and emergency maintenance on the EMCS, all components and software/firmware and all other elements of the EMCS.

2. Have a proven record of experience in the supply and installation of equivalent BACnet systems over a minimum period of five years. Provide documentation of at least three equal and complexity, if so requested by the Owner’s Representative.

3. Be a factory certified representative of the native BACnet EMCS manufacturer for design, installation, and service of the proposed system.

4. Have comprehensive local service, training and support facilities for the total EMCS as provided. Maintain local, supplies of essential expendable parts.

SUBMITTALS
X. ALL DOCUMENTS SUBMITTED SHALL BE IN NATIVE PDF FORMAT. NO SCANS.

Y. Shop Drawings:

1. The following information shall be included on the cover page for each shop drawing and equipment documentation submittal:
   a. Project name with date. Refer to the applicable specifications by name and number.
   b. Provide submittal number and re-submittal number and date as applicable.
   c. Provided name and address of Consulting Engineer, Mechanical Contractor, General Contractor

2. Shop drawings shall be CAD generated, plot size of 8-1/2” x 11” or 11” x 17”. Drawings shall include diagrams, mounting instructions, installation procedures, equipment details and software descriptions for all aspects of the system to be installed.

3. Provide schematic of systems indicating instrumentation locations, all interconnecting cables between supplied cabinets on a mechanical floor plan.

4. Software specifications and descriptions including operating sequences.

5. Provide a bill of material that indicates specific manufacturer, part number, part description and quantity of each device for all system components.

6. Provide a list of the wire labels to be installed on each end of the control wiring, at the device and the control panel terminal. Labels shall be machine generated, typed and legible with a maximum of 17 characters. The label description “AHU-1 SAT” shall indicate the supply air temperature of AHU-1.

7. Equipment Schematic: Provide an electronic equipment schematic for each piece of mechanical equipment. The schematic shall display all mechanical equipment characteristics including fans, dampers, valves, sensors and other applicable control devices. The schematic shall show wiring terminations to each control device as shown in the submittal and as-build documentation. Control devices shall be labeled by a symbol that can easily be identified in a bill of material that is shown on this graphic. The bill of material shall show the device symbol, description, manufacture and part number.

8. Sequence of Operations: The control sequences shall be viewable for each piece of mechanical equipment and be in a text format as shown in the as built documentation. The sequence of operations shall be selectable at the applicable location for the control program.

Z. Control component submittals:

1. Component technical data sheets with mounting and installation details.

2. The documentation shall include comprehensive and complete details of the BIBB and automation level documentation including address, associated controller type,
etc. as required and for the interface to the EMCS.

3. Details of networks/communications equipment, cabling and protocols proposed. Provide schedule of cabling including details of proposed cable types.

4. Module Drawing: Provide an electronic wiring diagram of each control module (as shown in submittal documentation). Diagram shall display wiring schematic and terminations to end devices. Diagram shall display each input and output terminals and label those that are used for the control application. Diagram shall display module type/name and network address.

5. Field sensor and instrumentation specification sheets. Provide complete manufacturer’s specifications for all items that are supplied. Include vendor name of every item supplied.

6. Schedule and specification sheets for dampers, valves and actuators.

7. Design and provide layout of all components of panel mounted control devices, terminal strips and power supplies.

AA. Colorgraphics: Provide sample layout of color graphic representations of the systems for review. The submittal shall indicate the quality of the graphic to be provided with the system with a sample of the specific control points to be included. Control points shall as a minimum include points indicated in the input/output summary, control schematic and primary controlling points defined in the sequences of operation. Provide a sample of a floor plan layout, typical AHU, terminal unit, outside air pretreatment unit, variable frequency drive, exhaust/supply fan, chiller plant and hot water plant. For control points to be provided by equipment BACnet integration provide sample of the control points, up to 25 totals.

BB. Verification Reports. The submittal shall include a sample of the verification reports to be utilized during the verification section of this specification. Sample reports shall be approved as submitted or be modified by the engineer or owner’s representative. The verification reports shall be included in the final Operation & Maintenance Manuals. Reports shall be provided in electronic PDF format.

1. Project Systems Verification Form for each controller.
   a. General information for each form shall include: project name; associated equipment with mark number; control panel number and location; controller number and model number; controller device instance number (address); MS/TP LAN segment number; verifying technician and date.
   b. Each connected control point and device shall contain the following columns with a separate line for each connected physical point: point description (same as device label); input/output number for each connected control device (AI-XX, AO-XX, DI-XX, or DO-XX).
   c. Check boxes confirming that the verification tasks have been completed: device location, proper termination at device; proper termination at control panel; sequence is verified; point trend is enabled.
   d. Data entry boxes indicating measured/confirmed values: preliminary control point value on the graphic; observed control point value; calibration or adjustment value to correct offset; final displayed point value on the color-
2. Control Panel Verification Form for each control panel.
   a. General information: panel location and identification number; panel dimensions and NEMA rating; panel properly installed; Class 1 and Class 2 wiring are properly separated; correct voltage to the panel; no shorts or grounds in panel; no induce voltages in panel wiring; point to point termination match submittal; devices are mounted in the correct location; controller software revision number; address of controllers; panel device checkout is complete; panel startup is complete.

3. Sequence of Operation Verification Form per piece of equipment (AHU, VAV, chiller, boiler, etc.).
   a. General information: project name; system identifier; building area served; control panel and controller numbers; controller model number and instance number (address); MS/TP LAN segment number; name of verifying technician and date.
   b. Each step of the sequence of operation for each piece of equipment shall be documented shall include a “description of test”, “input to trigger test” and “expected outcome”. A pass/fail checkbox shall indicate each of these actions. Provide space for technician approval with associated date.

CC. Operating and Maintenance (O&M) manuals: Provide O&M manual with full information to allow the owner to operate, maintain and repair installed products. Include trade names with model numbers, color, dimensions and other physical characteristics.

1. Format: Produce on 8-1/2 x 11-inch pages and bind in 3-ring/binders with durable plastic covers. Label binder covers with printed title “OPERATION AND MAINTENANCE MANUAL”, title of project, and subject matter and “Number _ of _” of binder. Provide substantial dividers tabbed and titled by section/component number.

2. Table of Contents for each volume:
   a. Part 1: Directory with name, address and telephone number of Designer, Contractor and Subcontractors and Suppliers for each Project Manual section.
   b. Part 2: Operation and maintenance instructions, arranged by Project Manual Section number where practical and where not, by system. Include:

3. Product design criteria, functions, normal operating characteristic and limiting conditions. Installation, alignment, adjustment, checking instructions and troubleshooting guide. Operating instructions for start-up, normal operation, regulation and control, normal shutdown and emergency shutdown. Test data and performance curves.

4. Spare parts list for operating products, prepared by manufacturers including detailed drawings giving location of each maintainable part, lists of spares recommended for user-service inventory and nearest source of in-stock spares.

DD. Record Documentation:
1. Details of all alarm, diagnostic, error and other messages. Detail the Operator action to be taken for each instance.

2. Detail special programs provided and provide a complete programming instruction manual. Detail operation of all software applications.

3. Detailed list of the database for all installed devices.

4. Record drawings shall be CAD generated and shall include final locations and point ID for each monitored and controlled device.

5. In addition to the required hard-copies, provide a CD-ROM with all of the record documentation in PDF format and a CD-ROM containing backup copies of all installed software and graphics.

6. Online as-built documentation: provide digital replications of as-builts that shall be accessible from each equipment graphic controlled or monitored by the EMCS.

WARRANTY

EE. Warranty work and the equipment provided under this contract shall be for a period of one year from the date of Substantial Completion. Warranty shall cover all components, system software, parts and assemblies supplied by this contractor and shall be guaranteed against defects in materials and workmanship for one (1) year from the date of Substantial Completion. Labor to troubleshoot, repair, reprogram or replace system components that have failed due to defects in materials and workmanship shall be provided by this contractor at no charge to the owner during the warranty period. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks. All warranty work shall be performed by the EMCS contractor’s local service group.

FF. Warranty shall not include routine maintenance, e.g., equipment cleaning, mechanical parts lubrication, pilot lamp replacement, operational testing, etc. Warranty shall not cover repair or replacement of equipment damaged by under- or over-voltage, misuse, lack of proper maintenance, lightning, water damage from weather or piping failure.

GG. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the EMCS contractor. The maximum acceptable response time to provide this service at the site shall be 24 hours, during normal working hours.

OPERATIONS PERSONNEL TRAINING

HH. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.

2. Principle of how the equipment works.
3. Important parts and assemblies.

4. How the equipment achieves its purpose and necessary operating conditions

5. Most likely failure modes causes and corrections.

6. On site demonstration that includes hands-on demonstration of the manipulation of setpoints, schedules and other adjustable elements of the system.

7. The demonstration shall be on the actual, completed graphic interface pages for the specific project.

II. Provide a second training session 3 months after initial session for any follow-up or additional training requested by owner’s personnel. Allow 3 hours for the second training session.

OPERATOR WORKSTATION (OWS)

JJ. The Operator Workstation shall be any personal computer, connected to the LAN, with appropriate web browser software installed.

ENGINEERING WORKSTATION (EWS)

KK. The Engineering Workstation shall be any personal computer, connected to the LAN, with a registered copy of the EMCS contractor supplied engineering and/or programming software installed. The EMCS contractor shall provide at least one copy of all required software(s), to enable the Owner complete editing/programming functions of all controllers, graphics, and control logic.

LL. The EMCS shall provide one personal computer (PC) which is compatible with the performance required by the EMCS Engineering Software if an engineering workstation is specified for the system.

PART 2 - PRODUCTS

THE ACCEPTABLE EMCS VENDORS ARE;

A. AUTOMATED LOGIC - Branch Office

B. ALERTON – Climatec

C. RELIABLE CONTROLS - Unify Energy Solutions

D. TEAM SOLUTIONS – Branch Office

PRIMARY NETWORK SERVER (PNS)

E. The EMCS Contractor shall provide and install the Primary Network Server as part of this
system. The PNS shall utilize the Internet and provide efficient integration of standard open protocols. The PNS shall maintain comprehensive database management, alarm management and messaging services, and graphical user interface as follows:

1. Support an unlimited number of users over the Internet/intranet with a standard web browser to access alarms, trend logs, graphics, schedules and configuration data. Access to the PNS shall be password protected utilizing authentication and encryption techniques. An audit trail of database changes indicating user, time stamp, and audit action shall be provided.

2. Enterprise level information exchange using an SQL database and HTTP/HTML/XML text formats.

3. Synchronize controller databases, database storage scheduling, control and energy management routines.

4. Alarm processing and routing which includes email, SMS text messages and paging.

5. HTML based help system that includes comprehensive online system documentation.

6. Support of multiple Network Area Controllers (NAC) connected to a Local Area Network.

F. Server Functions

1. It shall be possible to access all Network Area Controllers (NAC) via a single connection to the server through the Ethernet LAN. In this configuration, each Network Area Controller can be accessed from a single user login.

2. The PNS shall provide the following functions, at a minimum:
   a. The server shall provide complete access to distributed global data. The server shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote.
   b. The server shall include a master clock service for its subsystems and provide time synchronization for all NACs.
   c. The server shall provide scheduling for all NACs and their underlying field control devices.
   d. The server shall provide demand limiting control that operates across all NACs. The network server shall be capable of multiple demand limiting programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.
   e. The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to NACs. Each Network Area Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.
   f. The server shall provide central alarm management for all NACs supported.
by the server. Alarm management shall include: routing of alarms to a video
display, a printer, an email and pager; view and acknowledge alarms; query
alarm logs based on user-defined parameters
g. The server shall provide central management of logged data for all NACs
supported by the server. Logged data shall include process logs, runtime and
event counter logs, audit logs and error logs. Log data management shall
include: viewing and printing log data; exporting log data to other software
applications; query log data based on user-defined parameters

3. The Primary Network Server shall be capable of supporting the following open
system drivers;
a. BACnet/IP
b. Modbus TCP

G. Network Server Platform Requirements

1. Rack-Mounted Server Computer Hardware: DELL PowerEdge R220 or equal,
   Intel Pentium Core 2 Duo 2.0 GHz or higher, 8GB RAM, 500GB harddrive, video
card, 22” color monitor, and Ethernet adapter 1Gbps or higher.

2. Operating system software shall be Microsoft Windows 7 Professional or higher.

NETWORK AREA CONTROLLER (NAC)

H. Provide one or more Network Area Controllers (NAC) to meet the sequence of operations
and the type and quantity of devices being integrated into the system. The NAC shall
provide the interface between the local area network and the field controllers. The NAC
shall provide global supervisory control functions over the associated controllers and shall
be capable of executing application control programs to provide: calendar functions;
scheduling; trending; alarm monitoring and routing; time synchronization; integration of
controller data for each applicable protocol; network management functions for all network
devices. The user may view real-time information via web-based data.

I. The Network Area Controller shall provide the following hardware features as a minimum:
   Ethernet Ports 100Mbps or higher, BACnet MS/TP ports, battery backup, DDR RAM
   memory, flash memory for long term data backup.

J. Provide an uninterruptible power source (UPS) per network controller to maintain
   operation for 1 hours.

K. The NAC shall be capable of operation over a temperature range of 32 to 122 °F and
   operation over a humidity range of 5 to 95% RH, non-condensing; storage temperatures of
   between 32 and 158 °F.

L. The NAC shall provide multiple user access to the system and support for ODBC or SQL.
   A database resident on the NAC shall be an ODBC-compliant database or must provide an
   ODBC data access mechanism to read and write data stored within it.

M. The NAC shall be capable of supporting the following open system drivers;
   1. BACnet/IP
2. BACnet MS/TP
3. Modbus TCP
4. Modbus RTU

N. Event Alarm Notification and actions: The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers. Alarm conditions shall be routed to any defined user location whether connected to a local or wide-area network.

1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to: alarm; return to normal; fault.

2. Provide for the creation of a minimum of eight alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc. Allow timed routing of alarms by class, object, group, or node.

3. Provide alarm generation from binary object “runtime” and/or event counts for equipment maintenance (i.e. filter status, fan run status). Authorized users shall be able to reset runtime or event count values with appropriate password control.

4. Control equipment and network failures shall be treated as alarms and annunciated.

5. Alarms shall be annunciated in any of the following manners as defined by the user: screen message text; e-mail of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on: day of the week, time of day and recipient.

6. Color-graphic shall have flashing alarm object(s). Printed message may be routed directly to a dedicated alarm printer.

7. The following shall be recorded by the NAC for each alarm (at a minimum): time and date; location (building, floor, zone, office number, etc.); associated equipment. Upon acknowledgement of the alarm the NAC shall document the time, date and authorized user. The number of alarm occurrences since the last acknowledgement shall be recorded.

8. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user. Alarm actions may be initiated by user defined programmable objects created for that purpose.

9. Alarm archiving: A log of all alarms shall be maintained by the NAC and/or a server and shall be available for review by the user. Provide a “query” feature to allow review of specific alarms by user defined parameters. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

O. Data Collection and Storage: The NAC shall have the ability to collect data for any property of any object and store this data for future use.
1. The user shall designate the log as an interval log or deviation log. For an interval log, the object shall be configured for time of day, day of week and the sample collection interval. For deviation log, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

2. All log data shall be stored in a relational database in the NAC and the data shall be accessed from the server or a standard web browser. All log data, when accessed from the server, shall be capable of being manipulated using standard SQL statements.

3. All log data shall be available to the user in the following data formats: HTML, XML, plain text, comma separated values, as a minimum.

4. The NAC shall have the ability to archive its log data either locally or remotely to the server or other NAC on the network.

P. Local Access: The NAC shall provide redundancy of system access to the local controllers at the remote building if the Primary Network Server should lose communication or be off-line. The NAC shall maintain setpoint and scheduling features, access to the color-graphic displays, maintain trend logs and reports. Upon restoration of communication with the PNS the archived information shall be transmitted to the server for archiving.

SOFTWARE FOR THE NAC

Q. The distributed architecture of the operating system for the PNS and NACs shall provide the operator a comprehensive interface to allow the operator to configure and customize the EMCS to optimize the HVAC system to save energy, schedule and maintain equipment and provide occupant comfort. The provided graphical toolset shall allow the operator to create applications in a drag and drop environment.

1. Input/output capability shall allow the operator to request the current value or status of the control point; command/override equipment to a specific state; add, change or delete control points, alarm limits and controllers; change descriptors to control points and equipment; modify parameters; create or modify DDC loops.

R. Operator System Access: Via software password with five access levels at workstations and at each control unit.

S. Color graphic tools shall allow the user to create equipment and floor plan graphics from a standard library of symbols; allow custom generation of symbols; utilize over 64 or more colors; create real-time dynamic data for the graphics. Up to 60 control points may be displayed on each graphic.

1. Provide a link between compatible graphics to minimize the paths to additional information. For example, provide the link from the zone sensor to the VAV terminal to the air handling unit and to the central plant. Web pages shall be
provided to allow the operator to zoom into specific areas of the facility and then link the space to the floor plan to the overall building and then to the facility site plan.

2. Graphical tools shall allow the creation of bar graphs, pie graphs and other tools to visualize control information such as run time hours, energy consumed and occupant comfort.

T. Alarm processing tools shall allow the operator to create alarm messages that include as a minimum: time of alarm, point descriptor, alarm condition and remote annunciation. Critical alarms shall be displayed, archived to a storage device or printed on a alarm printer. Alarms shall be displayed in order of occurrence and have an optional audible alarm indicator.

1. Print alarm messages, up to 60 characters in length, for each alarm point specified.

2. Alarms may be routed to other devices including web-enabled cell phones, pagers, tablet PCs and designated personal computers on the network or Internet.

3. Operator specifies when alarm requires acknowledgment. Continue to indicate unacknowledged alarms after return to normal. An alarm log shall be maintained to archive alarms for future reference with the above specified parameters as well as indicating the person acknowledging the alarm.

4. The graphical display shall indicate the number of the current unacknowledged alarms by individual building site or by sum of all campus-wide facilities.

5. The operator may create and forward an e-mail message to another user directly from the graphical interface so that the message can be read when the second user logs on to the system.

U. Upon a power failure to equipment in the facility, the EMCS shall automatically start equipment upon the restoration of power. Program a time delay between individual equipment restart on a schedule to minimize demand charges from the utility company.

V. Custom reports may be created by the operator with a requested time and date manually or automatically. All reports may be logged to a storage device for future reference. The data reports shall allow customization and scaling of the X-Y coordinates; plotting of tabular reports; provide multi-point graphical reports with not less than eight variables on the same report. Print reports on daily, weekly, monthly, yearly or scheduled basis as scheduled.

W. The network server current operating system, database, color-graphics, custom reports shall be backed up automatically to a remote server or storage device as directed by the owner’s representative.

X. Maintenance Management capability shall allow the system to monitor and log the run-time for HVAC equipment; schedule maintenance reports that include recommended material and labor for the assigned task.

APPLICATION SPECIFIC CONTROLLERS (ASC)
Y. All devices required for single loop control shall be terminated on a single controller. (for example, CHW loop pressure control. The differential pressure sensor and the pump VFD ramp signal.)

Z. ASCs shall be capable of implementing control strategies for the system based on information from any or all connected inputs. The AC shall utilize factory pre-programmed global strategies that may be modified by field personnel on-site. Global control algorithms and automated control functions should execute via a 32-bit processor.

AA. Programming shall be object-oriented using control program blocks that will support a minimum of 500 Analog Values and 500 Binary Values. Analog and binary values shall support standard BACnet priority arrays. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing.

BB. Controller shall have adequate data storage to ensure high performance and data reliability. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1 year (cumulative). Battery shall be a field-replaceable (non-rechargeable) lithium type. The onboard, battery-backed real time clock must support schedule operations and trend logs.

CC. The base unit of the ASC shall host various I/O combinations including universal inputs, binary outputs, and switch selectable analog outputs (0-10V or 0-20 mA). Inputs shall support thermistors, 0-5VDC, 0-10VDC, 4-20mA, dry contacts and pulse inputs directly.

DD. All binary outputs shall have onboard Hand-Off-Auto switches and a status indicator light. HOA switch position shall be monitored. The position of each HOA switch shall be available system wide as a BACnet object.

EE. Controller shall be capable of BACnet communication. BACnet Conformance:

1. Standard BACnet object types supported shall include as a minimum: Analog Input, Binary Input, Analog Output, Binary Output, Analog Value, Binary Value, Device, File, Group, Event Enrollment, Notification Class, Program and Schedule object types. All necessary tools shall be supplied for working with proprietary information.

FF. Schedules: Each ASC shall support a minimum of 10 BACnet schedule objects.

GG. Logging Capabilities: Each controller shall support a minimum of 100 trend logs. Sample time interval shall be adjustable at the operator’s workstation. Controller shall periodically upload trended data to system server for long term archiving if desired. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

HH. Alarm Generation: Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures. Alarm logs shall be provided for alarm viewing. Log may be viewed on-site at the operator’s terminal or off-site via remote communications. Controller must be able to handle up to 200 alarm setups stored as BACnet event enrollment objects – system destination and actions individually configurable.

UNITARY SYSTEM CONTROLLERS (USC)
II. All devices required for single loop control shall be terminated on a single controller. (for example, cooling coil control valve control. The temperature sensor and the valve control signal.)

JJ. The EMCS Contractor shall provide all Unitary System Controllers. USCs shall be fully programmable or applications specific controllers with pre-packaged operating sequences maintained in Flash RAM.

KK. The USC shall be a node on the automation network and shall control its own communications so that the failure of any one node, shall not inhibit communications on the network between the remaining nodes. USCs shall be totally independent of other network nodes for their monitoring and control functions.

LL. Provide each USC with a battery back-up for the protection of volatile memory for a minimum of 72 hours. Batteries shall be rated for a seven-year life.

MM. All associated applications programs shall reside at the USC. The USC shall not require communication to any other panel for normal operating sequences other than time scheduled base commands.

NN. Control shall be based on algorithms, i.e. proportional plus integral plus derivative (PID), proportional plus integral (PI), or proportional to comply with the sequences of operation. PID algorithms shall maintain the system operation within +/- 2% of setpoint.

OO. The USC shall be configured with sufficient input/output capacity to achieve the required control points to meet the sequence of operations.

VAV TERMINAL UNIT CONTROLLER (TUC)

PP. All devices required for single loop control shall be terminated on a single controller. (for example, terminal unit air valve control. The flow sensor and the actuator control signal.)

QQ. The EMCS Contractor shall provide all controllers required for all variable air volume (VAV) terminal units. The number and location of terminal units and airflow rates shall be as indicated on the mechanical drawings.

RR. The TUC shall be capable of monitoring and controlling the following parameters for VAV terminal units per the sequences of operation and input/output summary: space temperature; primary air flow rate; damper modulation; heating coil stage control, heating valve control, heating SCR control (as applicable); fan on/off control; supply air sensor; occupancy sensor; carbon dioxide sensor or humidity sensor.

SS. Furnish primary damper actuators, for factory mounting, meeting the following requirements: direct shaft mounting; adequate torque, to properly operate the damper from fully open to fully closed without binding; locking “V” groove or similar means to prevent slippage between actuator and shaft.

TT. The EMCS Contractor shall field install the following components for each terminal unit: space temperature sensor; supply air temperature sensor; occupancy sensor, and carbon dioxide sensor as indicated on the Mechanical Drawings.
UU. The EMCS Contractor shall furnish to the terminal unit manufacturer the following components for factory installation and wiring for each terminal unit: VAV controller with integral differential pressure transducer and damper actuator.

VV. The terminal unit manufacturer may provide the following components for each terminal unit for interface and mounting of the TUC: primary air dampers; enclosure to house the TUC and associated components including suitable mounting brackets shall be NEMA 1 rating and located outside the terminal unit; multi-point averaging type flow sensor at the primary air inlet to the terminal unit; 24 VAC control transformer; 24 VAC fan control relay interface; 24 VAC heater control relay interface (up to two stages); 24 volt SCR heater input as scheduled (0-10 Vdc or 4-20 mA).

WW. Any items required for proper operation but not provided by TU vendor, shall be provided under this section.

AIR HANDLING UNIT CONTROLLER

XX. All devices required for single loop control shall be terminated on a single controller. (for example, AHU static pressure control. The differential pressure sensor and the VFD ramp signal.)

YY. The EMCS Contractor shall provide controllers required for chilled/hot water and DX/electric heat air handling units and fan coil units. Provide an enclosure to house the controller and associated components including suitable mounting brackets shall be NEMA 1 rated and located outside the FCUs.

ZZ. The controller shall be capable of monitoring and controlling the following parameters per the sequences of operation and input/output summary; space temperature; space relative humidity sensor; cooling/heating stage control or modulating valve control; fan on/off control and status; supply air sensor; occupancy sensor; carbon dioxide sensor; VFD control and monitoring.

EMCS CONTROLLER LEVEL NETWORK

AAA. EMCS Automation Level Network shall consist of BACnet MS/TP (76.8 Kbps minimum). Data transfer rate and data throughput as required to meet the alarm annunciation requirements.

SOFTWARE OVERVIEW

BBB. Dynamic Colored Floor plans: Dynamic colored floor plans that compare actual space conditions to setpoints shall be provided on all floorplan graphics displayed on the front-end. Floorplan enlargements shall also use the thermographs to display space conditions. Zones within the set point range shall appear transparent white. As the space gets warmer the zone color shall gradually modulate from transparent white to transparent red to identify a hot zone. As the space conditions get cooler the zone color shall gradually modulate from transparent white to transparent blue to identify a cold zone. Each zone shall indicate the current actual zone temperature within the zone. The floor plans shall use a dynamic scheduling icon to indicate schedule occupancy for each zone and provide direct one-click access to that zones unique schedule. Provide a designated icon or symbol indicating that the zone is in the occupied/unoccupied condition. From the floorplan graphic, the operator
shall be able to click on any zone and go directly to the graphic for the piece of equipment controlling that zone. All dynamic floor plans shall be visible via web interface as well as on the LAN. The authorized system operator shall be able to change the zone or system identifier (or name) on the graphic and that change shall be distributed to other associated graphics and to the equipment controller.

CCC. Pop up Trends: Provide trend logs that automatically pop up when the operator mouse clicks on the point from the graphic. Provide pop up trends for all dampers, control valves, temperature sensors, carbon dioxide sensors, humidity sensors, airflows, static pressures, flow meters, VFD speeds, etc. The EMCS contractor shall set up all trends for the owner. The pop-up trend shall include a trend tool that allows the operator to modify the trend time scale and sample interval for up to 10 sample values. The trends shall be graphical on the computer screen but shall provide an output as an .xls, .csv, .pdf, HTML, r text file.

DDD. Interactive Maps: Implement JAVA SCRIPT API 3.0 or newer, such as Google Interactive maps depicting the facility location to indicate the site plan. This is not a static image and must be completely interactive.

EEE. Custom User HTML applications: The EMCS shall utilize HTML applications as an extra feature. At minimum, provide 7-day forecast, weather radar, traffic map and hurricane tracker. All of these features shall be imbedded into the EMCS system.

FFF. Provided a web-based EMCS platform; contractor shall provide an Open License software. Licenses that are not open are not acceptable. There shall be no per seat or per user licensing fee charged to the owner by the contractor.

GGG. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. Schedules, setpoints, trends, and alarms shall be BACnet Objects.

HHH. User access shall include 50 assigned operators that shall include five levels of access within the web system. Each operator log-in shall have an expiration date to allow for temporary access to the system. The operator’s access description shall include his e-mail address and cell/phone numbers. The operator access can be limited from 5 minutes to permanent access. The user shall be limited to eight bad login attempts before being locked out of the system.

III. Global modification: Provide the capability for global modification of user definable parameters of all points shall be provided. Global modification is defined as the mass adjustment of user definable parameters across a defined group, area, facility, campus, or network. Parameters shall be included, but not be limited to temperature set point (VAV boxes, AHU Discharge, VAV AHU Static Pressure Setpoints etc.), equipment start/stop, equipment status, valve output signal, VFD speed control signal, and damper position signal. User shall be able to lock the definable parameter to a set value or adjust a set point to an operator adjustable value. This function shall be accomplished through the standard graphical user interface/workstation and is to be selectively applicable by the user to all controllers on the network, all controllers in a specific facility or all controllers in a specific zone within a specific facility.

JJJ. The system operator shall be able to override the output signal to the valves, dampers, variable frequency drives, etc. with the use of the PC mouse click on the device. The system
override shall include a Hand-Off-Auto (HOA) capability. If the output is commanded to the hand position the operator shall designate an output value of 0-100% in 1% increments. The hand override position shall be permanent or expire after a designated time period and revert to the auto position. The color-graphic shall indicate the device that has been overridden by a color change of the output value.

KKK. For non-emergency in-warranty events the system operator may submit a Service Request directly from the floor plan or system graphic. The web interface shall include the EMCS suppliers contact information including phone numbers and e-mail address. The service request will be logged into the EMCS suppliers service department. A non-response by the assigned technician shall elevate the request to the next highest manager or supervisor until the system operator receives an response that their request has been received and is scheduled for a resolution. All requests for service shall be maintained in the customer’s database for future reference. The service request capability may be extended after the expiration of the warranty as part of a service agreement.

LLL. The web-based system shall be accessible from Tablet PCs and provide the same functionality that is available from personal computers connected through the LAN or WAN to the system operator. The tablet PCs as a minimum shall include an Apple iPad and Google Android based tablet PC. Operation shall include touch screen capability and use of the tablet keyboard screen. The operator shall be able to view color-graphics, system trends, override setpoints, change time schedules, and override damper and valve positions.

ENERGY SAVING PROGRAMS

MMM. Demand Limiting: Monitor total power consumption for each power meter and shed associated loads automatically to reduce power consumption to an operator set maximum demand level.

NNN. Duty Cycling: Periodically stop and start loads, based on space temperature, and according to various on/off patterns.

OOO. Automatic Time Scheduling: Self-contained programs for automatic start/stop/scheduling of building loads. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary schedules.

PPP. Optimal Start/Stop: Perform optimized start/stop as function of outside conditions, inside conditions, or both. Optimization shall be adaptive and self-tuning, adjusting to changing conditions by modifying occupancy period based upon the desired temperature at beginning and end of the occupancy period. Base optimization on occupancy schedules, outside air temperature, seasonal requirements, and interior room temperature. Employ adaptive model prediction for how long building takes to warm up or cool down under different conditions.

QQQ. Night-Setback Program: Reduce heating space temperature setpoint or raise cooling space temperature setpoint during unoccupied hours in conjunction with scheduled start/stop and optimum start/stop programs.

RRR. Setpoint Reset: Setpoints for control of variable load systems shall be reset based on load demand, as described in the Sequence of Operations.
SSS. Calculated Points: Define calculations and totals computed from monitored points (analog/digital points), constants, or other calculated points.

TTT. Event Initiated Programming: Any data point capable of initiating event, causing series of controls in a sequence.

UUU. Holiday Scheduling

VVV. Direct Digital Control: Furnish software so operator is capable of customizing control strategies and sequences of operation by defining appropriate control loop algorithms and choosing optimum loop parameters.

WWW. Trend logging shall be provided for all points per the input/output summary where there is a change in the analog or binary signal. Each controller shall be capable of storing trend values and then automatically transfer data to the NAC or the NS hard disk. Trend data shall be updated continuously per the operator assigned interval at intervals as low as one minute. Collect samples at intervals specified in minutes, hours, days, or month. Output trend logs as line-graphs or bar graphs. Binary points (input and output) shall only be logged upon a change of value (COV). Display trend samples on workstation in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time versus data.

FIELD INSTRUMENTATION

XXX. Temperature Sensors: All temperature sensors shall be thermistor type, factory-calibrated to within 0.5 °F, interchangeable with housing appropriate for application. Sensors shall have a temperature curve rated for the application. Sensor wiring terminations shall be in a galvanized box.

1. Outside air temperature sensors shall be installed in weather proof enclosure with ventilated sun-shied

2. Duct mounted temperature sensors shall be averaging type for supply air, mixed air and low temperature applications for air handling units. Duct probe temperature sensor shall be acceptable for terminal units.

3. Space temperature sensors shall contain a backlit LCD digital display and user function keys along with temperature sensor, setpoint adjustment and after-hours override use. Override time may be set in one-hour increments.

4. Thermowell temperature sensors shall be stainless steel probe of length that is equivalent to a minimum of 50% of the pipe diameter. End-to-end accuracy shall be ± 0.5 deg. F. Connection box shall be moisture/water proof with conduit fitting. Furnish the stainless steel thermowell to the mechanical contractor for installation. A thermal conducting grease shall be installed in the thermowell to provide uniform temperature sensing.

5. Provide flat plate stainless steel space temperature sensors with no local setpoint adjustment as indicated on the drawings.

YYY. Carbon Dioxide Sensors: The sensor shall be capable of monitoring carbon dioxide
concentration with an accuracy of +/- 30 parts per million (PPM). The sensor shall produce a linear 0-10 VDC or 4-20 mA signal over the range of 0 to 2000 PPM. The sensor shall measure using non-dispersed infrared (NDIR) technology to measure carbon dioxide gas and shall be;

1. Wall mounted carbon dioxide sensors shall be Veris CWE series or equivalent.

2. Duct mounted carbon dioxide sensor shall be Veris CWD series or equivalent.

3. The EMCS contractor shall utilize the required calibration devices to properly commission and calibrate the sensors per the manufacturer’s requirements.

ZZZ. Relative Humidity Sensors: relative humidity sensors shall be a two-wire type, 4-20 mA output proportional to the relative humidity range of 0-100%. The accuracy of the sensors shall be +3% over a range of 5-95% RH.

1. Outdoor relative humidity sensors: provide non-corroding outdoor shield to minimize wind effects and solar heating. Install wall-mount weather proof enclosure with conduit fitting. Sensor shall be Veris HO series, or equivalent.

2. Wall-mounted relative humidity sensor: sensor shall be installed in a wall-mounted enclosure with white cover. Sensor shall be Veris HEW series or equivalent.

3. Duct-mounted relative humidity sensor: sensor shall be provided with a moisture resistant enclosure with conduit fitting. The probe length shall be 8” minimum. Sensor shall be Veris HED series or equivalent.

AAAA. Pressure Transducers:

1. Air pressure sensor: The pressure sensors shall have an input range compatible with the medium being measured. The proportional output signal shall be 0-10 VDC or 4-20 mA. Sensor shall be SETRA Model 264 or equivalent.

2. Water pressure sensors: The pressure sensors shall have an input range compatible with the medium being measured. The proportional output signal shall be 0-10 VDC or 4-20 mA. Sensor shall be SETRA Model 230 or equivalent. Sensor shall be installed with a valved piping bypass and bleed off for each port.

BBBB. Freezestat: Provide freezestats for all chilled water air handling systems that receive more than 10% untreated outside air. Freezestats shall provide vapor tension elements, which shall serpentine the inlet face on all coils. Provide additional sensors, wired in series, to provide one linear foot per square foot of coil surface area. Freezestat shall be manually reset at the switch. Interlock to the associated fan so that fan will shut down when HOA switch is in hand or auto position. Provide time delay relays with a 0-10-minute time delay relay duration to minimize nuisance freezestat trips. Time delay relay shall be adjustable at the associated control panel.

CCCC. Air differential pressure switch: For fan shutdown, provide air differential pressure switches for all fans controlled by a variable frequency drive (VFD) to shut down the associated fan in the event of sensing high differential pressure. Air differential pressure switches shall have an adjustable setpoint with a range of 0-10 inches w.g. with manual
reset at the switch. Provide ¼ inch copper tubing with compression fittings to mount to the side of the duct. Sensor shall be DWYER Series 1620 or equivalent.

DDDD. Momentary control relays: Provide momentary control relays as indicated. Relays shall have coil ratings of 120 VAC, 50 mA or 10-30 VAC/VDC, 40 mA as suitable for the application. Contact ratings shall be 10 amp. Provide complete isolation between the control circuit and the digital output. Relays shall be located in the UC or other local enclosures and have pin-type terminals. Relays shall have LED indication of status.

EEE. Current sensing relay: Current sensing relays shall be rated for the applicable load. The output relay shall have an accessible trip adjustment over its complete operating range. Enclosure shall have an LED to indicate relay status.

FFFF. Photocell: Ambient light level shall by a photocell in a non-corroding in a weatherproof housing with sun shield suitable for exterior installation. The control signal output shall be 4-20 ma or binary contact closure as specified in the sequences of operation. Mount the photocell on the north side of the building on the roof. The sensor reading shall be 0-750 foot-candles.

GGGG. Occupancy Sensors

1. The dual-technology occupancy ceiling mounted sensor shall be capable of detecting presence in the control area by via Doppler shifts in transmitted ultrasound and passive infrared (PIR) heat changes. Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic and PIR technologies. Detection verification of both technologies must occur in order to activate lighting systems. Sensor shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off. The sensor shall operate at 24 VDC/VAC. WattStopper DT-300 or approve equal.

2. Sensors shall have a time delay that is adjustable with configuration software or shall have a fixed time delay of 5 to 30 minutes, set by a DIP switch. Sensors shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.

3. The sensor shall have an additional single-pole, double throw isolated relay with normally open, normally closed and common outputs. The isolated relay is for use with HVAC control, data logging, and other control options. The sensor shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled.

WATER FLOW METERS

HHHH. Insertion Turbine Flow Meters shall be provided for HVAC applications in piping larger than 2 inches. The flow meter shall have a stainless-steel insertion probe with non-metallic rotors; 2.0 % accuracy of actual reading from 0.4 to 20 ft/s; turndown ratio of 30:1; pulse outputs proportional to flow rate. The flow meter shall be single turbine type on applications with 20 diameters of pipe upstream and 5 diameters of pipe downstream. The flow meter shall be a dual turbine type on applications with less than 20 diameters of pipe upstream and 5 diameters of pipe downstream. Provide full port valve to allow for removal

ENERGY MANAGEMENT AND CONTROL SYSTEM (EMCS)
and re-insertion without disruption to the water service, to be installed by Division 23. Meter shall be ONICON F-1200 series or pre-approved substitution.

III. Inline nutating-disk type flow meters shall be provided for domestic water and cooling tower metering applications. The meter shall include a pulse output for monitoring by the EMCS. Provide meter to be installed by Division 23. Meter shall be Badger RCDL series or approved substitution.

AIRFLOW MEASURING STATIONS (AFMS)

JJJJ. Duct mounted airflow measuring stations with combination airflow and air temperature measurement devices shall have the following features:

1. Multi-point sensors in one or more probe assemblies with a maximum of one to sixteen sensor nodes per location, and a single remotely mounted microprocessor-based transmitter for each measurement location. Each sensor node shall consist of two hermetically sealed bead-in-glass thermistors. Each sensing point shall independently determine the airflow rate and temperature at each node, which shall be equally weighted in calculations by the transmitter prior to output as the cross-sectional average. Each ducted sensor probe shall have an integral, U.L. Listed, plenum rated cable. Each independent temperature sensor shall have a calibrated accuracy of +/-0.14° F (0.08° C) over the entire operating temperature range of -20° F to 160° F (-28.9° C to 71° C) and be calibrated at 3 temperatures against standards that are traceable to NIST. Acceptable manufacturer shall be EBTRON, Inc. GTx116-PC.

2. Each transmitter shall have a display capable of simultaneously displaying both airflow and temperature. Airflow rate shall be field configurable to be displayed as velocity or volumetric rates, selectable as IP or SI units. Each transmitter shall operate on 24 VAC and be fused and protected from over voltage, over current and power surges.

3. Each independent airflow sensor shall have a laboratory accuracy of +/-2% of Reading over the entire calibrated airflow range of 0 to 5,000 fpm (25.4 m/s), and be wind tunnel calibrated at 16 points against air velocity standards that are traceable to NIST.

DAMPER ACTUATORS:

KKKK. Outside and exhaust air damper actuators shall be mechanical spring return. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.

LLLL. Outside and return air modulating actuators shall utilize analog (proportional) control 0-10 VDC. Actuators shall be driven in both the open and closed directions.

MMMM. Electric damper actuators shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.

NNNN. Single section dampers shall have one electronic actuator direct shaft mounted.
OOOO. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section.

PPPP. Damper actuators shall be BELIMO or equivalent.

CONTROL VALVES

QQQQ. Furnish all valves controlled by the EMCS as shown on the Mechanical Drawings. Furnish all automated isolation valves as shown on the Mechanical Drawings. Control valves shall be factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated. EMCS contractor to size control valve with a maximum of three psi pressure drop. 2-position isolation valves shall be full-line size.

1. All chilled water, condenser water, and hot water valves shall meet, at minimum, the following ANSI Class 150 ratings. Valves 0.5 inch to 2 inches shall have NPT female screwed ends. Valves 2.5 inches and larger shall have flanged ends.

2. Equal Percentage control characteristic shall be provided for all 3-way water coil control valves.

RRRR. Pressure Independent Characterized Control Valves (PICCV) ½” to 6”, for two-way modulating applications shall have equal percentage characteristics and control the flow from 0 to 100% full rated flow with an operating pressure differential range of 5 to 50 PSID across the valve. The pressure independent control valve shall be provided and delivered from a single manufacturer as a complete assembly. The actuator shall be integrally mounted to the valve at the factory with a single screw on a direct coupled DIN mounting-base. The PICCV valves shall be sized for the scheduled flow and not pressure drop. Valves shall be Belimo PICCV or approved equal. Circuit setters or equal shall be prohibited from use at coil circuit piping when utilizing pressure independent control valves. Where flow rates and/or pipe sizes are large enough such that a standard PICCV cannot accommodate system requirements, provide Belimo ePIV or approved equal.

1. NPS 2” and Smaller: Forged brass body rated at no less than 400 PSI, chrome plated brass ball and stem, female NPT union ends, dual EPDM lubricated O-rings and a brass or TEFZEL characterizing disc. Close off pressure rating of 200 psi.

2. NPS 2-1/2” through 6”: GG25 cast iron body according to ANSI Class 125, standard class B, stainless steel ball and blowout proof stem, flange to match ANSI 125 with a dual EPDM O-ring packing design, PTFE seats, and a stainless-steel flow characterizing disc. Close off pressure rating of 100 psi.

SSSS. Characterized Control Ball Valves (CCV) for ½’ to 2”: for 3-way modulating applications shall have equal percentage characteristics. Manufacturer shall be Belimo or approved equal.

1. Valve housing shall consist of forged brass rated at no less than 400 psi at 250 °F. Three-way valves shall have EPDM O-rings behind ball seals to allow for a minimum close-off pressure of 40 psi with an actuator that provides 35 in-lbs
torque for ½ to 2 in. sizes. Three-way valves shall be installed in a “tee” configuration with actuator perpendicular to the shaft. Confirm mixing or diverting application for correct valve selection.

TTTT. Globe Valves 2-1/2” to 6”: for 3-way modulating applications shall have equal percentage characteristics. Manufacturer shall be Belimo G7 series or approved equal.

1. Valve housing shall consist of cast iron rated at no less than 125 psi at 300 °F. Valve shall have stainless steel stem, plug and seat. Three-way valves shall be installed in a “tee” configuration with actuator perpendicular to the shaft. Confirm mixing or diverting application for correct valve selection.

UUUU. Butterfly valves: For chiller and cooling tower isolation control valves, butterfly control valves may be provided.

1. Butterfly Isolation valves shall be line-size. Design velocity shall be less than 12 feet per second when used with standard EPDM seats. Butterfly valves shall have ductile iron body, 304 stainless steel disc and EPDM seat. The valve body close-off pressure rating shall be 150 psi over a range of -20 F to 250 F. The flange shall be ANSI 125/250. Belimo F6 and F7 series or approved manufacturer.

VVVV. Control Valve Actuators for PICCV, CCV and Globe valves: Provide electric actuators for all control valves that are furnished as part of the EMCS contract. Two way and three-way control valve actuators shall meet, at minimum, the following requirements:

1. Motor driven type with gear assembly made of hardened steel. Actuator shall have an input voltage of 24 VAC. Interior actuator housings shall be NEMA-2 rated. Exterior housings shall require a weather shield or shall be NEMA-4 rated. Provide visual mechanical position indication

2. Valves shall be sized to meet the shut-off requirements when operating at the maximum system differential pressure and with the installed system pump operating at shut-off head. Actuators shall control against system maximum working pressures.

3. Normal and failure positions shall be as indicated in the operating sequences. Provide spring return action per the sequences.

4. Manual declutch lever to enable manual operation of the valve. It shall be possible for an operator to manually modulate valves located in mechanical rooms in the event of loss of power.

5. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for butterfly valve actuators.

6. All actuators shall be capable of being electronically programmed in the field by use of external computer software or a dedicated handheld tool for the adjustment of flow. Programming using actuator mounted switches or multi-turn actuators are
not acceptable.

7. Electric actuators shall be Belimo, compatible with the valves furnished.

WWWW. Butterfly Valve Industrial Actuators

1. Enclosure shall be NEMA 4 (weatherproof) enclosure and will have an industrial quality coating.

2. Actuator shall have a motor rated for continuous duty. The motor shall be fractional horsepower; permanent split capacitor type designed to operate on a 120 VAC, 1 phase, 60 Hz supply. Two adjustable cam actuated end travel limit switches shall be provided to control direction of travel. A self-resetting thermal switch shall be imbedded in the motor for overload protection.

3. Reduction gearing shall be designed to withstand the actual motor stall torque. Gears shall be hardened alloy steel, permanently lubricated. A self-locking gear assembly or a brake shall be supplied.

4. Actuator shall have a 6 ft wiring harness provided for ease in field wiring (above 1500 in-lbs). Two adjustable SPDT cam-actuated auxiliary switches, rated at 250 VAC shall be provided for indication of open and closed position. Actuator shall have heater and thermostat to minimize condensation within the actuator housing.

5. Actuator shall be equipped with a hand wheel for manual override to permit operation of the valve in the event of electrical power failure or system malfunction. Hand wheel must be permanently attached to the actuator and when in manual operation electrical power to the actuator will be permanently interrupted. The hand wheel will not rotate while the actuator is electrically driven.

6. The actuator shall be analog, floating, or two position as called out in the control sequence of operation. All analog valves shall be positive positioning, and respond to a 2-10 VDC, 4-20 mA, or adjustable signal as required. Analog actuators shall have a digital control card allowing any voltage input for control and any DC voltage feedback signal for position indication.

7. Butterfly valve actuators shall be Belimo furnished with specified butterfly valves.

PANELS AND ENCLOSURES

XXXX. Provide panels and enclosures for all components of the EMCS, which are susceptible to physical or environmental damage.

YYYY. Interior panels and enclosures shall meet be NEMA 1 rated painted steel panels with locking door.

ZZZZ. Exterior mounted panels and enclosures shall be NEMA 4 painted steel panels with locking door.

AAAAA. Panels for USCs shall be mounted on the outside of all unit ventilators and fan coil units with three feet of wall clearance in front of them and no higher than 7 feet to the
bottom of the panel.

LABELING and WARNING NOTICES

BBBBBB. Provide labeling for all control panels and enclosures.

CCCCCC. Provide labeling of all control wires and input/output points at the controller and at the control device; the label at each end of the wire shall be the same. Labels shall be machine generated, typed and clearly legible with a maximum of 17 characters. Hand written labels or labels written on the control wire jacket will not be acceptable. Each label shall be unique to its function and shall reference the applicable system. For example “AHU-1 SAT” will indicate the supply air temperature sensor for AHU-1. Improper labeling shall be removed and shall require re-commissioning of the control device and controller to document correct functionality.

DDDDDD. Provide high voltage warning notices at all equipment controlled by the EMCS and at all associated motor starters when used by equipment controller.

TUBING AND PIPING

EEEEEE. Provide tubing and piping as required for the field instrumentation.

FFFFFF. Tubing within equipment rooms, vertical risers, and penetrations to ductwork shall be either copper pipe or shall be plastic tubing within conduit. Tubing for all water-based instrumentation shall be copper pipe. Identify the type of tubing proposed in the shop drawing submittal.

GGGGGG. Provide suitable bulk head fittings for duct and panel penetrations.

HHHHHH. Tubing in plenum rated areas may be plastic tubing. Polyethylene tubing shall meet, at minimum, the following requirements: flame retardant; crack resistant; 300 psi burst pressure.

CONDUIT AND FITTINGS

IIIIII. Provide all conduits, raceways and fittings for the EMCS monitoring, communication and control cabling. All work shall meet all applicable codes.

JJJJJJ. Conduit, where required, shall meet, the requirements specified within Division 26.

KKKKKK. EMCS monitoring and control cable shall not share conduit with cable carrying voltages in excess of 90 VAC.

CABLING

LLLLLL. Provide all cables for the EMCS. Cable shall meet, at minimum, the following requirements:

1. Minimum 98% conductivity stranded copper.

2. Proper impedance for the application as recommended by the EMCS component
manufacturer.

3. Monitoring and control cable shall be #18 AWG or larger, dependent on the application. Analog input and output cabling shall be shielded.

4. Management Level Network cable shall be CAT 6, 24 gauge unshielded.

5. Automation Level Network cable shall be #24 AWG shielded.

6. Shield shall be grounded at the CCP, UC, or control panel. Ground at one end only to avoid ground loops.

7. Identification of each end at the termination point. Identification should be indicated on and correspond to the record drawings.

MMMMMM. 120 VAC power wiring shall be of #12 AWG solid conductor or larger as required.

PART 3 - EXECUTION

PRE-CONSTRUCTION

A. The EMCS supplier shall provide a pre-construction coordination meeting with the affected trades to ensure a cooperative efficient process of installation. The invited trades shall include the general contractor, mechanical contractor, electrical contractor, test and balance contractor, owner’s representative, consulting engineer and others with a direct interest in the coordination of the affected systems. The EMCS contractor shall provide an outline of the meeting agenda highlighting the construction schedule, coordination with mechanical and electrical trades. Provide a sign-in sheet and submit it through the attendees along with a summary of the meeting notes for future reference.

INSPECTION DURING INSTALLATION

B. Provide a technician to assist the Engineer or Owner’s Representative with inspections made during the installation period that are required to review the progress and quality of ongoing work. The engineer/owner’s representative shall generate field observation reports on the findings of the inspection. The engineer or owner’s representative shall advise the EMCS contractor during the inspection of any concerns noted with respect to the installation and shall repeat the concerns in writing as soon as possible after the inspection is completed. The EMCS contractor shall take corrective action to meet the requirements of the specifications. Upon correction, the EMCS contractor shall submit written documentation through the contractors to the engineer.

INSTALLATION OF COMPONENTS

C. Provide all interlock and control wiring. All wiring shall be installed in a neat and professional manner in accordance with specification Division 26 and all national, state and local electrical codes.

D. Provide wire and wiring techniques recommended by equipment manufacturers. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect
switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the Owner's Representative prior to rough-in. Provide auxiliary pilot duty relays on motor starters as required for control function.

E. Electrical Contractor shall provide 120 or 277-volt power at a junction box within 48” of the controller. The BAS Contractor shall coordinate with the Electrical Contractor to identify locations of power requirements prior to the installation of the controls.

F. Conduit for control wiring shall be provided whenever one of the following conditions exists:
   1. Conduit is indicated on the drawings or specifically required by the specifications.
   2. Cabling runs through inaccessible areas such as within partitions/walls, above closed in ceilings, under floor; within trenches and underground; on the exterior of the building; exposed on the surface of the building; when encased in concrete or other material that makes the cable inaccessible or when located such that access to the cable is not readily obtained.
   3. Cable within mechanical, telecommunications and electrical equipment rooms and control rooms.
   4. Conduit shall be installed, inside wall from sensor box to above the wall, for all wall mounted temperature, humidity and CO2 sensors.

G. Control wiring located above an accessible ceiling space may be plenum rated cable. Plenum rated wire shall be bundled and routed at right angles to the building lines and secured to the building structure every 15 feet.

H. Control wiring located in underground conduits shall be provided with direct-burial-rated insulation.

I. When communication bus enters or exits a building, a surge suppressor shall be installed. The surge suppressor shall be installed according to the controls manufacturer’s instructions.

J. Provide sleeves for all cable and conduit passing through walls, partitions, structural components, floors and roof.

K. All sensor wiring shall be labeled to indicate the origination (at the device) and destination of data (at the control panel). The description shall indicate the type and location of the control device such as “AHU-1 SA temp” or “VAV 1-1 space temp”.

L. Wall temp sensors at 48” above the finished floor to comply with ADA requirements and to match the height of the light switches. Mount humidity sensor at equal height to wall temperature sensor.

VERIFICATION REQUIREMENTS

M. Verification shall be provided by the EMCS contractor to demonstrate and confirm that the
installed system complies with the specifications and the control sequences of operation herein specified. Upon completion of the verification process the EMCS contractor shall demonstrate to the engineer or owner’s representative the functionality of the control system devices is in compliance with the contract documents.

N. Technicians provided by the EMCS contractor shall be factory trained and qualified in the operation of the provided control system. The EMCS contractor shall provide, if requested, the factory training certificates of the individuals providing the verification services on this project.

O. Verification tools, applicable to the system provided, shall be utilized by the factory-trained technicians for proper verification of system operation and functionality. Temperature verification sensors shall be NIST certified within the last 12 months. Meters such as Fluke 52 series or better shall be utilized. Use of non-certified meters may require the system to be re-verified with certified meters at no cost to the owner.

P. Documentation of the verification process shall be provided per the project general conditions in electronic PDF format as required. Documentation shall include the following forms:

1. Project System Verification Forms for each controller provided on the project to verify the proper function of each controller, control device and system component provided.

2. Panel Verification Forms for each control panel to document the proper installation and function of each control panel provided.

3. Sequence of Operation Verification Forms for each piece of controlled equipment to confirm compliance of the control system with the specified sequences of operation.

4. Not providing proper documentation for each control devices, panel, or system, upon request by the engineer or owner’s representative, may require the EMCS contractor to re-verify the applicable systems at no additional cost to the owner.

Q. After completion of the verification, the EMCS contractor shall be able to demonstrate the sequence of operations for each system to the engineer and the owner’s representative.

R. Equipment checkout sheets are to be produced by this contractor showing checkboxes and compliance with the following procedures for each piece of equipment and turned over to the owner and/or mechanical engineer.

COLORGRAPHICS

S. The colorgraphics shall be provided for the EMCS system prior to system acceptance and owner training.

T. The colorgraphics provided shall include the following as a template. Provide forward and backward links on the graphic.

1. Site plan with link to overall building plan including detached buildings. The site
plan shall be referenced to an automatically updated aerial view or map view of the area such as Google Maps or Bing Maps. Provide link to proceed to the overall building floor plan.

2. The overall building plan shall indicate space temperature conditions referenced by the color of the zone. Specific details of the zone temperatures and equipment are not required. Provide a link to the floor plan wings, upper floors and remote buildings.

3. The floor plan colorgraphics shall indicate the space temperatures by color references. Additional information shall indicate the space temperature, the occupancy of the zone, air handling units, VAV terminals and ductwork with diffusers. A link at each terminal unit or AHU shall automatically connect the system operator to the equipment colorgraphic.

4. The colorgraphics for the equipment shall as a minimum be equal to the points from the input/output summary or control schematic. Primary control devices as required by the sequences of operation shall also be provided.

5. Control points from equipment that are integrated into the EMCS via BACnet shall be provided to convey the operating conditions of the attached equipment. Coordination of the integration points shall be accomplished during the submittal phase. The EMCS contractor shall provide a list of all integrated points on their submittal.

CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

U. Startup testing documentation: Prepare the checklist documenting startup testing of each input and output device, with technician's initials and date certifying each device has been tested and calibrated prior to acceptance testing. This document shall indicate proof that the following functions have been commissioned and shall be included in the as-built documentation: short to ground check, configuration of trends, confirmation that colorgraphics are accurately representing actual systems, point to point checkout, all damper and valve actuators respond to input change, control modules are addressed and have functional descriptors, specified interlocks are functional, calibration report of all sensors, discrete outputs respond to time schedule or manual enable command.

V. Demonstration. Prior to acceptance, demonstrate the following performance tests to demonstrate system operation and compliance with specifications.

1. Engineer, owner’s representative and mechanical contractor shall be invited to observe and review system demonstration. Provide attendees at least 10 days notice.

2. Demonstration shall follow process approved as part of the submittal and shall include complete checklists and forms for each system as part of system demonstration.

3. Demonstrate actual field operation of each sequence of operation as specified. Demonstrate calibration and response of any input and output points requested by engineer or owner’s representative.
4. Demonstrate complete operation of operator interface including review of color-graphics, time schedules, trend logs, alarm notification, functionality of tablet PC operation.
   a. PID loop response. Supply graphical trend data output showing each PID loop's response to a set point change representing an actuator position change of at least 25% of full range. Trend sampling rate shall be selectable from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show set point, actuator position, and controlled variable values.
   b. Demand limiting. Supply trend data output showing demand-limiting algorithm action. Trend data shall document each minute over at least a 30-minute period and shall show building kW, demand limiting setpoint, and status of set points and other affected equipment parameters.
   c. Trend logs for each system. Trend data shall indicate set points, operating points, valve positions, and other data as specified. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs.

5. Alarms and Interlocks. Check each alarm with an appropriate signal at a value that will trip the alarm. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction. Alarm verification shall include temperatures exceeding alarm threshold (high and low), fan failure safety, duct high static pressure switch, freezestat, and smoke detector shutdown.

6. Tests that fail to demonstrate proper system operation to the engineer shall be repeated after contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

W. Owner Acceptance.

1. After tests described in this specification are performed to the satisfaction of both engineer and owner’s representative, the engineer shall accept the control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond EMCS contractor's control. Engineer shall provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.

2. System shall not be accepted until completed demonstration forms and checklists are submitted and approved by the engineer.

DEMONSTRATION AND OWNER TRAINING

X. Furnish basic operator training for multiple persons on data display, alarm and status descriptors, requesting data, execution commands and log requests. Include a minimum of 16 hours: 8 hours instructor time for onsite training and 8 hours of hands on class environment training. Training sessions may be provided in 4-hour increments as approved by the owner’s representative.

2. Change/modify time of day, holiday and override schedules.

3. Display, create, and modify trends of system points.

4. Update room numbers on the color-graphics.

Y. Demonstrate complete and operating system to Owner. Provide written documentation listing the attendees of the specified training with sign-in sheet and training time and date.

PART 4 - SEQUENCE OF OPERATIONS

Refer to the Mechanical Drawings for project control schematics and sequence of operations.

END OF SECTION 23 09 63
SECTION 23 21 13 – ABOVE GROUND HYDRONIC PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Pipe and pipe fittings.

B. Valves.

C. Heating water piping system.

D. Chilled water piping system.

E. Condenser water piping system.

F. Condensate drain piping.

1.3 RELATED WORK

A. Section 23 05 16 – Expansion Fittings and Loops for HVAC Piping.

B. Section 23 05 29 – Hangers and Supports for Piping and Equipment HVAC.

C. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

D. Section 23 05 53 – Identification for HVAC Piping and Equipment.

E. Section 23 07 19 – HVAC Piping Insulation.

F. Section 23 21 16 – Underground Hydronic Piping.

G. Section 23 21 19 – Hydronic Specialties.

1.4 REFERENCES

A. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.

B. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.

C. ANSI/ASME B31.9 - Building Services Piping.

D. ANSI/AWS A5.8 - Brazing Filler Metal.

F. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

G. ASTM A106 - Seamless Carbon Steel Pipe for High-Temperature Service


I. ASTM B32 - Solder Metal.

J. ASTM B88 - Seamless Copper Water Tube.

K. REGULATORY REQUIREMENTS

L. Conform to ANSI/ASME B31.9.

1.5 QUALITY ASSURANCE

A. Foreign made pipes, valves and fittings will not be acceptable.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9. and applicable state labor regulations.

D. Welder’s Certification: In accordance with ANSI/ASME SEC 9.

1.6 SUBMITTALS

A. Submit product data under provisions of Division One.

B. Include data on pipe materials, pipe fittings, valves, and accessories.

C. Include welder’s certification of compliance with ANSI/ASME SEC 9.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division One.

B. Store and protect products under provisions of Division One.

C. Deliver and store valves in shipping containers with labeling in place.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, proper storage and dunnage, completing sections of the work, and isolating parts of completed system. Tape will not be allowed as an acceptable end cover.
PART 2 - PRODUCTS

2.1 CHILLED PIPING

A. Steel Pipe: ASTM A53, Schedule 40, 0.375-inch wall for sizes 12 inch and over, black.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53, Schedule 40 galvanized.
   1. Fittings: Galvanized cast iron, or ANSI/ASTM B16.3 malleable iron.
   2. Joints: Screwed or grooved mechanical couplings.

2.3 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; 1/16-inch-thick preformed neoprene bonded gasket.

C. Grooved mechanical pipe couplings, fittings, valves and other grooved components may be used as an option to weld, threading or flanged methods. All grooved components shall be of one manufacturer and conform to local code approval and/or is listed by ANSI-B-31.1, B-31.3, B-31.9, ASME, UL/ULC. FM, IAPMO or BOCA. Grooved end manufacturer to be ISO-9001 certified. Grooved couplings shall meet the requirements of ASTM F-1476. Manufacturer shall be Victaulic or approved equal. Can be utilized only in mechanical rooms or cooling tower areas.

2.4 ACCEPTABLE MANUFACTURERS - GATE VALVES

A. Milwaukee.

B. Crane.

C. Dezurik.

D. Nibco.

E. Substitutions: Under provisions of Division One.

2.5 GATE VALVES

A. Up to 2 Inches: Bronze body, bronze trim, rising stem, handwheel, inside screw, single wedge or disc, threaded ends.
B. Over 2 Inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, single wedge, flanged ends.

2.6 ACCEPTABLE MANUFACTURERS - GLOBE VALVES
A. Milwaukee.
B. Nibco.
C. Stockham.
D. Dezurik.

2.7 GLOBE VALVES
A. Up to 2 Inches: Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable stainless-steel disc, screwed ends, with back seating capacity.
B. Over 2 Inches: Iron body, bronze trim, rising stem, hand wheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

2.8 ACCEPTABLE MANUFACTURERS - BALL VALVES
A. Milwaukee.
B. Nibco.
C. Jamesbury.
D. Dezurik.
E. Kitz.
F. Victaulic (For grooved systems only)

2.9 BALL VALVES
A. Up to 2 Inches: Bronze two-piece body, 600 PSI full port, stainless steel ball and stem, teflon seats and stuffing box ring, lever handle, and balancing stops, threaded ends.
B. Over 2 Inches: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, or gear drive hand wheel for sizes 10 inches (250 mm) and over, flanged.
C. Ball valves installed in insulated lines shall have stem extensions compatible with up to 2” of insulation. Extensions shall be non-metallic equal to Nibco “nib-seal”.

2.10 ACCEPTABLE MANUFACTURERS - PLUG COCKS
A. Nibco.
B. Jenkins.
C. Dezurik.

D. Milwaukee.

2.11 PLUG COCKS

A. Up to 2 Inches: Bronze body, bronze tapered plug, non-lubricated, teflon packing, threaded ends, with one wrench operator for every ten plug cocks.

B. Over 2 Inches: Cast iron body and plug, pressure lubricated, teflon packing, flanged ends, with wrench operator with set screw.

2.12 ACCEPTABLE MANUFACTURERS - BUTTERFLY VALVES

A. Milwaukee.

B. Nibco.

C. WECO.

D. Dezurik.

E. Victaulic (For grooved systems only)

F. Substitutions: Under provisions of Division One.

2.13 BUTTERFLY VALVES

A. Iron body, aluminum bronze disc, resilient replaceable seat for service to 180 degrees F lug or grooved ends, extended neck, infinite position lever handle with memory stop. Valve shall be rated at full working pressure with downstream flange removed in either direction.

2.14 ACCEPTABLE MANUFACTURERS - SWING CHECK VALVES

A. Milwaukee.

B. Nibco.

C. Stockham.

D. Dezurik.

E. Victaulic (For grooved systems only)

F. Substitutions: Under provisions of Division One.

2.15 SWING CHECK VALVES

A. Up to 2 Inches: Bronze 45-degree swing disc, screwed ends.
B. Over 2 Inches Iron body, bronze trim, 45-degree swing disc, renewable disc and seat, flanged or grooved ends.

2.16 ACCEPTABLE MANUFACTURERS - SPRING LOADED CHECK VALVES

A. Milwaukee.
B. Nibco.
C. Mueller.
D. Dezurik.
E. Victaulic (For grooved systems only)
F. Substitutions: Under provisions of Division One.

2.17 SPRING LOADED CHECK VALVES

A. Iron body, bronze trim, stainless steel spring, aluminum bronze disc, screwed, grooved, wafer or flanged ends.

2.18 ACCEPTABLE MANUFACTURERS - RELIEF VALVES

A. Nibco.
B. Jenkins.
C. Dezurik.
D. Milwaukee.
E. Substitutions: Under provisions of Division One.

2.19 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
B. Remove scale and dirt on inside and outside before assembly.
C. Prepare piping connections to equipment with flanges or unions.
D. After completion, fill, clean, and treat systems.
3.2 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.

B. Install piping to conserve building space, and not interfere with use of space and other work.

C. Group piping whenever practical at common elevations.

D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.

E. Provide extended necks for all vents, thermometer wells, pressure gauge wells, pet cocks and pete’s plugs.

F. Provide clearance for installation of insulation, and access to valves and fittings.

G. Group piping whenever practical at common elevations.

H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Division 8.

I. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

K. Prepare pipe, fittings, supports, and accessories for finish painting. Refer to Division 9.

L. Install valves with stems upright or horizontal, not inverted.

M. All grooved components (couplings, fittings, valves, gaskets, and specialties) shall be of one manufacturer.

N. Grooved manufacturer shall provide on-site training for contractor’s field personnel by a factory trained representative in the proper use of grooving tools, application of groove, and the product installation. Factory trained representative shall periodically visit the job site and inspect installation. Contractor shall remove and replace any improperly installed products.

3.3 APPLICATION

A. Use grooved mechanical couplings and fasteners only in mechanical rooms or cooling tower area.

B. Install unions downstream of valves, and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

D. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Install plug valves for throttling, bypass, or manual flow control services.
F. Provide spring loaded check valves on discharge of condenser and chilled water pumps.

G. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

H. Use only butterfly valves in condenser water systems for throttling and isolation service.

I. Use lug end butterfly valves to isolate equipment.

J. Provide chain operated butterfly valve for installations at 12 feet or higher.

K. Provide 3/4-inch ball (drain) valves equal to Nibco T-585-70-HC at main shut-off valves, low points of piping, bases of vertical risers, and at equipment and pipe to nearest drain.

L. Provide automatic air vents at all high points and air pockets in the system.

3.4 CONDENSATE DRAIN PIPING

A. Drain piping from each unit shall be extended to the nearest floor drain or condensate drainage system. Drains shall be of the size indicated but not less than the full size of the drain pan connections.

B. Use plugged tees in lieu of elbows.

C. Pipe shall be Schedule 40 galvanized with malleable iron screwed or type "L" copper fittings.

D. Slope all drain lines 1/8" per foot, minimum.

E. Provide auxiliary drain pan on all AHU's above ceiling with auxiliary drain line routed to discharge in visually prominent area. Discharge location shall be coordinated with Architect.

3.5 PIPE FABRICATION AND INSTALLATION

A. All pipes shall be cut accurately to measurements established at the site and shall be worked into place without springing or forcing.

B. Piping layout and installation shall be made in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance from other work. Particular attention shall be given to piping in the vicinity of equipment; layout shall be made in such manner as to preserve maximum access to the various equipment parts for maintenance.

C. All changes in directions shall be made with fittings; field bending, and mitering of pipe is prohibited.

D. Air vents and air chambers shall be installed as hereinafter specified.

3.6 OFFSETS AND FITTINGS

A. Due to the small scale of the Drawings, it is not possible to indicate all offsets, fittings, etc.
which may be required. The Contractor shall carefully investigate structural and finish conditions affecting the Work and shall take such steps as may be required to meet such conditions at no additional cost to the Owner.

B. All piping shall be installed close to walls, ceilings and columns, (consistent with the proper space for covering, removal of pipe and special clearances), so as to occupy the minimum of space, and all offsets, fittings, etc., required shall be provided at no additional cost to the Owner.

3.7 SECURING AND SUPPORTING

A. All piping shall be adequately supported to line and grade, with due provisions for expansion and contraction.

B. Piping shall be supported on approved clevis type, split ring, or trapeze type hangers properly connected to the structural members of the building.

C. All insulated piping shall be fitted with suitable steel protection saddles.

D. Perforated bar hangers, straps, wire or chains will not be permitted.

3.8 ISOLATION VALVES

A. All piping systems shall be provided with line size shut-off valves located at risers, at branch connections to mains, and at other locations as indicated and required.

3.9 TESTING OF PIPING SYSTEMS

A. During the progress of the Work and upon completion, tests shall be made as specified herein and as required by Authorities Having Jurisdiction, including Inspectors, Owner or Engineer. The Engineer or duly authorized Construction Inspector shall be notified in writing at least 2 working days prior to each test or other Specification requirement which requires action on the part of the Construction Inspector.

B. Tests shall be conducted as part of this Work and shall include all necessary instruments, equipment, apparatus, and service as required to perform the tests with qualified personnel. Submit proposed test procedures, recording forms, and test equipment for approval prior to the execution of testing.

C. Tests shall be performed before piping of various systems have been covered or furred-in. For insulated piping systems, testing shall be accomplished prior to the application of any insulation.

D. All piping systems shall be tested and proved absolutely tight for a period of not less than 2 hours at a pressure of 150 psi(g) or 150% of design pressure, whichever is greater. Tests shall be witnessed by the Engineer or an authorized representative and pronounced satisfactory before pressure is removed or any water drawn off.

E. Leaks, damage or defects discovered or resulting from test shall be repaired or replaced to a like new condition. Leaking pipe joints, or defective pipe, shall be removed and replaced with acceptable materials. Test shall be repeated after repairs are completed and shall continue.
until such time as the entire test period expires without the discovery of any leaks, damage, or defects.

F. Wherever conditions permit, each piping system shall thereafter be subjected to its normal operating pressure and temperature for a period of no less than five 5 days. During that period, it shall be kept under the most careful observation. The piping systems must demonstrate the propriety of their installation by remaining absolutely tight during this period.

3.10 PIPE CLEANING, FLUSHING AND PURGING REQUIREMENTS AND PROCEDURES

The hydronic system shall be flushed and purged by contractor:

1. All mains, branches and zones shall be cleaned and treated per steps indicated below.

2. Owner/Engineer shall be given 72-hour notice prior to each step being performed.

A. Pre-flush requirements: Purpose is to get system ready for flushing and purging:

1. Piping must pass all required pressure testing and visual inspection for leaks.

2. All pumps shall be tested for rotation and properly aligned and lubricated.

3. Chemicals planning on being used must have certificate of assurance and product cut sheets presented to the owner/engineer prior to being used. All chemicals must: be approved by the state prior to being added to the system, FDA approved and meet ASTM-1384. Automotive grade chemicals are not allowed.

4. Bypass all terminal units and coils by connecting the supply and return piping together.

5. Fill entire system with clean fresh potable water.

B. The flush requirements: Purpose is to completely remove all debris, dirt and air from hydronic system.

1. Add system cleaner that contains detergent and emulsifying agents to properly remove grease, grime and other debris for steel pipe. Volume of cleaner used shall be about 10% of total volume.

2. System shall be circulated for a minimum of 48 hours with water velocities of a minimum of 5 ft/sec or greater. After completed all strainers shall be removed and cleaned thoroughly. House pumps are acceptable to circulate water.

3. The system shall be entirely drained and flushed out to remove all of the cleaner from the system as quickly as possible after cleaning to prevent debris from settling. All strainers shall be removed and thoroughly cleaned after no more dirt and cleaner is visible in the flushing water as it leaves the system.

C. Final fill:

1. All air vents shall be opened to allow air to escape during filling.
2. Reconnect all flex connections to equipment.

3. System shall be drained and filled with a local domestic/softened water mixture as required by chemical treatment supplier. System shall be filled with pressure reducing valve at the specified fill pressure.

D. Purging: Purpose is to remove all air from the system:

1. System shall be circulated for a minimum of one hour with water velocities of a minimum of 5 ft/sec or greater until all visible air is removed.

E. Final chemical addition: Purpose is to install chemicals during inhibitor as required:

1. After the above final fill and purging has been completed and accepted by the engineer/owner the final chemical addition can be done.

2. Chemical treatment shall be added to the system after thoroughly mixing water per the manufacturer’s recommendations. Chemical treatment shall include inhibitors. Quantities and concentrations of inhibitor/chemicals should be applied per the manufacturer’s specifications and approval submittals.

3. System water shall be tested for chemical inhibitor concentrations, reserve alkalinity and PH. Reports shall be submitted to engineer/owner.

4. All records and documentation shall be kept and given to the owner upon completion.

END OF SECTION 23 21 13
SECTION 23 21 16 – UNDERGROUND HYDRONIC PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Pipe and pipe fittings.

B. Valves.

C. Chilled water piping system.

1.3 RELATED SECTIONS

A. Section 23 05 16 – Expansion Fittings and Loops for HVAC Piping.

B. Section 23 05 29 – Hangers and Supports for Piping and Equipment - HVAC.

C. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

D. Section 23 05 53 – Identification for HVAC Piping and Equipment.

E. Section 23 07 19 – HVAC Piping Insulation.

F. Section 23 21 13 – Above Ground Hydronic Piping.

G. Section 23 21 19 – Hydronic Specialties

1.4 REFERENCES

A. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.

B. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.

C. ANSI/ASME B31.9 - Building Services Piping.

D. ANSI/AWS A5.8 - Brazing Filler Metal.

E. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

F. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.
G. ASTM B32 - Solder Metal.
H. ASTM B88 - Seamless Copper Water Tube.

1.5 REGULATORY REQUIREMENTS
A. Conform to ANSI/ASME B31.9.

1.6 QUALITY ASSURANCE
A. Valves: Manufacturer's name and pressure rating marked on valve body.

1.7 SUBMITTALS
A. Submit product data under provisions of Division One.
B. Include data on pipe materials, pipe fittings, valves, and accessories.
C. Include welder’s certification of compliance with ANSI/ASME SEC 9.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Deliver products to site under provisions of Division One.
B. Store and protect products under provisions of Division One.
C. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 PRE-INSULATED PIPE
A. Pipe shall be the pre-insulated type, as manufactured by Thermacor Process Inc. Perma Pipe, or "approved equal." All sections shall be factory fabricated to job dimensions with all fittings, anchors, and other accessories.
B. Polyurethane foam insulation shall be injected into the annular space between carrier pipe and jacket with one shot to the thicknesses shown for the specific pipe size. Insulation shall be rigid, 90-95% closed cell polyurethane with a 2.5 to 3.5 pounds per cubic foot density and a coefficient of thermal conductivity (K Factor) of .14 at 50-degree F or .17 at 75 degree F and conform to HH-I-1751/4.
C. Jackets for pre-insulated piping, including fittings, shall be HDPE in accordance with ASTM D1248, Type 3, Class C. For systems where the entire surface of the factory applied pipe insulation can be visually inspected prior to the application of the jacket, the minimum thickness of the jacket shall be 80 mils for pipe sizes 6” and below, 100 mils for sizes 8”-12”,...
102 mils for 14”-20”, and 150 mils 24” and larger. For systems manufactured by injection of urethane foam into the annulus between the carrier pipe and jacket, thereby not allowing visual inspection of the entire insulation surface, jacket thickness shall be 50% greater than the above minimums.

**MIN. INSULATION THICKNESS R - VALUE**

<table>
<thead>
<tr>
<th>Pipe Size (in.)</th>
<th>Chilled Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤1.5”</td>
<td>3.7</td>
</tr>
<tr>
<td>&gt;1.5”-4”</td>
<td>5.6</td>
</tr>
<tr>
<td>&gt;4”</td>
<td>7.4</td>
</tr>
</tbody>
</table>

D. Carrier pipe shall be standard weight, carbon steel, seamless or ERW, ASTM A-106, ASTM A-53, Grade B. All joints shall be butt-welded for 2 ½” and greater, and socket or butt-welded for 2” and below. Pipe fittings shall be forged, long radius bends, beveled for butt welding, having a wall thickness equal to the pipe.

E. Anchors shall be pre-insulated and jacketed at the factory and provided at locations shown on the Contract Drawings. Factory anchors shall be encased in concrete, per the manufacturer’s recommendations, keyed into undisturbed soil. Manufacturer shall provide expansion pillows at expansion bends and include details of thickness, length, and location in data submitted for approval. Expansion pillows and anchors are not required for chilled water systems.

F. Fittings shall be field insulated with liquid urethane foam insulation, jacketed with a PVC fitting cover and wrapped with polyethylene backed, pressure sensitive butyl rubber tape, or pressure sensitive PVC tape.

G. Underground systems shall be buried in a trench not less than two (2) feet deeper than the top of the pipe and not less than twelve inches wider than the combined O.D. of all piping systems and a minimum of six (6) inches of spacing between pipes in a shared trench. All backfill material shall be clean bank sand to a minimum thickness of 24 inches over the top of the jacket to meet H-20 highway loading. All piping will be pressure tested for 150 psi for 48 hours prior to cover-up.

H. A representative of the manufacturer shall be present during critical periods of installation and testing, to verify that the installation is being made in accordance with the manufacturer's recommendations.

**PART 3 - EXECUTION**

3.1 All pipes shall be installed in accordance with the manufacturer’s recommendations and printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Contractor’s price shall include all items required as per manufacturer’s requirements.

3.3 **PREPARATION**

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. After completion, fill, clean, and treat systems.

E. Provide access for valves located underground. Coordinate size and location of access doors with Division 8.

F. Install valves with stems upright only, not inverted.

3.4 PIPE FABRICATION

A. All pipes shall be cut accurately to measurements established at the site and shall be worked into place without springing or forcing. Piping layout and installation shall be made in the most advantageous manner possible with respect to valve access and clearance from other work.

B. All changes in directions shall be made with fittings; field bending, and mitering of pipe is prohibited.

C. Piping shall be carefully sloped so as to eliminate traps and pockets.

D. Where pipes change size, eccentric fittings shall be used to prevent the pocketing of air.

E. Group piping whenever practical at common elevations.

3.5 OFFSETS AND FITTINGS

Due to the small scale of the Drawings, it is not possible to indicate all offsets, fittings, etc. which may be required. The Contractor shall carefully investigate the site and conditions affecting the work and shall take such steps as may be required to meet such conditions.

3.6 PIPE SLEEVES

A. All pipes passing through masonry and concrete construction shall be fitted with sleeves.

B. Each sleeve shall extend through the respective wall and shall project 3 inches on both sides. Sleeves shall be two pipe sizes larger. Sleeves shall be made of galvanized steel pipe.

3.7 ISOLATION VALVES

All piping systems shall be provided with line size shut-off valves located at branch connections to mains and at other locations as indicated and required.

3.8 AUTOMATIC VENT VALVES

Automatic vent valves shall be installed at high points and at any other air pockets of all closed circulating piping systems.

3.9 TESTING OF PIPING SYSTEMS
A. During the progress of the Work and upon completion, tests shall be made as specified herein and as required by Authorities Having Jurisdiction, including Inspectors, Owner or Architect. The Architect or duly authorized Construction Inspector shall be notified in writing at least 2 working days prior to each test or other Specification requirement which requires action on the part of the Construction Inspector.

B. Tests shall be conducted as part of this Work and shall include all necessary instruments, equipment, apparatus, and service as required to perform the tests with qualified personnel. Submit proposed test procedures, recording forms, and test equipment for approval prior to the execution of testing.

C. Tests shall be performed before piping of various systems have been covered or furred-in. For insulated piping systems, testing shall be accomplished prior to the application of insulation.

D. All piping systems shall be tested and proved absolutely tight for a period of not less than 2 hours at a pressure of 150 psi(g) or 150% of design pressure, whichever is greater. Tests shall be witnessed by the Engineer or an authorized representative and pronounced satisfactory before pressure is removed or any water drawn off.

E. Leaks, damage or defects discovered or resulting from test shall be repaired or replaced to a like new condition. Leaking pipe joints, or defective pipe, shall be removed and replaced with acceptable materials. Test shall be repeated after repairs are completed and shall continue until such time as the entire test period expires without the discovery of any leaks, damage, or defects.

3.10 PIPE CLEANING AND STERILIZATION

A. After piping systems have been pressure tested and approved for tightness, they shall be thoroughly cleaned and flushed using an approved pipe cleaning compound.

B. All temporary connections required for cleaning, purging and circulating are included in this Section. Provide suitable pipe bypasses at each coil and heat exchanger during this cleaning operation. All air vents, gauges, strainers, etc., valved connections in piping systems shall be blown clean after cleaning operation is completed.

C. After cleaning, drain the system, fill with fresh water and flush thoroughly until clear water is obtained. Purge all air from the system with the installed manual and automatic air vents.

END OF SECTION 23 21 16
PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Expansion tanks.

B. Volume tanks.

C. Air vents.

D. Air separators.

E. Strainers.

F. Pump suction fittings.

G. Flow indicators, controls, meters.

H. Relief valves.

1.3 RELATED SECTIONS

A. Section 23 21 13 – Above Ground Hydronic Piping.

B. Section 23 21 16 – Underground Hydronic Piping.

C. Section 23 21 23 – Hydronic Pumps.

D. Section 23 05 29 – Hangers and Supports for Piping and Equipment HVAC.

1.4 REGULATORY REQUIREMENTS

A. Conform to ANSI/ASME Boilers and Pressure Vessels Code Section 8D for manufacturer of tanks.

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.6 OPERATION AND MAINTENANCE DATA
A. Submit operation and maintenance data under provisions of Division One.

B. Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division One.

B. Store and protect products under provisions of Division One.

1.8 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.

2. Principle of how the equipment works.

3. Important parts and assemblies.

4. How the equipment achieves its purpose and necessary operating conditions.

5. Most likely failure modes, causes and corrections.

6. On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - EXPANSION TANKS

A. Bell and Gossett.

B. TACO.

C. Wessels Co.

D. John Wood

2.2 EXPANSION TANKS

A. Construction: Closed, welded steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code; 125 psi rating; cleaned, prime coated, and supplied with steel support saddles; with tappings for installation of accessories.

B. Gage Glass Set: Brass compression stops, guard, and 3/4-inch red line glass, maximum 24
inches length, long enough to cover tank for 2 inches above bottom to 2 inches below top.

C. Quick Connect Air Inlet: Automotive tire valve type, manual air vent, tank drain, and pressure relief valve.

D. Automatic Cold-Water Fill Assembly: Pressure reducing valve, reduced pressure double check backflow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

E. Hot Water Heating System: Set expansion tank pressure relief valve at 20 psi maximum and pressure reducing valve at 12 psi.

F. Chilled Water System: Set expansion tank pressure relief valve at 25 psi maximum and pressure reducing valve at 12 psi.

2.3 ACCEPTABLE MANUFACTURERS - DIAPHRAGM-TYPE COMPRESSION TANKS

A. Bell and Gossett.

B. TACO.

C. Wessels Co.

D. John Wood

2.4 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Construction: Welded steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

B. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to 12 psig.

2.5 ACCEPTABLE MANUFACTURERS – CHILLED WATER VOLUME TANKS

A. TACO.

B. Wessels Co.

C. John Wood

D. Reco

2.6 CHILLED WATER VOLUME TANKS

A. Construction: Carbon steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code; supplied with National Board Form U-1, rated for working pressure of 125 psig, with internal baffle, exterior painted primer finish, and steel base ring or angle legs.

B. Accessories: Tank vent and drain; flanged inlet and outlet connections; 1” thick flexible, elastomeric thermal insulation, Armaflex AP or equal.
2.7 ACCEPTABLE MANUFACTURERS - AIR VENTS
   A. Armstrong.
   B. ITT.
   C. Bell and Gossett.

2.8 AIR VENTS
   A. Manual Type: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
   B. Float Type: Brass or semi-steel body, copper float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
   C. Washer Type: Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring-loaded ball check valve.

2.9 ACCEPTABLE MANUFACTURERS - AIR SEPARATORS
   A. Bell and Gossett.
   B. McDonald Miller.
   C. TACO.
   D. Spirotherm

2.10 AIR SEPARATORS
   A. Dip Tube Fitting: For 125 psig operating pressure; to prevent free air from rising into system.
   B. In-line Air Separators: Cast iron for sizes 1-1/2 inch and smaller, or steel for sizes 2 inch and larger; tested and stamped in accordance with Section 8D of ANSI/ASME Code; for 125 psig operating pressure.
   C. Air Elimination Valve: Bronze, float operated, for 125 psig operating pressure.
   D. Combination Air/Dirt Separators: Steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code, for 150 psig operating pressure, with air elimination valve, internal coalescing medium, tangential inlet and outlet connections, and bottom drain connection with isolation ball valve.

2.11 ACCEPTABLE MANUFACTURERS - STRAINERS
   A. Armstrong.
   B. Bell and Gossett.
   C. Mueller Steam Specialty.
D. Victaulic (For grooved systems only)

2.12 STRainers

A. Size 2 inch and Under: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32-inch stainless steel perforated screen.

B. Size 2-1/2 inch to 4 inch: Flanged or grooved iron body for 175 psig working pressure, Y pattern with 3/64-inch stainless steel perforated screen.

C. Size 6 inch and Larger: Flanged or grooved iron body for 175 psig working pressure, basket pattern with 1/8-inch stainless steel perforated screen.

2.13 ACCEPTABLE MANUFACTURERS - PUMP SUCTION FITTINGS

A. Bell and Gossett.

B. TACO.

C. Victaulic (For grooved systems only)

2.14 SUCTION FITTINGS

A. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged or grooved for 2-1/2 inch and larger, rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16-inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.

B. Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

2.15 ACCEPTABLE MANUFACTURERS - FLOW INDICATORS

A. Bell and Gossett.

B. Watson McDaniel.

2.16 FLOW INDICATORS

A. Brass construction, threaded for insertion into piping system, packless, with paddle with removable segments, vapor proof electrical compartment with switches.

2.17 ACCEPTABLE MANUFACTURERS - FLOW CONTROLS

A. Bell and Gossett.

B. ITT Hoffman.

C. TACO.

D. Victaulic/TA
2.18 FLOW CONTROLS

A. Construction: Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet, and outlet, blowdown/backflush drain.

B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control.

C. Control Mechanism: Stainless steel or nickel-plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

D. Accessories: In-line strainer on inlet, and ball valve on outlet.

2.19 ACCEPTABLE MANUFACTURERS - FLOW METERS

A. Bell and Gossett.

B. ITT Hoffman.

C. TACO.

D. Victaulic/TA

2.20 FLOW METERS

A. Orifice principle by-pass circuit with direct reading gauge, soldered, or flanged piping connections for 125 psig working pressure, with shut off valves, and drain and vent connections.

B. Cast iron, wafer type, orifice insert flow meter for 250 psig working pressure, with read-out valves equipped with integral check valves with gasketed caps.

C. Calibrated, plug type balance valve with precision machined orifice, readout valves equipped with integral check valves and gasketed caps, calibrated nameplate and indicating pointer.

D. Cast iron or bronze, globe style, balance valve with handwheel with vernier type ring setting and memory stop, drain connection, readout valves equipped with integral check valves and gasketed caps.

E. Portable meter consisting of case containing two, 3 percent accuracy pressure gauges with 0-135 inches and 0-60 feet pressure ranges for 500 psig maximum working pressure, color coded hoses for low and high-pressure connections, and connectors suitable for connection to read-out valves.

2.21 ACCEPTABLE MANUFACTURERS - RELIEF VALVES

A. Bell and Gossett.

B. McDonnell-Miller.
C. TACO.

2.22 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

A. Install specialties in accordance with manufacturer's instructions to permit intended performance.

B. Support tanks inside building from building structure in accordance with manufacturer's instructions.

C. Where large air quantities can accumulate, provide enlarged air collection standpipes.

D. Provide manual air vents at system high points and as indicated on details and drawings.

E. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

F. Provide air separator on suction side of system circulation pump and connect to expansion tank.

G. Provide valved drain and hose connection on strainer blow down connection.

H. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.

I. Support pump fittings with floor mounted pipe and flange supports.

J. Provide relief valves on pressure tanks; and on low pressure side of reducing valves, heat exchangers, and expansion tanks.

K. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

L. Pipe relief valve outlet to nearest floor drain.

M. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

END OF SECTION 23 21 19
SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. In-line circulators.

B. Base mounted pumps.

1.3 RELATED SECTIONS

A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

C. Section 23 07 16 - HVAC Equipment Insulation.

D. Section 23 07 19 - HVAC Piping Insulation.

E. Section 23 21 16 - Underground Hydronic Piping.

1.4 REFERENCES

A. ANSI/UL 778 - Motor Operated Water Pumps.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum five years’ experience.

B. Alignment: Base mounted pumps shall be aligned by qualified millwright and alignment certified.

C. Impellers: All impellers shall be dynamically balanced.

D. The Mechanical Contractor shall be responsible for accurately checking all pumping heads, based upon the actual piping and equipment installation. The Contractor shall be responsible for furnishing pumps and motors of proper sizes suitable for the actual installation. Do not provide pumps with capacities less than the amount indicated on
1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

C. Submit manufacturer's installation instructions under provisions of Division One.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division One.

B. Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division One.

B. Store and protect products under provisions of Division One.

1.9 EXTRA PARTS

A. Provide one set of replacement mechanical seals for each size of pump. After the pumps are in operation for ninety days, the Contractor shall check the seals and replace any that are defective. If the replacement seals are not used during the 90-day operational period, they shall be delivered to the Owner.

1.10 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.

2. Principle of how the equipment works.

3. Important parts and assemblies.

4. How the equipment achieves its purpose and necessary operating conditions.

5. Most likely failure modes, causes and corrections.
6. On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Taco.
B. Aurora.
C. Bell and Gossett.
D. Armstrong
E. Grundfos/Paco.

2.2 GENERAL CONSTRUCTION REQUIREMENTS

A. Balance: Rotating parts, statically and dynamically.
B. Construction: To permit servicing without breaking piping or motor connections.
C. Pump Motors: Operate at 1750 rpm unless specified otherwise. Provide totally enclosed motors when mounted outdoors. Refer to Section 23 05 13.
D. Pump Connections: Flanged, for pipe size two inches and larger. Provide union for pipe sizes less than two inches.
E. Critical speed of each pump shall be at least 115% of the running speed listed in the schedule.

2.3 IN-LINE CIRCULATORS

A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 125 psig maximum working pressure.
B. Casing: Cast iron.
C. Impeller: Brass or bronze, keyed to shaft.
D. Bearings: Two, oil lubricated bronze sleeves.
E. Shaft: Stainless steel with stainless steel sleeve, integral thrust collar.
F. Seal: Carbon rotating against a stationary ceramic seat viton fitted, [225 degrees F] [275 degrees F] maximum continuous operating temperature.
G. Drive: Flexible coupling.

2.4 BASE MOUNTED PUMPS

A. Type: Horizontal shaft, single stage, direct connected, back pull-out, radially or horizontally split casing, for 125 psig maximum working pressure.

B. Casing: Cast iron, with suction and discharge gauge ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze or Stainless Steel, fully enclosed, keyed to shaft.

D. Bearings: Grease or Permanently lubricated roller or ball bearings, 40,000-hour minimum life.

E. Shaft: Alloy steel with copper, bronze, or stainless-steel shaft sleeve.

F. Seal: Carbon rotating against a stationary ceramic seat, viton fitted 225 degrees F maximum continuous operating temperature.

G. Drive: Flexible drop-out coupling with coupling guard.

H. Baseplate: Cast iron or fabricated steel with integral drain rim or pan.

I. For pumps driven by motors 25 horsepower and larger, the steel base shall be fabricated of structural shapes and formed steel sections. The main structural member and formed steel section shall have a depth of at least 1/12 the overall length of the base but not less than 4 inches. The base shall be filled with concrete or grout after installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pumps in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

C. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

D. Pumps shall be free of flashing and cavitation at all flow rates from 25% to 125% of design flow under the suction conditions of the pump installation.
E. The impeller selected for compliance with design requirements shall not exceed 85% of cutwater diameter for the selected pump casing size. This shall be clearly certified on the Shop Drawing submittal.

F. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge lines.

G. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.

H. Provide air cock and drain connection on horizontal pump casings.

I. Provide drains for bases and seals, piped to and discharging into floor drains.

J. Lubricate pumps before start-up.

K. Install base mounted pumps on concrete base, with anchor bolts, set and level, and grout in place.

L. Qualified millwright shall check, align, and certify base mounted pumps prior to start-up.

END OF SECTION 23 21 23
SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 – Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for Owner's use.

PART 2 – PRODUCTS

2.1 GENERAL

Provide for the systems as shown. Submit shop drawings of piping systems showing all traps, pipe sizes, and accessories; drawing to be marked "Approved", and signed by a representative of the Application Engineering Department of the condensing unit manufacturer. Pipe sizes shall be as recommended by unit manufacturer. Refer to piping schematic on Drawings.

2.2 MATERIAL

A. PIPE: Copper ACR hard-drawn tubing.

B. FITTINGS: Wrought copper streamlined sweat fitting.

C. SOLDER: Sil-Fos; except on valves use solder recommended by valve manufacturer.

2.3 ACCESSORIES

All accessories shall be UL listed and rated in accordance with ARI Standard 710.

A. On systems 7-1/2 tons and larger, each separate refrigerant circuit shall have a separate filter dryer. Each filter dryer shall have a replaceable core and a three-valve bypass. The filter dryer shall be full line size and installed in the refrigerant liquid line. The filter shall have a minimum 4-3/4 inches diameter shell with removable flange and gasket. Flange shall be tapped for 1/4-inch FPT access valve. Size filter-drier for maximum 2.0 psi pressure drop at evaporator operating temperature. Similar to Mueller Brass Company model Drymaster micro-guard refillable filter series SD-485 through SD19217 or Sporlan catch-all.

B. On systems less than 7-1/2 tons, the filter dryer shall be the sealed type; sizes as above. One drier per refrigerant circuit.

C. Liquid-Moisture Indicator shall be installed in liquid refrigerant line; full line size similar to Mueller Brass Company model "Vuemaster" with soldered ends.
D. Thermostatic expansion valve shall have adjustable super heat and be as manufactured by Sporlan.

2.4 EVACUATION

Evacuate moisture completely by applying a commercial vacuum pump for a minimum of 24 hours. Moisture indicator shall indicate a completely moisture-free condition at time of final inspection. The vacuum pump shall run until the system indicates a maximum of 35 degrees FDB. The system shall be flushed with the operating refrigerant and the vacuum pump connected and rerun to repeat the evacuation. Evaluation shall be performed under supervision of the Engineer.

2.5 REFRIGERANT AND OIL

A. Contractor shall leave the refrigeration system with a full charge of refrigerant and oil and shall be responsible for the maintenance of a full charge of refrigerant and oil in the systems for a period of one year from date of Substantial Completion.

B. Should any leaks in the refrigeration system occur during the guarantee period, the Contractor shall eliminate such leaks and recharge system to a full charge of refrigerant and oil at no cost to the Owner.

PART 3 - EXECUTION

3.1 All equipment and piping shall be installed in accordance with the manufacturer’s recommendations and printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the Drawings or in the Specifications. Provide all items required as per manufacturer’s requirements.

END OF SECTION 23 23 00
SECTION 23 25 13 – WATER TREATMENT FOR CLOSED LOOP HYDRONIC SYSTEMS

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 – Basic Materials and Methods is included as a part of this Section as though written in this document.

1.2 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for Owner’s use.

1.3 DESCRIPTION OF WORK

A. Work Included: Perform water analysis and provide all water treatment products, equipment and labor for testing, cleaning, flushing and dispensing products to control water quality for each system specified hereinafter as follows:


A. Chemicals: Provide, at no additional cost to the Owner, all chemicals required for operating and testing all water treatment systems prior to and for one (1) year after Substantial Completion.

B. Instructions: Provide operating and maintenance instructions for each water treatment system; include one set in each Owner’s Manual and deliver one set to Owner’s operating personnel.

C. Testing Equipment and Reagents: Furnish suitable water treatment testing equipment for each system, complete with apparatus and reagents necessary for operation prior to and for three (3) months after Substantial Completion.

Service Representative:

1. Cleaning and Flushing test required verifying satisfactory completion of pipe cleaning.

2. Provide water analysis report quarterly on each operating system.

3. Annually perform microbiological culture study on the system to monitor bacteria.

D. Replacement and Rework: Replace defective or nonconforming materials and equipment with new materials and equipment at no additional cost to Owner for one (1) year after Substantial Completion; monthly reports shall be provided to the Owner and Architect/Engineer.

1. Guarantee: Provide system produced by manufacturer who is willing to execute the required guarantee.

2. Agreement to Maintain: Provide system produced by manufacturer who is willing to
execute (with the Owner) the required agreement for continued maintenance of the system.

1.4 QUALITY ASSURANCE

A. Qualifications: The Water Treatment Contractor for work under this Section shall have:

1. Research and development facilities.

2. Regional laboratories capable of making a water analysis.

3. A service department and qualified technical service representative located within a reasonable distance of the project site.

4. Service representatives who are Registered Engineers or factory-certified technicians with not less than five (5) years of water treatment experience with the water treatment system manufacturer. A Certified Water Technologist (CWT) qualified professional is preferred.

B. Packaging and Labeling: Water treatment chemicals will be supplied in a container suitable for product and will be in accordance with DOT shipping standards.

C. Electrical Standards: Provide electrical products which have been tested, listed and labeled by Underwriters Laboratories (UL) and which comply with National Electrical Manufacturers’ Association (NEMA) standards.

D. Chemical Standards: Provide chemical products acceptable under state and local pollution control or other governing regulations.

1.5 SUBMITTALS

A. Test reports: Submit test reports certified by an officer of the firm, on water treatment company letterheads, of samples of each treated water system specified. Comply with ASTM D 596 for reporting. Indicate the ASTM best methods for each test. Tests will be included by are not limited to conductivity, pH, chemical residual, iron, copper, and bacteria count.

B. Shop Drawings: Submit shop drawings for each water treatment system. Show wiring, pumps, piping and tubing sizes, fittings, accessories, valves and connections and monitoring equipment.

C. Guarantee: Submit written guarantee, signed by the Manufacturer and countersigned by the Installer and Contractor, agreeing to adjust or replace the chemicals in the systems as required to achieve the required performance, during a one (1) year period following the final start-up or the continued operation of the systems.

D. Agreement to Maintain: Prior to the time of final acceptance, the Manufacturer of the chilled water treating system shall submit four (4) copies of an “Agreement for Continued Service and the Owner’s Possible Acceptance.” Offer terms and conditions for furnishing chemical and providing continued testing and equipment for a one (1) year period with option for renewal of the Agreement by Owner.

1.6 OPERATIONS PERSONNEL TRAINING
A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

PART 2 – PRODUCTS

2.1 GENERAL

A. Water Analysis: Determine which chemicals to use from the results of a water sample analysis taken from the building site by the system manufacturer. Provide ingredients necessary to achieve the desired water conditions.

B. Pre-Treatment: Treat water piping systems with chemicals to remove and permit flushing of mill scale, oil, grease and other foreign matter.

C. FDA and USDA Approval: Use only FDA and USDA approved products in system with direct connection to domestic water systems.

D. Governing Laws: Ensure that neither products, waste, blow-down nor other effluents violate local, state, EPA, or other agency regulations in effect in the project area.

2.2 APPROVED WATER TREATMENT SERVICE

A. Water Treatment Services

B. ChemCal (Div. of U.S. Water Services)

C. Chem Treat

D. Nalco

E. Garratt Callahan

2.3 CHILLED WATER SYSTEM

A. Chemicals: Provide water treatment products which contain inhibitors that perform the following:
1. Form a protective film to prevent corrosion and scale formation;

2. Scavenge oxygen and protect against scale;

3. Remain stable throughout operating temperature range, and;

4. Are compatible with pump seals and other elements in the system.

5. Corrosion inhibitor chemical – chill loop. This product must be in liquid form and impart the following active ingredients at the following dosages when fed in CHILL LOOP water: 1) nitrite (as NO2) = 400-800 ppm, 2) borate = 200-400 ppm, 3) azole = 20-60 ppm. The resulting bulk water pH range should be 9.0-10.5.

6. Corrosion inhibitor chemical – hot loop. This product must impart the following active ingredients at the following dosages when fed in HOT LOOP water: 1) nitrite (as NO2) = 800-1200 ppm, 2) borate = 400-600 ppm, 3) azole = 40-80 ppm. The resulting bulk water pH range should be 9.0-10.5., for aluminum condensing boiler molybdate at 10 to 25 ppm.

B. Equipment: For each system, provide a 5-gallon filter feeder constructed of materials which are impervious to the products dispensed. Feeder shall be designed for not less than 200-psig operating pressure. Filter feeder shall be as manufactured by Vector Industries model FA-900 or approved equal. Provide flow indicator meter on discharge of filter feeder.

C. Test Kit: Provide test kit and reagents for determining proper water conditions. Test kit should be capable of testing presence of corrosion inhibitor and pH. A handheld connectivity/TDS meter shall be part of the test kit package.

D. Treatment: Treat initial water charge to water system, after system has been flushed and prepped, to achieve a water quality as specified. Test report required to verify cleaning.

E. Reports: Prepare certified test report for each required water performance characteristic. Comply with the following ASTM standard, where applicable:

1. D1067 – Tests for Acidity or Alkalinity of Water.


PART 3 – EXECUTION

3.1 THE WATER TREATMENT CONTRACTOR

A. General: After piping systems are erected pressure tested and proven free of leaks, administer chemicals required for preparation treatment and flushing. Apply chemicals for the time
period and in the concentration recommended by the water treatment manufacturer for this portion of the work. Flushing must be for a minimum of 24 continuous hours.

B. Testing: After completion of 24 continuous hours of flushing, perform test procedures and submit a written report of test conditions and results to the Engineer. If test results are unsatisfactory, repeat preparation treatment as necessary to achieve test results approved by the Owner’s insurance carrier and the Engineer.

PART 4 – MECHANICAL CONTRACTOR

4.1 SERVICES OF MECHANICAL CONTRACTOR

A. Piping systems shall be pressure tested and approved for tightness, they shall be thoroughly cleaned and flushed using and approved pipe cleaning.

B. After initial chemical treatment has been added, the systems must be circulated for 48 hours with all valves opened; then the automated building system can be initiated.

4.2 PIPE CLEANING, STERILIZATION, AND FLUSHING

A. Additions/Renovations: When connecting existing lines to newly installed lines, provide wire strainer with fine mesh screens.

B. All connections required for cleaning, purging and circulating shall be included as permanent installation with valves. Provide permanent pipe bypasses at each coil and heat exchanger during this cleaning operation and for future flushing. All air vents, gauges, strainers, etc., valved connections in piping systems shall be blown clean during and after cleaning operation is completed and during.

C. After cleaning, drain the system, fill with fresh water and flush thoroughly for a minimum of 24 hours on a system that is not greater than 3,000 gallons. Systems greater than 3,000 gallons should be flushed thoroughly for a minimum of 48 hours or as recommended by Engineer.

D. All flushing, cleaning, and initial chemical treatment shall be complete and witnessed by Owner prior to starting systems.

E. Start-up procedures: During water system start-up, operate water treating system (after changing with specified chemicals) to maintain the required steady-state characteristics of water. Demonstrate system operation to Owner’s operating personnel.

PART 5 – ADDITIONAL REQUIREMENT FOR THE WATER TREATMENT CONTRACTOR

5.1 Vendor shall warrant the chemicals used in the water treatment program and will have no detrimental effects on the metallic or non-metallic materials in the equipment being treated; if applied according to Vendor’s instructions.

A. All testing of the Owner’s systems are to be completed on-site and discussed with Owner’s HVAC personnel with a copy of the report given to him/her for signature.

B. All work shall be performed in cooperation with Owner’s HVAC personnel.
C. Periodic de-scaling with inhibited acids will not be considered as meeting this specification.

D. Sulfuric acid or other inhibited acids shall not be used in the chemical treatment program of Owner.

E. The Contractor shall provide a biocide program consisting of both an oxidizing biocide and bio-dispersant if required.

5.2 PERSONNEL TRAINING

A. Operator Training: Train Owner’s personnel in use and operation of heating water, chilled water treating systems. A Program Administration Manual shall be furnished encompassing all systems in this section of the Specifications.

B. Provide two (2) hours in use and operation of water treating systems.

END OF SECTION 23 25 13
SECTION 23 31 13 - METAL DUCTWORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Low pressure ductwork.
B. Medium and high-pressure ductwork.
C. Laboratory fume hood exhaust ductwork.
D. Duct cleaning.

1.2 RELATED SECTIONS

Division 9 - Finishes: Weld priming, weather resistant, paint or coating.
A. Section 23 02 00 - Basic Material and Methods.
B. Section 23 05 29 – Hangers and Support for Piping and Equipment HVAC.
C. Section 23 05 93 - Testing, Adjusting and Balancing.
D. Section 23 07 13 - Duct Insulation.
E. Section 23 33 00 - Ductwork Accessories.
F. Section 23 37 13 - Air Distribution Devices.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer’s Qualifications: Firms with least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.

C. Codes and Standards:
   1. SMACNA Standards: Comply with latest SMACNA’s “HVAC Duct Construction Standards, Metal and Flexible” for fabrication and installation of metal ductwork.

1.4 **GENERAL DESCRIPTION**

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

1.5 **SUBMITTALS**

A. Submit shop drawings, duct fabrication standards and product data under provisions of Division One.

B. Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration prior to start of work.

C. The contract documents are schematic in nature and are to be used only for design intent. The contractor shall prepare sheet metal shop drawings, fully detailed and drawn to scale, indicating all structural conditions, all plumbing pipe and light fixture coordination, and all offsets and transitions as required to permit the duct to fit in the space allocated and built. All duct revisions required as a result of the contractor not preparing fully detailed shop drawings will be performed at no additional cost.

1.6 **DEFINITIONS**

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain indicated clear size inside lining. Where offsets or transitions are required, the duct shall be the equivalent size based on constant friction rate.

B. Low Pressure: Low pressure ductwork shall be rated for an operating pressure of 2”. Low pressure ductwork shall be defined as all return, exhaust, and outside air ducts, all supply ductwork associated with constant volume air handling units with a scheduled external static pressure of less than 2”, and all supply ductwork downstream of terminal units in variable volume systems.

C. Medium Pressure: Medium pressure ductwork shall be rated for an operating pressure of 4”. Medium pressure ductwork shall be defined as all supply ductwork extending from variable volume air handling units to terminal units in variable volume systems with air handling units having a scheduled external static pressure of less than 4”. The supply ductwork of constant volume air handling units having a scheduled external static pressure greater than 2” and less than 4” shall be rated for medium pressure.

D. High Pressure: High pressure ductwork shall be rated for an operating pressure of 6”, or the scheduled external pressure of the equipment it is connected to, whichever is greater. The supply ductwork of air handling units having a scheduled external static pressure greater than 4” shall be high pressure.

1.7 **DELIVERY, STORAGE, AND HANDLING**

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage
and prevent dirt and moisture from entering ducts and fittings, use sheet metal end caps on any lined duct exposed to the weather.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.

B. Sheet Metal.: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality, with G 90 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations.

C. Stainless Steel Sheet: Where indicated, provide stainless steel complying with ASTM A167; Type 316; with No. 4 finish where exposed to view in occupied spaces, No. 1 finish elsewhere. Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation.


2.2 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Non-combustible and conforming to UL 181, Class 1 air duct materials.

B. Flexible Ducts: Flexmaster U.S.A., Inc. Type 3M or approved equal, corrosive resistant galvanized steel formed and mechanically locked to inner fabric with 1” thick insulation when flexible ducts are located in conditioned spaces and with R-5 insulation when located in unconditioned spaces. Flexible duct shall have reinforced metalized outer jacket comply with UL 181, Class 1 air duct.

C. Sealants: Hard-Cast “iron grip” or approved equal, non-hardening, water resistant, fire resistive and shall not be a solvent curing product. Sealants shall be compatible with mating materials, liquid used alone or with tape or heavy mastic.

D. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

1. For exposed stainless-steel ductwork, provide matching stainless-steel support materials.

2. For aluminum ductwork, provide aluminum support materials.

2.3 LOW PRESSURE DUCTWORK
A. Fabricate and support in accordance with latest SMACNA Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by approved shop drawings. Obtain engineer's approval prior to using round duct in lieu of rectangular duct.

C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

E. Use crimp joints with bead for joining round duct sizes 6 inch smaller with crimp in direction of airflow.

F. Use double nuts and lock washers on threaded rod supports.

2.4 MEDIUM AND HIGH-PRESSURE DUCTS

A. Fabricate and support in accordance with SMACNA Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

B. Construct T's, bends, and elbows with radius of not less than 1½ times width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is required, provide turning vanes of perforated metal with glass fiber insulation. Weld in place.

C. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.

D. Fabricate continuously welded medium and high-pressure round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4-inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

E. Provide standard 45-degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

2.5 DISHWASHER/SHOWER/LOCKER ROOM EXHAUST DUCTWORK

A. All ductwork shall be stainless steel, one gauge heavier than that required for galvanized steel duct.

B. Slope all duct to drain out grilles or provide drain line to floor drain.
2.6 LABORATORY FUME HOOD EXHAUST DUCTWORK

A. Construct of 18-gauge type 316 stainless steel.

B. All welded construction.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Obtain manufacturer's inspection and acceptance of fabrication and installation of ductwork at beginning of installation.

B. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

D. Connect terminal units to medium or high-pressure ducts with four feet maximum length of flexible duct. Do not use flexible duct to change direction.

E. Connect diffusers or troffer boots to low pressure ducts with 6 feet maximum, 4 feet minimum, length of flexible duct. Hold in place with strap or clamp.

F. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

G. The interior surface of all ductwork shall be smooth. No sheet metal parts, tabs, angles, or anything else may project into the ducts for any reason, except as specified to be so. All seams and joints shall be external.

H. All ductwork located exposed on roof shall be "crowned" to prevent water from ponding. Ref: Insulation for additional requirements.

I. Where ducts pass through floors, provide structural angles for duct support. Where ducts pass through walls in exposed areas, install suitable sheet metal escutcheons as closers.

J. All angles shall be carried around all four sides of the duct or group of ducts. Angles shall overlap corners and be welded or riveted.

K. All ductwork shall be fabricated in a manner to prevent the seams or joints being cut for the installation of grilles, registers, or ceiling outlets.

L. All duct hangers shall be attached to building structure. Cutting slots in roof or floor decking for hanger straps to be cast in concrete is not acceptable.
3.2 INSTALLATION OF FLEXIBLE DUCTS

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 6'-0" extended length.

B. Installation: Install in accordance with Section III of SMACNA’s, “HVAC Duct Construction Standards, Metal and Flexible”.

3.3 DUCTWORK APPLICATION SCHEDULE

<table>
<thead>
<tr>
<th>AIR SYSTEM</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Pressure Supply</td>
<td>Galvanized Steel, Aluminum</td>
</tr>
<tr>
<td>Medium and High</td>
<td>Galvanized Steel</td>
</tr>
<tr>
<td>Return and Relief</td>
<td>Galvanized Steel, Aluminum</td>
</tr>
<tr>
<td>General Exhaust</td>
<td>Galvanized Steel, Aluminum</td>
</tr>
<tr>
<td>Shower/Locker Room</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>Fume Hood Exhaust</td>
<td>Stainless Steel, Glass Fiber</td>
</tr>
<tr>
<td></td>
<td>Reinforced Plastic if not in air plenum.</td>
</tr>
<tr>
<td>Outside Air Intake</td>
<td>Steel</td>
</tr>
</tbody>
</table>

3.4 DUCTWORK HANGERS AND SUPPORTS

A. All ductwork shall be properly suspended or supported from the building structure. Hangers shall be galvanized steel straps or hot-dipped galvanized rod with threads pointed after installation. Strap hanger shall be attached to the bottom of the ductwork, provide a minimum of two screws one at the bottom and one in the side of each strap on metal ductwork. The spacing, size and installation of hangers shall be in accordance with the recommendations of the latest SMACNA edition.

B. All duct risers shall be supported by angles or channels secured to the sides of the ducts at each floor with sheet metal screws or rivets. The floor supports may also be secured to ducts by rods, angles or flat bar to the duct joint or reinforcing. Structural steel supports for duct risers shall be provided under this Division.

3.5 AIR DUCT LEAKAGE: (From SMACNA Duct Standards Latest Edition) Test all ductwork (designed to handle over 1000 CFM) as follows:

A. Test apparatus
   The test apparatus shall consist of:

1. A source of high pressure air--a portable rotary blower or a tank type vacuum cleaner.
2. A flow measuring device consisting of straightening vanes and an orifice plate mounted in a straight tube with properly located pressure taps. Each orifice assembly shall be accurately calibrated with its own calibration curve. Pressure and flow readings shall be taken with U-tube manometers.

B. Test Procedures

1. Test for audible leaks as follows:

2. Close off and seal all openings in the duct section to be tested. Connect the test apparatus to the duct by means of a section of flexible duct.
   a. Start the blower with its control damper closed.
   b. Gradually open the inlet damper until the duct pressure reaches 1.5 times the standard designed duct operating pressure.
   c. Survey all joint for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealants have set.

3. After all audible leaks have been sealed, the remaining leakage should be measured with the orifice section of the test apparatus as follows:
   a. Start blower and open damper until pressure in duct reaches 50% in excess of designed duct operating pressure.
   b. Read the pressure differential across the orifice on manometer No. 2. If there is no leakage, the pressure differential will be zero.
   c. Total allowable leakage shall not exceed one (1) percent of the total system design air flow rate. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.
   d. Even though a system may pass the measured leakage test, a concentration of leakage at one point may result in a noisy leak which, must be corrected.

4. Testing Report
   a. Contractor shall provide a testing report for each air system to the engineer. The report shall indicate the completion of testing and compliance with testing specification.
   b. All duct testing reports shall be included in the final close out documents.

3.6 DUCT SYSTEM CLEANING

A. Duct system cleaning shall be performed in accordance with the current published standards of ASHRAE and NADCA.

B. Duct system cleaning method used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment is assured.

C. All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums.
D. All vacuum devices exhausting air outside the facility shall be equipped with Particulate Collection including adequate filtration to contain debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.

E. Fibrous glass thermal or acoustical insulation elements present in any equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations.

F. Duct cleaning method used shall not damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

G. Replace the fiberglass material if there is any evidence of damage, deterioration, delamination, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating.

H. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

I. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

J. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

K. Cleaning Report: Contractor shall provide a report to the Owner indicating the completion of duct cleaning per specification and areas of the duct system found to be damaged and/or in need of repair.

3.7 DUCT JOINTS AND SEAMS

A. Seal all non-welded duct joints with duct sealant as indicated.

END OF SECTION 23 31 13
SECTION 23 33 00 – DUCTWORK ACCESSORIES

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Volume control dampers.

B. Round Duct Taps.

C. Fire dampers.

D. Combination fire and smoke dampers.

E. Back draft dampers.

F. Air turning devices.

G. Flexible duct connections.

H. Duct access doors.

I. Duct test holes.

1.2 RELATED WORK

A. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

B. Section 23 31 13 - Metal Ductwork.

1.3 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

B. SMACNA - Low Pressure Duct Construction Standards.

C. UL 33 - Heat Responsive Links for Fire-Protection Service.

D. UL 555 - Fire Dampers and Ceiling Dampers.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Provide shop drawings for shop fabricated assemblies indicated, including volume control dampers duct access doors duct test holes. Provide product data for hardware used.

C. Submit manufacturer's installation instructions under provisions of Division 1, for fire dampers and combination fire and smoke dampers.
2.1 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

B. Fabricate splitter dampers of material same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.

C. Fabricate splitter dampers of double thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/2-inch diameter rod in self aligning, universal joint, action flanged bushing, with set screw.

D. Fabricate single blade dampers for duct sizes to 9-1/2 x 24 inch.

E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch.

1. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

2. On outside air, return air, and all other dampers required to be low leakage type, provide galvanized blades and frames, seven inches wide maximum, with replaceable vinyl, EPDM, silicone rubber seals on blade edges and stainless-steel side seals. Provide blades in a double sheet corrugated type construction for extra strength. Provide hat channel shape frames for strength and blade linkage enclosure to keep linkage out of the air stream. Construction leakage not to exceed 1/2%, based on 2,000 fpm and 4-inch static pressure.

F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends.

H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

2.2 ROUND DUCT TAPS

A. Taps to trunk duct for round flexible duct shall be spin-in fitting with locking quadrant butterfly damper, model no. FLD-B03 by Flexmaster or approved equal.

2.3 ACCEPTABLE MANUFACTURERS - FIRE DAMPERS

A. Greenheck.

B. Louvers and Dampers Inc.

C. Ruskin.
2.4 FIRE DAMPERS
A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
B. Provide curtain type dampers of galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream.
C. Fabricate multiple blade fire dampers per U.L. with 16-gauge minimum galvanized steel frame and blades, oil-impregnated bronze or stainless-steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
D. Fusible links, UL 33, shall separate at 160 degrees F. Provide adjustable link straps for combination fire/balancing dampers.

2.5 ACCEPTABLE MANUFACTURERS – BACKDRAFT DAMPERS
A. Greenheck
B. American Warming and Vent.
C. Louvers and Dampers Inc.
D. Ruskin.
E. Pottorff
F. Substitutions: Under provisions of Division One.

2.6 BACKDRAFT DAMPERS
A. Gravity back draft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturers standard construction.
B. Fabricate multi-blade, parallel action gravity balanced back draft dampers of 16-gauge galvanized steel, or extruded aluminum, with blades of maximum 6-inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.7 ACCEPTABLE MANUFACTURERS – AIR TURNING DEVICES
A. Young Regulator.
B. Titus.
C. Tuttle and Bailey.
D. Substitutions: Under provisions of Division One.

2.8 AIR TURNING DEVICES

A. On duct sizes less than 12 x 12, multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.

B. Multi-blade device with radius blades attached to pivoting frame and bracket, steel or aluminum construction, with worm drive mechanism with 18-inch-long removable key operator.

2.9 ACCEPTABLE MANUFACTURERS – FLEXIBLE DUCT CONNECTIONS

A. Metaledge.

B. Ventglass.

C. Substitutions: Under provisions of Division One.

2.10 FLEXIBLE DUCT CONNECTIONS TO AIR MOVING EQUIPMENT

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 oz per sq yd, approximately 6 inches wide, crimped into metal edging strip.

2.11 ACCEPTABLE MANUFACTURERS – DUCT ACCESS DOORS

A. Greenheck.

B. American Warming and Vent.

C. Ruskin.

D. Titus.

E. Substitutions: Under provisions of Division One.

2.12 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards and as indicated.

B. Review locations prior to fabrication.

C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one-inch thick insulation with sheet metal cover. Insulation shall be replaceable without field cutting or patching.
D. Access doors smaller than 12 inches square may be secured with sash locks.

E. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.

F. Access doors with sheet metal screw fasteners are not acceptable.

2.13 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions.

B. Balancing Dampers

1. Provide at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts and as required for air balancing. Use splitter dampers only where indicated.

2. All regulators mounted on externally insulated ductwork shall have 16-gauge elevated platforms at least 1/8 inch higher than the thickness of the insulation. Damper shaft shall have Ventlock No. 607 bearing mounted on ductwork within elevated platform. If duct is inaccessible the operating handle shall be extended, and the regulator installed on the face of the wall or ceiling. Where regulators are exposed in finished parts of the building, they shall be flush type, Ventlock No. 666. All regulators shall be manufactured by Ventlock or approved equal.

3. All dampers in lined ductwork shall have bushing to prevent damper damage to liner.

C. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

D. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner's representative.

E. Provide back draft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

F. Provide flexible duct connections immediately adjacent to equipment in ducts associated with
fans and motorized equipment. Provide at least one-inch slack at all flexible duct connections.

G. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 8 x 8-inch size for hand access, 18 x 18-inch size for shoulder access, and as indicated.

H. Provide duct test holes where indicated and required for testing and balancing purposes.

END OF SECTION 23 33 00
SECTION 23 34 00 – HVAC FANS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Centrifugal roof ventilators.

B. Ceiling and inline ventilators.

C. Roof supply fans.

D. Utility fans.

1.3 RELATED SECTIONS

A. Section 23 05 13 – Common Motor Requirements for HVAC Equipment

B. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment

C. Section 23 09 00 – Building Automation System

D. Section 23 05 93 – Testing, Adjusting and Balancing

1.4 QUALITY ASSURANCE

A. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators."

B. UL Compliance: Fans and components shall be UL listed and labeled.

C. Nationally Recognized Testing Laboratory Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

E. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

F. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

B. Product data for selected models, including specialties, accessories, and 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 fan accessories.
   4. Materials, gages and finishes, include color charts.
   5. Dampers, including housings, linkages, and operators.
   6. Full color paint samples.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Coordination drawings, in accordance with Division 23, Section "Basic Materials and Methods", for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:
   1. Roof framing and support members relative to duct penetrations.
   2. Ceiling suspension members.
   3. Method of attaching hangers to building structure.
   4. Size and location of initial access modules for acoustical tile.
   5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

F. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer installed wiring and field installed wiring.

G. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.

H. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23, Section "Basic Materials and Methods".
1.6 DELIVERY, STORAGE, AND HANDLING

A. Fans shall be stored and handled in accordance with the unit manufacturer’s instructions.

B. Lift and support units with the manufacturer's designated lifting or supporting points.

C. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

D. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.7 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.

1.8 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.

2. Principle of how the equipment works.

3. Important parts and assemblies.

4. How the equipment achieves its purpose and necessary operating conditions.

5. Most likely failure modes, causes and corrections.

6. On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. PennBarry

B. Loren Cook Company

C. Greenheck Fan Corporation

D. ACME

E. Twin City Fan and Blower
2.2 GENERAL DESCRIPTION

A. Provide fans that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.

B. Fans and Shafts shall be statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

C. Provide factory baked-enamel finish coat after assembly. Color for roof mounted fans shall be chosen by Architect during the submittal process.

2.3 CENTRIFUGAL ROOF VENTILATORS

A. Fan shall be a spun aluminum, centrifugal, roof mounted, direct driven or belt driven as indicated.

B. Fan shall be listed by Underwriters Laboratories (UL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance.

C. 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.

D. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. A discharge baffle conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections.

E. The motor, bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Unit shall bear an engraved aluminum nameplate and shall be shipped in transit tested packaging.

F. 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.

G. Motor shall be heavy duty type with permanently lubricated sealed ball bearings.

H. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty re-greaseable ball type in a cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

I. Accessories: The following accessories are required.

1. Disconnect Switch: Non-fusible type, with thermal overload protection, mounted inside fan housing, factory-wired through an internal aluminum conduit.

2. Bird Screens: Removable ½ inch mesh, 16-gauge, aluminum or brass wire.
3. **Dampers:** Motor-operated, parallel-blade, volume control dampers mounted in curb base.

4. **Roof Curbs:** Prefabricated, 12-inch-high, heavy-gauge, galvanized steel; mitered and welded corners; 2-inch-thick, rigid, fiberglass insulation adhered to inside walls; built-in cants and mounting flange for flat roof decks; and 2 inch wood nailer. Size as required to suit roof opening and fan base. Roof curb shall match roof slope so that the curb is level.

### 2.4 CEILING AND INLINE VENTILATORS

**A.** Ceiling and inline ventilators shall be direct drive or belt drive as indicated, centrifugal blower type. Fan wheel shall be constructed of galvanized steel and shall be dynamically balanced. The housing shall be constructed of minimum 20-gauge corrosion resistant galvanized steel and acoustically insulated for quiet operation. Blower and motor assembly shall be easily removable from the housing without disturbing the ductwork. The motor shall be permanently lubricated with built-in thermal overload protection and shall be factory tested prior to shipment. The ceiling ventilators shall be furnished standard with a powder-painted white steel grille.

**B.** Ventilators shall be certified and licensed to bear the AMCA Seal for Air and Sound Performance. Ventilator performance shall be based on tests and procedures performed in accordance with AMCA publication 211 and comply with the requirements of the AMCA Certified Ratings Program. Fan sound power level ratings shall be based on tests and procedures performed in accordance with AMCA publication 311 and comply with the requirements of the AMCA Certified Ratings Program. Ventilators shall be UL listed and CSA certified.

**C.** Accessories: The following accessories are required.

1. **Dampers:**
   a. Aluminum backdraft damper.
   b. Motor-operated volume control damper.
   c. U.L. listed ceiling radiation damper for ceiling fans comply with NFPA Standard 90A rated for 3 hours.

2. ** Disconnect Switch:** Nonfusible type with thermal overload protection.

3. **Speed Controls:** Fan mounted, solid state speed controller.

### 2.5 ROOF SUPPLY FANS

**A.** Roof-mounted, filtered air supply units are of the belt-driven, double width, double inlet (DWDI), forward curved centrifugal blower type. The unit’s blower assembly shall be mounted on vibration isolators. Motor drives shall be machine cast iron and variable pitch and shall be factory set to the specified RPM. Belts shall be non-static and oil resistant. Both motor and blower bearings shall be permanently lubricated with sealed ball bearings. The blower housing shall be fabricated of heavy gauge painted steel.

**B.** Fan shall be listed by Underwriters Laboratories (UL 705) and shall bear the AMCA certified rating seal for sound and air performance.
C. Units housing shall be minimum 18-gauge extruded aluminum with a removable aluminum cover. The insulated cover shall be held in place with bolts for easy access to fan components.

D. Filters shall be permanent, one inch, washable, aluminum type and shall be easily removed for cleaning. Units carry the AMCA Certified Ratings Seal for air performance with filters in place.

E. Accessories: The following items are required.

1. Disconnect Switch: Non-fusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.

2. Bird Screens: Removable ½ inch mesh, 16-gauge, aluminum or brass wire.


4. Roof Curb: Prefabricated, 12-inch-high, heavy gauge, galvanized steel; mitered and welded corners; 2-inch-thick, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2-inch wood nailer. Size as required to suit roof opening and fan base.

2.6 UTILITY FANS

A. Fans shall be of the direct driven or belt driven utility fan type as indicated with a single width, single inlet housing in AMCA arrangement 10.

B. The housing shall be constructed of minimum 14-gauge steel with continuously welded or lock formed seams permitting no air leakage. The housing shall be field rotatable to any of the eight standard discharge positions. Housing and bearing supports shall be constructed of minimum 10-gauge welded steel members to prevent vibration and rigidly support the shaft and bearings. Side access inspection port shall be provided for access to the motor compartments.

C. The fan wheel shall be of the forward curved type C, non-overloading backward inclined, centrifugal fan type and constructed of heavy gauge steel.

Wheels shall be statically and dynamically balanced. The wheel cone and fan inlet cone shall be carefully matched for maximum performance and operating efficiency.

D. Motors shall be permanently lubricated, heavy duty, ball bearing type carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. The fan shaft shall be ground and polished solid steel mounted in heavy duty, permanently sealed, pillow block ball bearings. Bearings shall be selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. The motor pulley shall be adjustable for final system balancing.

E. Fan performance shall be based on tests conducted in accordance with AMCA Standard 210 test code for air moving devices. Fans shall be licensed to bear the AMCA Certified Ratings Seal for air performance.
2.7 PROPELLER WALL AXIAL VENTILATORS

A. Unless noted otherwise, all materials shall be of noncorrosive aluminum or stainless steel.

B. Ventilator and assembly shall consist of propeller wall axial ventilator section, motorized damper section and accessories as scheduled.

C. Motorized Damper Section:
   1. Blades and frame shall be of aluminum construction with Air Dry Phenolic (Heresite VR-500) coating.
   2. Blade edge seals shall be Ruskiprene type or equivalent, mechanically locked in extruded blade slots.
   3. Linkage shall be stainless steel, mounted in frame.
   4. Axles shall be square or hexagonal, stainless steel construction.
   5. Bearings shall be non-corrosive molded synthetic.
   6. Shaft shall be stainless steel.
   7. Damper actuator shall be mounted inside NEMA 4 type enclosure, factory wired through an internal aluminum conduit.

D. Gravity Damper Section:
   1. Blades and frame shall be of aluminum construction with Air Dry Phenolic (Heresite VR-500) coating.

E. Propeller Wall Axial Ventilator Section:
   1. Fan motor shall be in TEFC type enclosure.
   2. All steel fan components shall be coated with Air Dry Phenolic (Heresite VR-500) coating.

F. Wall collar shall be of aluminum construction.

G. Accessories: The following items are required:
   1. Disconnect Switch: Non-fusible type, with thermal overload protection mounted inside NEMA 4 enclosure, factory-wired through an internal aluminum conduit.
   2. Bird Screens: Removable ½ inch mesh, 16-gauge, aluminum or brass wire.

PART 3 – EXECUTION
3.1 Install in accordance with manufacturer’s instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer’s requirements.

END OF SECTION 23 34 00
SECTION 23 34 39 – HIGH-VOLUME, LOW-SPEED PROPELLER FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Powerfoil X3.0, Essence and Basic 6 Fans - The ceiling-mounted, circulation fan is the model scheduled with the capacities indicated. The fan shall be furnished with standard mounting hardware and variable speed control to provide cooling and destratification.

B. Summary of Work

1. Installation of the fan, miscellaneous or structural metal work (if required), field electrical wiring, cable, conduit, fuses and disconnect switches, other than those addressed in the installation scope of work, shall be provided by others.

1.2 RELATED SECTIONS

A. Section 21 00 00 – Fire Suppression
B. Section 23 02 00 – Basic Materials and Methods
C. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
D. Section 23 05 53 - Identification for HVAC Piping and Equipment
E. Section 26 02 00 – Electrical Basic Materials and Methods
F. Section 28 31 00 – Fire Alarm and Smoke Detection System

1.3 REFERENCES

A. National Fire Protection Agency (NFPA)
B. Underwriters Laboratory (UL)
C. Restriction of Hazardous Substances (ROHS)
D. International Organization for Standardization (ISO)
E. National Electrical Manufacturers Association (NEMA)
F. National Electrical Code (NEC)
G. International Organization for Standardization (ISO)

1.4 SUBMITTALS

A. Shop Drawings: Drawings detailing product dimensions, weight, and attachment methods.
B. Product Data: Specification sheets on the ceiling-mounted fan, specifying electrical and installation requirements, features and benefits, and controller information.

C. Revit Files: File provided for Contractor’s coordination drawings.

D. Installation Guide: The manufacturer shall furnish a copy of all operating and maintenance instructions for the fan. All data is subject to change without notice.

E. Schedule

1.5 QUALITY ASSURANCE

A. Certifications

1. The fan assembly, as a system, shall be Intertek/ETL-certified and built pursuant to the guidelines set forth by UL standard 507 and CSA standard 22.2 No. 113.


3. Controllers shall comply with National Electrical Code (NEC) and Underwriters Laboratory (UL) standards and shall be labeled where required by code.

B. Manufacturer Qualifications

1. The fan and any accessories shall be supplied by a company that has a minimum of ten (10) years of product experience.

2. ISO 9001-certified

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver product in original, undamaged packaging with identification labels intact. The fan shall be new, free from defects, and factory tested.

B. The fan and its components must be stored in a safe, dry location until installation.

1.7 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.

2. Principle of how the equipment works.

3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.

5. Most likely failure modes, causes and corrections.

6. On site demonstration.

1.8 WARRANTY

A. The manufacturer shall replace any products or components defective in material or workmanship for the customer free of charge including transportation charges in accordance to the following schedule:

1. HVLS fans scheduled as Powerfoil X3.0 Fans:
   a. Mechanical 15 years
   b. Electrical 7 years
   c. Labor 1 year

2. HVLS fans scheduled as Essence Fans:
   a. Mechanical 10 years
   b. Electrical 5 years
   c. Labor 1 year

3. HVLS fans scheduled as Basic 6 Fans:
   a. Mechanical 7 years
   b. Electrical 3 years
   c. Labor 1 year

PART 2 - PRODUCT

2.1 ACCEPTABLE MANUFACTURERS

A. Big Ass Fans

B. Entrematic

C. Macroair

2.2 HIGH VOLUME, LOW SPEED FANS – BIG ASS FANS POWERFOIL X3.0

A. Complete Unit

1. Regulatory Requirements:
   a. The entire fan assembly (with or without light kit) shall be Intertek/ETL-certified and built pursuant to the construction guidelines set forth by UL standard 507 and CSA standard 22.2 No. 113.
   b. [The BAFCon controller shall be compliant with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) The device may not cause harmful interference, and (2) The device must accept any interference received, including interference that may cause undesirable operation.]

2. Sustainability Characteristics:
a. The fan shall be designed to move an effective amount of air for cooling and
destratification in a variety of applications (including industrial and
agricultural) over an extended life. The fan components shall be designed
specifically for high volume, low speed fans to ensure lower operational
noise. Sound levels from the fan operating at maximum speed measured in a
laboratory setting shall not exceed 55 dBA. Actual results of sound
measurements in the field may vary due to sound reflective surfaces and
environmental conditions.

b. [The BAFCon controller shall be designed to control Big Ass Fans and
lighting systems from a secure, centralized location. The system shall be
designed specifically for high volume, low speed Big Ass Fans to ensure
maximum control. The system shall include optional SmartSense
functionality to maximize energy savings. SmartSense shall provide the
capability to automatically control the speed of Big Ass Fans using
information from user-determined settings and built-in temperature and
humidity sensors.]

3. Good workmanship shall be evident in all aspects of construction. Field balancing of
the airfoils shall not be necessary.

B. Onboard Fan Control

1. The onboard fan controller shall be constructed using a variable frequency drive
(VFD) that is pre-wired to the motor and factory-programmed to minimize the starting
and braking torques for smooth and efficient operation. The onboard controller shall
be prewired to the motor using a short run of flexible conduit with a dedicated ground
conductor to minimize electromagnetic interference (EMI) and radio frequency
interference (RFI). A 15-ft incoming power cord shall be pre-wired to the controller
with one of the following plugs: NEMA L6-20P Twist-Lock Plug, NEMA L6-30P
Twist-Lock Plug, NEMA L15-20P Twist Lock Plug, NEMA L16-20P Twist-Lock
Plug.

2. [As an option, the architect or owner may upgrade to the “harsh environment
package,” which includes a seal for the weather-resistant onboard VFD enclosure and
a motor with IP55 NEMA classification.]

3. For fans with single-phase input, conversion to three-phase output takes place at the
VFD.

C. Airfoil System

1. The fan shall be equipped with eight (8) Powerfoil airfoils of precision extruded
aluminum alloy. The airfoils shall be connected by means of two (2) high strength
locking bolts per airfoil. The airfoils shall be connected to the hub and interlocked
with zinc plated steel retainers.

2. The fan shall be equipped with eight (8) Powerfoil winglets (standard) [or eight (8)
Powerfoil Plus winglets (optional)] on the ends of the airfoils and eight (8)
AirFences® positioned on the airfoils at the optimum location for performance. Both
the winglets and AirFences shall be molded of a polypropylene blend. The standard
color of the winglet and AirFence shall be “Safety Yellow.” Color shall be as
scheduled and shall be coordinated with the architect and owner prior to ordering.
3. **Airfoil Restraint System**
   a. All 20- to 24-ft (6- to 7.3-m) diameter fans shall be equipped with a patented airfoil restraint system to provide redundant safety between the ends of the airfoils and the fan hub. The airfoil restraint system shall be available as an option on smaller diameter fans.
   b. The airfoil restraint system shall be comprised of durable, lightweight nylon safety straps that shall extend from winglets through the airfoils and secure to the fan hub with 12-gauge stamped steel safety clips.
   c. The straps shall be made of 1 in. (24 mm) wide heavy-duty nylon webbing rated for 825 lb (374 kg). The loops at the ends of the straps shall be secured in a double-stitch pattern for reinforced durability.
   d. The straps shall be precisely matched to each fan’s diameter, eliminating the need for a tensioning mechanism and reducing opportunity for noise.
   e. The straps shall run along the inside of the airfoils for an uninterrupted look.
   f. Safety clips are preattached to each winglet at the factory to comprise the outer anchor points and provide tension, while clips on the opposite end secure to threaded inserts incorporated in the fan hub.

D. **Motor**

1. The fan motor shall be an AC induction type inverter rated at one of the following:
   a. 1725 RPM, 200–240/400–480 VAC, 50/60 Hz, three-phase

2. The motor shall be totally enclosed, fan cooled (TEFC) with an IP44 NEMA classification. A NEMA 56C standard frame shall be provided for ease of service. The motor shall be manufactured with a double baked Class F insulation and be capable of continuous operation in 32°F to 122°F (0°C to 50°C) ambient conditions.

3. The motor shall have a C-face attachment that shall enable technicians to detach the motor for easy field service. The C-face motor adapter shall be designed to work with the NitroSeal™ gearbox.

4. [As an option, the architect or owner may upgrade to the “harsh environment package,” which includes a motor with an IP55 NEMA classification. As part of the “harsh environment package,” the onboard VFD enclosure is sealed for weather-resistant operation.]

E. **Gearbox**

1. The fan gearbox shall be a NitroSeal™ Drive designed specifically for the Powerfoil X series. The gearbox shall include a high-efficiency, hermetically sealed, nitrogen-filled, offset helical gear reducer with two-stage gearing, a hollow output shaft, cast iron housing, double lip seals, high quality SKF Explorer Series bearings with crowned cages for optimal lubrication flow, and precision machined gearing to maintain backlash less than 11 arc-minutes over the life of the unit. Lubrication shall be high-grade, low-foaming synthetic oil with extreme pressure additives and a wide temperature range, and shall be lubricated for the life of the product (no oil changes required).

2. The gearbox shall be equipped with a hollow shaft threaded to accept a ¾” NPT fitting in which wiring, piping, etc., can be routed to below the fan. A standard junction box
can be affixed to this hollow shaft to allow for installing optional features such as lights or cameras. The inclusion of the hollow shaft shall be specified at the time of order.

F. Mounting Post

1. The fan shall be equipped with a mounting post that provides a structural connection between the fan assembly and extension tube. The mounting post shall be formed from A36 steel, contain no critical welds, and be powder coated for corrosion resistance and appearance.

G. Mounting System

1. The fan mounting system shall be designed for quick and secure installation on a variety of structural supports. The design of the upper mount shall provide two axes of rotation. This design shall allow for adjustments to be made after the mount is installed to the mounting structure to ensure the fan will hang level from the structure.

2. The upper mount shall be of ASTM A-36 steel, welded construction, at least 3/16” thick, and powder coated for appearance and corrosion resistance. No mounting hardware or parts substitutions, including cast aluminum, are acceptable.

3. All mounting bolts shall be SAE Grade 8 or equivalent.

H. Hub

1. The fan hub shall be 19” (48 cm) in diameter and shall be made of precision cut aluminum for high strength and light weight. The hub shall consist of two (2) aluminum plates, eight (8) aluminum spars, and one (1) aluminum spacer fastened with a pin and collar rivet system. The overall design shall provide a flexible assembly such that force loads experienced by the hub assembly shall be distributed over a large area to reduce the fatigue experienced at the attachment point for the fan blade.

2. The hub shall be secured to the output shaft of the gearbox by means of (10) high strength bolts. The hub shall incorporate five (5) safety retaining clips made of 1/4” (0.6 cm) thick steel that shall restrain the hub/airfoil assembly.

I. Safety Cables

1. The fan shall be equipped with an upper safety cable that provides an additional means of securing the fan assembly to the building structure. The upper safety cable shall have a diameter of Ø3/8” (1 cm).

2. The fan shall be equipped with two lower safety cables pre-attached to the fan hub that shall provide an additional means of securing the fan to the extension tube. The lower safety cables shall have a diameter of 1/4” (0.6 cm).

3. The safety cables shall be fabricated out of 7 x 19 galvanized steel cable. The end loops shall be secured with swaged Nicopress® sleeves, pre-loaded and tested to 3,200 lbf (13,345 N).
4. Field construction of safety cables is not permitted.

J. Digital Variable Speed Wall Controller

1. The fan shall be equipped with a digital variable speed wall controller. The controller user interface shall be a wall-mounted, touch interface.

2. The controller shall be mounted to a standard rectangular or square outlet box.

3. A 150-ft (45.7-m) CAT5 cable shall be provided for connecting the controller to the fan’s VFD and to provide power to the controller.

4. The controller mounting location shall meet the requirements of OSHA standard 29 CFR 1910.303(g) for accessibility minimum clearances.

5. The controller shall have an IP65 rating.

6. The controller shall provide fan start/stop, speed, and direction control functions.

7. The controller shall provide diagnostic and fault history information for the connected fan, as well as the ability to configure fan parameters with the assistance of Big Ass Fans Customer Service.

8. The controller interface shall be able to be secured with a passcode to prevent unauthorized access to fan controls and settings.

9. The controller shall operate out of the box without setup and upon connection to CAT5 cable.

K. [BAFCon Controller (Optional)]

1. The fan shall have the option of operating with the BAFCon controller.

2. The digital controller user interface shall be a wall-mounted touchscreen with a 5-inch (127-mm) display and an 800 (RGB) x 480 pixel resolution.

3. The digital controller shall be mounted to a standard rectangular or square outlet box.

4. A 150-ft (45.7-m) CAT5 cable shall be provided for connecting the digital controller to the fan’s VFD, allowing for seamless communication between BAFCon and the VFD. The cable shall provide power to the digital controller.

5. The digital controller shall not require a 120 V power supply at the controller mounting location.

6. The digital controller mounting location shall meet the requirements of OSHA standard 29 CFR 1910.303(g) for accessibility minimum clearances.

7. The digital controller shall support up to eight Powerfoil D fans controlled as a group or individually.

8. The digital controller shall provide fan start/stop, speed, and direction control functions.
9. The digital controller shall provide diagnostic and fault history information for each connected fan as well as the ability to configure fan parameters with the assistance of Big Ass Fans Customer Service.

10. The digital controller shall include optional SmartSense functionality to maximize energy savings. SmartSense shall provide the capability to automatically control the speed of Big Ass Fans using information from user-determined settings and built-in temperature and humidity sensors.

11. The digital controller interface shall be able to be secured with user and admin passcodes to prevent unauthorized access to fan controls and settings.

12. The digital controller shall include Bluetooth® functionality for receiving firmware updates from a mobile app. The app shall be supported by iOS® and Android™ mobile devices. The digital controller’s Bluetooth functionality can be disabled if not needed or permitted.

13. [BAFCon Multi-Fan Accessory Kit (Optional)
   a. If multiple fans will be installed, the BAFCon Multi-Fan Accessory Kit shall be available.
   b. The kit shall include a two-screw RJ45 terminal block, a ¼ Watt, 120 Ohm termination resistor, RJ45 pass through splitters, and split-gland cord grips for connecting multiple fans to the controller.
   c. The accessory kit shall include a two-screw RJ45 terminal block, a ¼ Watt, 120 Ohm termination resistor, RJ45 pass through splitters, and split-gland cord grips for daisy chaining multiple fans to the controller.]

L. Fire Control Panel Integration

1. Includes a 10–30 VDC pilot relay for seamless fire control panel integration. The pilot relay can be wired Normally Open or Normally Closed in the field.

M. Guy Wires

1. Included for installations with extension tubes 4 ft (1.2 m) or longer to limit the potential for lateral movement.

2.3 HIGH VOLUME, LOW SPEED FANS – BIG ASS FANS BASIC 6

A. Complete Unit

1. Regulatory Requirements: The entire fan assembly shall be Intertek/ETL-certified and built pursuant to the construction guidelines set forth by UL standard 507 and CSA standard 22.2 No. 113.

2. Sustainability Characteristics: The fan shall be designed to move an effective amount of air for cooling and destratification in industrial applications over an extended life. The fan components shall be designed specifically for high volume, low speed fans to ensure lower operational noise. Sound levels from the fan operating at maximum speed measured in a laboratory setting shall not exceed 55 dBA. Actual results of sound measurements in the field may vary due to sound reflective surfaces and
environmental conditions.

3. Good workmanship shall be evident in all aspects of construction. Field balancing of the airfoils shall not be necessary.

B. Airfoil System

1. The fan shall be equipped with six (6) Powerfoil airfoils of precision extruded aluminum alloy. The airfoils shall be connected by means of two (2) high strength locking bolts per airfoil. The airfoils shall be connected to the hub and interlocked with zinc plated steel retainers.

2. The fan shall be equipped with six (6) Powerfoil winglets on the ends of the airfoils. The winglets shall be molded of a polypropylene blend. The standard color of the winglet shall be “Safety Yellow.” Color shall be as scheduled and shall be coordinated with the architect and owner prior to ordering.

C. Motor

1. The fan motor shall be an AC induction type inverter rated at 1725 RPM, 200–240/400–480 VAC, 50/60 Hz, three-phase.

2. The motor shall be totally enclosed, fan cooled (TEFC) with an IP56. A B5 standard frame shall be provided for ease of service. The motor shall be manufactured with a double baked Class F insulation and be capable of continuous operation in 50  F to 1040  F (-150  C to 400  C) ambient conditions.

D. Gearbox

1. The gearbox shall be a helical gear reducer, precision finished from hardened steel for low noise and long service life with double lip seals to retain oil and prevent contamination. The gearbox shall be lubricated for life. The gear reducer shall have a standard backlash of less than 25 arc minutes and be equipped with a 17-4 stainless steel shaft of 1-1/4” (3.2 cm) diameter.

E. Motor Frame

1. The motor frame and mount shall be constructed of steel and powder coated for corrosion resistance and appearance.

F. Mounting System

1. The fan mounting system shall be designed for quick and secure installation on a variety of structural supports. The design of the upper mount shall provide two axes of rotation. This design shall allow for adjustments to be made after the mount is installed to the mounting structure to ensure the fan will hang level from the structure.

2. The upper mount shall be of ASTM A-36 steel, welded construction, at least 3/16” thick, and powder coated for appearance and corrosion resistance. No mounting hardware or parts substitutions, including cast aluminum, are acceptable.
3. All mounting bolts shall be SAE Grade 8 or equivalent.

G. Hub

1. The fan hub shall be 19” (48 cm) in diameter and shall be made of precision cut aluminum for high strength and light weight. The hub shall consist of two (2) aluminum plates, six (6) aluminum spars, and one (1) aluminum spacer fastened with a pin and collar rivet system. The overall design shall provide a flexible assembly such that force loads experienced by the hub assembly shall be distributed over a large area to reduce the fatigue experienced at the attachment point for the fan blade.

2. The hub shall be secured to the output shaft of the gearbox by means of a steel coupling interface. The hub shall incorporate three (3) safety retaining clips made of 1/4” (0.6 cm) thick steel that shall restrain the hub/airfoil assembly.

H. Safety Cables

1. The fan shall be equipped with an upper safety cable that provides an additional means of securing the fan assembly to the building structure. The upper safety cable shall have a diameter of Ø3/8” (1 cm).

2. The fan shall be equipped with two lower safety cables pre-attached to the fan hub that shall provide an additional means of securing the fan to the extension tube. The lower safety cables shall have a diameter of 1/4” (0.6 cm).

3. The safety cables shall be fabricated out of 7 x 19 galvanized steel cable. The end loops shall be secured with swaged Nicopress® sleeves, pre-loaded and tested to 3,200 lbf (13,345 N).

4. Field construction of safety cables is not permitted.

I. Variable Frequency Drive

1. The Variable Frequency Drive (VFD) shall be a NEMA 4X VFD that is factory programmed to minimize starting and braking torques. The VFD shall have touchpad controls and an LED display for controlling the fan’s direction, operation, speed, and programming. The VFD may be equipped with an EMI/RFI filter to limit interference with other electronic equipment and a rotary switch disconnect for lock-out/tag-out requirements.

2. Onboard Variable Frequency Drive: The VFD may be mounted on the fan motor frame. A wall-mounted remote keypad equipped with touchpad controls and an LED display shall be provided for such installations, allowing access to all VFD functions.

3. Wall-Mounted Variable Frequency Drive: The VFD may be wall-mounted for ease of access.

J. Fire Control Panel Integration

1. Includes a 10–30 VDC pilot relay for seamless fire control panel integration. The pilot relay can be wired Normally Open or Normally Closed in the field.
K. Guy Wires

1. Included for installations with extension tubes 4 ft (1.2 m) or longer to limit the potential for lateral movement.

2.4 HIGH VOLUME, LOW SPEED FANS – FANS SCHEDULED AS BIG ASS FANS ESSENCE

A. Complete Unit

1. Regulatory Requirements: The entire fan assembly shall be Intertek/ETL-certified and built pursuant to the construction guidelines set forth by UL standard 507 and CSA standard 22.2, No. 113.

2. Sustainability Characteristics: The fan shall be designed to move an effective amount of air for cooling and destratification of conditioned commercial applications over an extended life. The fan components shall be designed specifically for high volume, low speed fans to ensure lower operational noise. Sound levels from the fan operating at maximum speed measured in a laboratory setting shall not exceed 40 dBA. Actual results of sound measurements in the field may vary due to sound reflective surfaces and environmental conditions.

3. Good workmanship shall be evident in all aspects of construction. Field balancing of the airfoils shall not be necessary.

B. Controls

1. The fan controller shall be incorporated into the fan assembly and housed in an enclosure independent of the motor to prevent overheating or electrical interference. The fan controller shall be factory programmed to minimize starting and braking torques and shall be equipped with a simple diagnostic program and an LED light to identify and relay faults in the system.

C. Airfoil System

1. The fan shall be equipped with eight (8) high volume, low speed airfoils of precision extruded, anodized aluminum alloy. Each airfoil shall be of the high-performance Mini-Elipto design. The airfoils shall be connected to the hub and interlocked with eight (8) stainless steel retainers and two (2) sets of stainless steel bolts and lock washers per airfoil.

2. The fan shall be equipped with eight (8) upswept winglets designed to redirect outward airflow downward, thereby enhancing efficiency. The winglets shall be molded of high strength polymer and shall be attached at the tip of each airfoil with a stainless steel screw. The standard color of the winglets shall be silver or black. Color shall be as scheduled and shall be coordinated with the architect and owner prior to ordering.

3. [As an option, the fan shall be equipped with eight (8) plug-style airfoil tips, molded of high strength polymer, in place of the eight (8) upswept winglets. The airfoil tips shall be attached at the tip of each airfoil with a stainless steel screw. The standard color of the airfoil tips shall be black. Color shall be as scheduled and shall be...]

HIGH-VOLUME, LOW-SPEED PROPELLER FANS

23 34 39 - 11
coordinated with the architect and owner prior to ordering.]

D. Motor

1. The motor shall be a permanent magnet brushless motor rated for continuous operation at maximum speed with the capability of modulating the fan speed from 0–100% without the use of a gearbox or other mechanical means of control.

2. The motor shall operate from any voltage ranging from 100–120 VAC or 200–240 VAC, single phase, and 50/60Hz, without requiring adapters or customer selection. The motor shall be a non-ventilated, heat sink design with the capability of continuous operation in -4°F to 131°F (-20°C to 55°C) ambient condition.

3. The motor shall be rated IP43.

4. The standard color of the motor unit shall be white with silver trim or silver with black trim.

E. Mounting System

1. The fan mounting system shall be designed for quick and secure installation from a variety of structural supports. All components in the mounting system shall be of formed metal design using low-carbon steel no less than 3/16” (0.5 cm) thick and containing no critical welds. The mounting system shall be powder coated for appearance and resistance to corrosion. All mounting bolts shall be metric stainless steel or equivalent. No mounting hardware substitutions, including cast aluminum, are acceptable.

2. The fan extension tube shall be a round, extruded aluminum tube. The extension tube shall include a chrome plate with forward and reverse controls and a fan status indicator light that is visible from the floor.

F. Hub

1. The fan hub shall be constructed of zinc plated steel for high strength and durability. The hub shall be precision machined to achieve a well-balanced and solid rotating assembly.

G. Safety Cable

1. The fan shall be equipped with a safety cable that provides an additional means of securing the fan assembly to the building structure. The safety cable shall be Ø3/16” (0.5 cm) diameter and fabricated out of 7 x 19 stranded galvanized steel, pre-loaded and tested to 3,200 lbf (13,345 N).

2. Field construction of safety cables is not permitted.

H. Wall Control

1. Wired (standard). The fan shall be equipped with a low-voltage wired remote wall control providing control of all fan functions. The wall control shall be capable of mounting to a standard electrical box or directly to a wall surface. The wall control
shall include a rotary-style dial for controlling the fan’s power and speed and an LED light to identify and relay faults in the system. Communication with the fan drive and controller shall be by a standard, commercially available CAT5 (or higher) Ethernet cable that is field installed and provided by the installer.

2. [Wireless (optional). As an option, the fan shall be equipped with an optional radio frequency (RF) remote wall control in place of the wired wall control. The wall control shall provide control of all fan functions. The wall control shall be capable of mounting to a standard electrical box with an owner-supplied wall plate and shall include a capacitive touch display for controlling the fan’s power and speed. Communication with the fan drive and controller shall be wireless.]

I. Fire Control Panel Integration
   1. Includes a 10–30 VDC pilot relay for seamless fire control panel integration. The pilot relay can be wired Normally Open or Normally Closed in the field.

J. Guy Wires
   1. Guy wires shall be included for installations with extension tubes 4 ft (1.2 m) or longer to limit the potential for lateral movement.

PART 3 - EXECUTION

3.1 PREPARATION
   A. Fan location must have a typical bar joist or existing I-beam structure from which to mount the fan. Additional mounting options may be available.
   B. Mounting structure must be able to support weight and operational torque of fan. Consult structural engineer if necessary.
   C. Fan location must be free from obstacles such as lights, cables, or other building components.
   D. Check fan location for proper electrical requirements. Consult installation guide for appropriate circuit requirements.
   E. Each fan requires dedicated branch circuit protection.
   F. [Before the BAFCon controller is installed, the fan system shall be installed by a factory-certified installer according to the instructions in the fan Installation Guide.
   G. Install a rectangular or square outlet box at the BAFCon controller mounting location.
   H. If the BAFCon controller will be mounted more than 250 ft (76.2 m) from the fan or if multiple fans will be daisy chained, ensure the optional BAFCon Accessory Kit is included. The accessory kit shall be installed by a factory-certified installer according to the instructions included with the kit.]

3.2 INSTALLATION
A. The fan [and BAFCon controller] shall be installed by a factory-certified installer according to the manufacturer’s Installation Guide, which includes acceptable structural dimensions and proper sizing and placement of angle iron for bar joist applications. Contractor shall consult a structural engineer for installation methods outside the manufacturer’s recommendation and a certification, in the form of a stamped print or letter, submitted prior to installation.

B. Minimum Distances

1. Airfoils must be installed at a minimum distance above the floor as recommended by the fan manufacturer.

2. Installation area must be free of obstructions such as lights, cables, sprinklers or other building structures with the airfoils at least 2 ft (0.61 m) clear of all obstructions.

3. The structure the fan is attached to shall be capable of supporting the operational torque load indicated by the fan manufacturer.

C. The fan shall not be located where it will be continuously subjected to wind gusts or in close proximity to the outputs of HVAC systems or radiant heaters.

D. In buildings equipped with sprinklers, including ESFR sprinklers, fan installation shall comply with all of the following:

1. The maximum fan diameter shall be 24 ft (7.3 m).

2. The HVLS fan shall be centered approximately between four adjacent sprinklers.

3. The vertical clearance from the HVLS fan to the sprinkler deflector shall be a minimum of 3 ft (0.9 m).

4. All HVLS fans shall be interlocked to shut down immediately upon receiving a waterflow signal from the alarm system in accordance with the requirements of NFPA 72 - National Fire Alarm and Signaling Code.

E. Mount the BAFCon controller to a flat, readily accessible surface that is free from vibration and away from foreign objects and moving equipment. The controller mounting location must meet the requirements of OSHA standard 29 CFR 1910.303(g) for accessibility minimum clearances.

F. If the SmartSense feature will be used, the BAFCon controller must not be mounted adjacent to or above a radiant heat source, near HVAC ventilation intakes/exhausts, on a poorly insulated exterior wall, or in a different temperature/humidity environment than the fans it will control. Additional mounting guidelines can be found in the Installation Guide.

END OF SECTION 23 34 39
SECTION 23 36 13 - SERIES FAN-POWERED TERMINAL UNIT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Series type fan-powered terminal unit.

1.2 RELATED SECTIONS

A. Section 23 02 00 - Basic Materials and Methods
B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment
C. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping And Equipment
D. Section 23 05 93 - Testing, Adjusting and Balancing
E. Section 23 80 00 - Commissioning of HVAC Systems
F. Section 23 09 63 - Energy Management and Control System
G. Section 23 31 13 - Metal Ductwork
H. Section 23 31 19 - Ductwork Accessories
I. Section 23 34 00 - HVAC Fans
J. Section 23 73 13 - Modular Indoor Central Station Air Handling Units

1.3 QUALITY ASSURANCE

A. Terminal Units shall be certified under the AHRI Standard 880-98 and carry the AHRI Seal.
B. The terminal units shall be designed, built and tested as a single unit including fan motor and fan assembly, primary air damper assembly, water or electric heating coils and accessories.
C. The entire terminal unit and all electrical components shall be UL listed and installed in accordance with the National Electric Code.

1.4 GENERAL DESCRIPTIONS

A. Furnish, and install fan powered terminal units of the sizes and capacities shown on the plans.
B. Terminal Unit shall ship as a complete assembly requiring no field assembly (including accessories). Terminal unit manufacture shall factory mount EMCS controls, provided by Section 23 09 63 (EMCS contractor).

1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division 01.
B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.

C. Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, and gauges and finished of materials.

D. Submit product data or filter media and filter performance data.

E. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory installed and field installed wiring.

F. Submit manufacturer’s installation instructions under provisions of Division 01.

G. Submit operation and maintenance data under provisions of Section 23 02 00.

H. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

I. Terminal units shall include a QR code tag to link directly to the specific IOM for the terminal unit to be accessed by mobile device.

1.6 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled in accordance with the unit manufacturer’s instructions.

1.7 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.

1.8 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On-site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
2.2 TERMINAL CASING

A. The terminal casing shall be minimum 20-gauge galvanized steel, internally lined with 1" natural fiber or fiberglass free insulation which complies with UL 181 with regard to resistance to erosion and mold growth and NFPA 90A. Insulation shall have R-values of 4.0. Exposed fiberglass is not acceptable. The insulation shall be mechanically fastened to the unit casing. The fasteners shall be weld pins. Lining material glued in place without mechanical fasteners are not acceptable. Any exposed insulation edges shall be coated with NFPA 90A approved sealant or covered with galvanized brackets or foil tape. The terminal shall have round duct collars for the primary air connections and a rectangular discharge suitable for flanged duct connection. The casing shall be provided with mounting brackets for hanging from structure.

B. The terminal casing shall have a bottom or side access panel, which allows removal of fan and servicing of terminal without disturbing duct connections.

C. The terminal casing shall have a filter rack/bracket for securing the air filter over the return air inlet. This filter rack shall be sized so that standard sized filters can be installed by the owner as part of ongoing maintenance.

2.3 FAN AND FAN MOTOR

A. The fan shall be constructed of steel and have a forward curved dynamically balanced wheel with direct drive motor.

B. The terminal unit shall utilize an ECM variable-speed DC brushless motors specifically designed for use with single phase, 277-volt, 60 hertz electrical input. Motor shall be complete and operated by a single-phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator. All motors shall be designed for synchronous rotation. Rotor shall be permanent magnet type with near zero rotor losses. Motor shall have built-in soft start and soft speed change ramps. Motor shall be able to be mounted with shaft in horizontal or vertical orientation. Motor shall be permanently lubricated with ball bearings. Motor shall be directly coupled to the blower. Motor shall maintain a minimum of 70 percent efficiency over its entire operating range. Provide a motor that is designed to overcome reverse rotation and not affect life expectancy.

C. The terminal unit manufacturer shall provide a factory-installed controller for manual fan cfm adjustment. The manual PWM controller shall be field adjustable with a standard screwdriver. The factory shall preset the fan cfm as shown on the schedule

2.4 CONTROL DAMPER
A. Cooling inlet shall have a damper assembly with factory set and calibrated pressure independent control. The damper shall be heavy gauge steel with shaft rotating in Delrin (Polyoxymethylene) self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent over-stroking and a synthetic seal to limit close-off leakage.

B. Damper and casing leakage shall be tested in accordance with ASHRAE Standard 130 and shall not exceed 2% of rated airflow based on a nominal inlet velocity of 2000 FPM at 2.0 IN WG of static pressure.

C. Terminals with interior actuator linkage connection must include gasketed access panel, removable without disturbing ductwork.

2.5 ELECTRIC HEATING COILS

A. Modulating electric coils shall be supplied and installed on the terminal unit by the manufacturer. Coils shall be ETL listed. Coils shall be housed in an attenuator section integral with the terminal with element grid recessed from unit discharge a minimum of 5 inches to prevent damage to elements during shipping and installation. Elements shall be 80/20 nickel chrome, supported by ceramic isolators a maximum of 3½ inches apart, staggered for maximum thermal transfer and element life, and balanced to ensure equal output per step. The integral control panel shall be housed in a NEMA 1 enclosure with a hinged access door for access to all controls and safety devices.

B. Electric coils shall contain a primary automatic reset thermal cutout, a secondary replaceable heat limiter per element, differential pressure airflow switch for proof of flow, and line terminal block. Coil shall include an integral door interlock type disconnect switch, which will not allow the access door to be opened while power is on. Non-interlocking type disconnects are not acceptable. All individual components shall be UL listed or recognized.

C. Heaters shall be equipped with modulating control (Lynergy Comfort Controller (LCC) or equal) to control heater coil firing. The control panel shall include an interface to control heater coil firing in proportion to the EMCS signal. The EMCS signal shall connect to low voltage universal signal interface circuitry supplied and installed by the terminal manufacturer. The universal interface shall be selected for either 0-10 VDC or 0-20 mA interface options, without additional interface circuitry.

D. Discharge air temperature limit shall be provided through the modulating controller incorporating a downstream air temperature sensor. When invoked, the discharge air from the heater shall not exceed an adjustable maximum temperature setpoint.

2.6 FAN INTAKE FILTER

A. The filter shall be 1” thick, disposable construction type mounted in a rack on the fan air inlet and designed for ease of service.

B. Filter size shall be based on standard sizes that are readily available.

2.7 SOUND CRITERIA
A. Sound ratings for the terminals shall not exceed 40 NC in the occupied space at 1.0 inch w.g. inlet static pressure, and discharge static pressure of 0.25 inch w.g. NC estimations shall be calculated per ARI 885-98, Appendix E. The terminal shall be provided with factory installed internal and external attenuators if sound requirements are not met. The external attenuator shall be shipped internal to the unit to protect it from shipping damage. The external attenuator shall be slid into the operation position and secured without the need for additional screws. Factory provided attenuators that require field installation are not acceptable.

2.8 CONTROLS AND SENSORS

A. The terminal shall mount the pressure independent electronic controls that are provided by Section 23 09 63.

B. The terminal unit shall incorporate a multi-point, center-averaging velocity sensor. A minimum of four measuring ports must be parallel to the takeoff point from the sensor. Sensors with measuring ports in series are not acceptable. The sensor must provide a minimum differential pressure signal of 0.03 IN WG at an inlet velocity of 500 FPM. The sensor must provide airflow control signal accuracy of ± 5%, with a hard 45° or 90° elbow attached directly to the inlet.

C. The terminal unit manufacturer shall provide, mount and wire fan relay, 24-volt transformer, and disconnect switch.

D. Flow measuring taps and flow curves shall be supplied with each terminal for field balancing airflow. Each terminal shall be equipped with labeling showing unit location, size, minimum and maximum cfm setpoints, damper fail position, QR code label as per submittal section, and thermostat action.

E. All electronic accessories, including switches for activation of fan shall be supplied and calibrated by the terminal manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Terminal units shall be installed with all required service clearances, according to manufacturer’s installation instructions.

B. Terminal units with electric heat shall be installed with clearance that meets National Electrical Code requirements.

C. All equipment shall be installed in accordance with the manufacturer’s recommendations and printed installation instructions.

D. Space limitation shall be reviewed carefully to ensure that all terminals will fit the available space.

E. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturers requirements.

END OF SECTION 23 36 13
SECTION 23 36 16 - SINGLE DUCT VAV TERMINAL BOX

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Single duct variable volume terminal box.

1.2 RELATED SECTIONS

A. Section 23 02 00 – Basic Materials and Methods
B. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
C. Section 23 31 13 – Metal Ductwork
D. Section 23 33 00 – Ductwork Accessories
E. Section 23 80 00 – Commissioning of HVAC Systems
F. Section 23 09 63 – Energy Management and Controls System
G. Section 23 05 93 – Testing, Adjusting, and Balancing
H. Section 23 73 13 – Modular Indoor Central Station Air Handling Units

1.3 QUALITY ASSURANCE

A. Terminals shall be certified under the AHRI Standard 880-98 and carry the AHRI Seal.
B. The entire terminal and all electrical components shall be UL listed.

1.4 GENERAL DESCRIPTIONS

A. Furnish, and install single duct terminal unit with controls of the sizes and capacities shown on the plans.
B. Unit shall ship as a complete assembly requiring no field assembly (including accessories). Terminal unit manufacturer shall factory mount EMCS controls provided by section 23 09 63 (EMCS contractor)

1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.
B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.
C. Product data shall indicate dimensions, weights, capacities, ratings and gauges and finished of materials.
D. Submit electrical requirements for power supply wiring including wiring diagrams for control wiring, clearly indicating factory installed and field installed wiring.

E. Submit manufacturer’s installation instructions under provisions of Division One.

F. Submit operation and maintenance data under provisions of Section 23 02 00.

G. Include instructions for spare parts lists, and wiring diagrams.

H. Terminal units shall include a QR code tag to link directly to the specific IOM for the terminal unit to be accessed by mobile device.

1.6 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled in accordance with the unit manufacturer’s instructions.

1.7 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.

2. Principle of how the equipment works.

3. Important parts and assemblies.

4. How the equipment achieves its purpose and necessary operating conditions.

5. Most likely failure modes, causes and corrections.

6. On-site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. TITUS

B. METALAIRE

C. KRUEGER

D. NAILOR

E. PRICE

2.2 TERMINAL CASING
A. The terminal casing shall be minimum 22-gauge galvanized steel, internally lined with R-2.0 rated natural fiber or fiberglass free insulation which complies with UL 181 and NFPA 225. Any exposed insulation edges shall be coated with NFPA 90A approved sealant or foil. The terminal shall have round or oval duct collars for the primary air connections and a rectangular discharge suitable for flanged duct connection. The casing shall be provided with mounting brackets for hanging from structure.

2.3 CONTROL DAMPER

A. Terminal inlet shall have a damper assembly with factory set and calibrated pressure independent control. The damper shall be heavy gauge steel with shaft rotating in Delrin self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent over stroking and a synthetic seal to limit close-off leakage

B. Damper and casing leakage shall be tested in accordance with ASHRAE Standard 130 and shall not exceed 2% of rated airflow based on a nominal inlet velocity of 2000 FPM at 2.0 IN WG of static pressure.

2.4 SOUND CRITERIA

A. Sound ratings for the terminals shall not exceed scheduled NC in the occupied space at 1.0 inch w.g. inlet static pressure, and discharge static pressure of .25 inch w.g. NC estimations shall be calculated per ARI 885-98, appendix E.

2.5 CONTROLS AND SENSORS

A. The terminal unit manufacturer shall mount the pressure independent electronic controls provided by section 23 09 63.

B. The terminal shall incorporate a multi-point, center-averaging velocity sensor. A minimum of four measuring ports must be parallel to the takeoff point from the sensor. Sensors with measuring ports in series are not acceptable. The sensor must provide a minimum differential pressure signal of 0.03 IN WG at an inlet velocity of 500 FPM. The sensor must provide airflow control signal accuracy of ±5%, with a hard 45° or 90° elbow attached directly to the inlet.

C. Tubing from airflow cross sensor to the DDC controller shall be Tygon tubing or approved equal.

D. Flow measuring taps and flow curves shall be supplied with each terminal for field balancing airflow. Each terminal shall be equipped with labeling showing unit location, size, minimum and maximum cfm setpoints, damper fail position, QR code label as per submittal section, and thermostat action.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Terminal units shall be installed with all required service clearances, according to manufacturer’s installation instructions.

B. All equipment shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.

C. Space limitation shall be reviewed carefully to ensure that all terminals will fit the available space.

D. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturers requirements.

END OF SECTION 23 36 16
SECTION 23 37 13 - AIR DISTRIBUTION DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Ceiling air diffusers.
B. Wall registers and grilles.
C. Louvers.
D. Other air devices indicated on drawings and schedules.

1.2 RELATED SECTIONS

A. Section 23 02 00 – Basic Materials and Methods
B. Section 23 05 93 – Testing, Adjusting and Balancing
C. Section 23 31 13 – Metal Ductwork
D. Section 23 31 16 – Fibrous Glass Ductwork
E. Section 23 31 19 – Ductwork Accessories

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air distribution devices of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:
   1. ARI Compliance: Test and rate air distribution devices in accordance with ARI 650 "Standard for Air Outlets and Inlets".
   2. ASHRAE Compliance: Test and rate air distribution devices in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
   3. AMCA Compliance: Test and rate louveres in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
   4. AMCA Seal: Provide louveres bearing AMCA Certified Rating Seal.
   5. NFPA Compliance: Install air distribution devices in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".
1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air distribution devices including the following:

1. Schedule of air distribution devices indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.

2. Data sheet for each type of air distribution devices, and accessory furnished; indicating construction, finish, and mounting details.

3. Performance data for each type of air distribution devices furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air distribution devices, indicating materials and methods of assembly of components.

C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air distribution devices wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air distribution devices in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

1.6 WARRANTY

A. Warrant the installation of the Work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from defective or nonconforming workmanship.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Titus Company

B. Metalaire Industries, Inc.

C. Nailor Industries

D. Krueger
E. Price

F. Substitutions under provisions of Division One.

2.2 GENERAL DESCRIPTION

A. Unless otherwise indicated, provide manufacturer’s standard air devices when shown of size, shape, capacity, type and accessories indicated on drawings and schedules, constructed of materials and components as indicated and as required for complete installation and proper air distribution.

B. Provide air devices that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer’s current data.

C. Unless noted otherwise on drawings, the finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250-hour ASTM-870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

D. Provide air device with border styles that are compatible with adjacent ceiling or wall system, and that are specially manufactured to fit into the wall construction or ceiling module with accurate fit and adequate support. Refer to architectural construction drawings and specifications for types of wall construction and ceiling systems.

E. Provide integral volume damper with roll formed steel blades where indicated on drawings or schedules. Dampers shall be opposed blade design with a screw driver slot or a concealed lever operator for adjustment through the face of the air device.

F. Air devices designated for fire rated systems shall be pre-assembled with UL classified radiation damper and thermal blanket. Fire rated air devices shall be shipped completely assembled; one assembly per carton, Each assembly shall be enclosed in plastic shrink wrap with installation instructions.

2.3 LOUVERS

A. Except as otherwise indicated, provide manufacturer's standard louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Provide louvers that have minimum free area, and maximum pressure drop of each type as listed in manufacturer's current data, complying with louver schedule.

C. Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to architectural construction drawings and specifications for types of substrate.

D. Louvers shall be constructed of aluminum extrusions, ASTM B 221, Alloy 6063-T5. Weld
units or use stainless steel fasteners.

E. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

F. Acceptable Manufacturers:
   1. Ruskin Manufacturing Company
   2. Greenheck Company
   3. Louvers and Dampers, Inc.
   4. Pottorff
   5. Arrow
   6. Substitutions under provisions of Division One.

PART 3 – EXECUTION

3.1 All interior surfaces of all air devices shall be painted flat black.

3.2 See floor plans for type, neck size and CFM of air for all air distribution devices.

3.3 Install all air distribution devices as detailed on plans and in accordance with manufacturer’s recommendations.

END OF SECTION 23 37 13
SECTIO\n23 41 00 - AIR FILTERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 23 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

PART 2 - PRODUCTS

2.1 FILTERS

A. The filters shall be FARR 30/30 2 inch thick or approved equal.

B. APPROVED MANUFACTURERS: The following manufacturers are approved subject to specification compliance.

1. American Air Filter.

2. Airguard Industries, Inc.

3. Cambridge.

4. Filtration Group

2.2 LOW VELOCITY FILTER SECTION

A. Filters shall be of the throwaway cartridge type in 24 inches X 24 inches X 2 inch frames. When installing multiple filters into slide-in frames tape adjacent filters together with duct tape to prevent bypassing of air around the filter. Media shall be rated at 500 feet per minute.

B. Filtering media shall be formed of non-woven reinforced cotton fabric type filtering media bonded to 96% open area media support grid folded into a non-creased radial pleat design. The filter pack shall be bonded to the inclosing frame to prevent air bypass. Average efficiency shall be 25-30% on ASHRAE test standard 52-76. Initial resistance shall not exceed 0.20 inches water gauge at 350 FPM face velocity.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install differential pressure switch to activate "Filter Dirty" light when pressure difference across filters reaches 0.5-inch W.G. (adjustable). Locate "filter dirty" lights in mechanical rooms with identifying label.

B. Install and relocate filters in the mechanical or the storage room in accordance with manufacturer's recommendations.

C. Refer to Section 23 02 00 for additional filter information.

END OF SECTION 23 41 00
SECTION 23 62 13 - AIR COOLED CONDENSING UNITS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 – Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for Owner's use.

1.3 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.

2. Principle of how the equipment works.

3. Important parts and assemblies.

4. How the equipment achieves its purpose and necessary operating conditions.

5. Most likely failure modes, causes and corrections.

6. On site demonstration.

PART 2 - PRODUCTS

2.1 AIR-COOLED CONDENSING UNITS

A. Air-cooled condensing unit shall be designed for use with split system having a remote direct-expansion (DX) cooling coil mounted in evaporator fan unit. Capacity shall be as called for on the Drawings when matched to the appropriate evaporator coil.

B. Condensing unit shall consist of high-efficiency hermetic compressor, air-cooled condenser with quiet fan, factory wired controls, R410A or R407C refrigerant and refrigeration circuit and valves.

C. Cabinet shall be heavy-gauge galvanized steel with bonding primer and baked-enamel finish coat. The entire cabinet shall be protected from rust.
D. Compressor shall be protected from excessive current and temperatures and shall be provided with a thermostatically controlled crankcase heater to operate only when needed for protection of the compressor. Compressor shall be spring-mounted on rubber isolators. Compressor shall be located in compartment isolated from condenser fan and coil. Provide a high-capacity dryer in the system to remove moisture and dirt.

E. Condenser fan shall be directly connected to a weather-protected, quiet, high-efficiency motor. Fan guard shall be provided and shall be protected from rust by PVC finish. Condenser coil shall be aluminum fin with copper tube.

F. Connections for refrigerant suction and liquid lines shall be extended outside the cabinet and provided with service valves with gauge connections.

G. Power connections shall be made to the connectors located inside the electrical connection box.

H. Standard operating and safety controls shall include high-pressure switch, low pressure switch, compressor overload service, and solid-state timed-off control.

I. All components (parts and labor) of the sealed refrigeration circuit shall be warranted by the manufacturer for five years.

2.2 AUXILIARY EQUIPMENT

A. Auxiliary equipment shall consist of refrigerant lines prepared for the unit involved. These lines shall be cleaned, dried, and pressurized at the factory.

B. Low ambient kit to allow operation at outside temperature below 35 deg. F (2 deg. C) shall be provided.

C. Expansion valve shall be provided with the evaporator coil.

D. Provide thermostat to match the requirements of the job. Thermostat shall provide subbase with Heat-Cool-Off and Fan On-Auto switch. See section on controls for other related requirements.

E. Provide polyethylene structural base designed for that service and intended to support the unit and eliminate vibration transmission.

F. Provide hard-start kit with unit.

G. Provide guards for condenser coils.

2.3 ACCEPTABLE MANUFACTURERS

A. Condensing unit shall be the make and model number shown on the drawings or acceptable equivalents by Carrier, York, Trane, or Daikin.

PART 3 - EXECUTION
3.1 All HVAC equipment shall be installed as per manufacturer’s printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the Drawings or in the Specifications. Provide all items required as per manufacturer’s requirements.

3.3 INSTALLATION

   A. Install the condensing unit on proper foundation as shown on the Drawings, and in location that will not restrict the air entry or discharge from the unit.

   B. Install refrigerant lines as recommended by the manufacturer, taking care not to lose the refrigerant charge contained in the lines, or allow air to enter the lines or equipment. Locate the lines in such a way as to not obstruct access to the condensing unit or other equipment. Lines located underground or under concrete shall be installed in a PVC sleeve for protection.

   C. Provide electrical connections as required by the applicable codes. Provide control wiring required. All power wiring and control wiring shall be in conduit and located so as not to obstruct access to the unit or other equipment.

3.4 TESTING

   A. Operate the condensing unit and the system to assure that unit is operating properly and without excessive noise and vibration.

   B. Read and record the power draw and the refrigeration suction and liquid pressures as required by Section 23 05 93 – Testing, Adjusting, and Balancing.

END OF SECTION 23 62 13
SECTION 23 64 23 - AIR COOLED WATER CHILLERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 The Basic Materials and Methods, Section 23 02 00, are included as a part of this Section as though written in full in this document.

1.3 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner’s use.

1.4 QUALITY ASSURANCE

A. Unit shall be rated in accordance with ARI Standard 550/590, latest revision (U.S.A.).

B. Unit construction shall comply with ASHRAE 15 Safety Code, UL 1995, NEC and ASME applicable codes (U.S.A. codes).

C. Unit shall be manufactured in a facility registered to ISO 9002/BS5750, Part 2 Manufacturing Quality Standard.

D. Unit shall be tested at the factory.

1.5 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled per unit manufacturer’s recommendations.

1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Submit shop drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and electronic valves required for complete system.

C. Verify unit voltage matches voltage on electrical drawings.

D. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

E. Submit written certification that components of package not furnished by manufacturer have been selected in accordance with manufacturer's requirements.

F. Submit manufacturer's installation instructions including: Power, power wiring requirements, control wiring requirements, insulation details for unit motor starter details, etc.

G. Performance Data - Submittal shall include chiller manufacturer's computer-generated performance ratings. These computer ratings shall be certified in accordance with ARI
550-90. Computer ratings shall also contain ARI Certified part load values for operation at 100%, 75%, 50%, and 25% of full load.

H. WARRANTY

1. Provide five-year compressor, motor, parts, labor, and refrigerant warranty.

2. Warranty: Include parts and labor coverage for complete chiller package by chiller manufacturer for five (5) years from project substantial completion.

PART 2 - PRODUCTS

2.1 AIR COOLED LIQUID CHILLER

A. General: Factory assembled, single-piece, air-cooled liquid chiller. Contained within the unit cabinet shall be all factory wiring, piping, controls, refrigerant charge of HFC-410a and special features required prior to field start-up.

2.2 UNIT CABINET

A. Frame shall be of heavy-gage, painted galvanized steel.
B. Cabinet shall be galvanized steel casing with a pre-painted finish.
C. Cabinet shall be capable of withstanding 500-hour salt spray test in accordance with the ASTM (U.S.A.) B-117 standard.

2.3 FANS

A. Condenser fans shall be direct-driven and shall be statically and dynamically balanced with inherent corrosion resistance. Air shall be discharged vertically upward.
B. Fans shall be protected by coated steel wire safety guards.

2.4 COMPRESSORS

A. Unit shall have hermetic scroll type, direct drive compressors protected by motor temperature sensors.
B. Each compressor shall be equipped with a discharge shutoff valve, a crankcase heater to minimize oil dilution, and mounted on external rubber-in-shear vibration isolation.
C. Compressor shall start in unloaded condition. Capacity control shall be provided by staging individual compressors, with capability to reduce unit capacity to 15% of full load. Provide hot gas bypass as necessary to achieve minimum load.
D. Motor cooling shall be provided by suction gas and protected by internal overload thermistor.
E. Lube oil system shall include filtration devices

2.5 EVAPORATOR

A. Evaporator shall be tested and stamped in accordance with ASME code (U.S.A.) for a minimum refrigerant working-side pressure of 430 psig and shall be tested for a maximum water-side pressure of 150 psig.
B. Evaporator shall be UL listed brazed-plate type heat exchanger of stainless steel construction.
C. Heat exchanger shall be provided with 3/4” thick, closed-cell flexible elastomeric foam insulation.
D. Shall be equipped with weld-on or grooved fluid connections.
E. Shall incorporate 2 independent refrigerant circuits.
F. Shall have a cooler drain and vent.
G. Shall incorporate a refrigerant level sensing device.

2.6 CONDENSER
A. Coil shall be air-cooled with integral sub-cooler and shall be constructed of aluminum fins mechanically bonded to seamless copper tubes. The tubes are then cleaned, dehydrated, and sealed. All aluminum microchannel condenser coils shall be an acceptable alternative only if aluminum fin/copper tube heat exchanger is not available.
B. Condenser coils shall be leak tested and shall be pressure tested at 450 psig.
C. Provide louvered hail guard to protect the condenser coils.

2.7 REFRIGERATION COMPONENTS
A. Refrigerant circuit components shall include oil separator, high and low side pressure relief device, discharge and liquid line shutoff valves, replaceable-core filter drier, moisture indicating sight glass, electronic expansion device and complete operating charge of both refrigerant and compressor oil.

2.8 UNIT CONTROLS
A. All unit controls are housed in a weathertight enclosure with removable plates to allow for customer connection of power wiring and remote interlocks. All controls, including sensors, are factory mounted and tested prior to shipment. All cataloged units are UL listed.
B. Microcomputer controls provide all control functions including start-up and shut down, leaving chilled water temperature control, compressor and electronic expansion valve modulation, fan sequencing, anti recycle logic, automatic lead/lag compressor starting and load limiting.
C. Unit protective functions include loss of chilled water flow, evaporator freezing, loss of refrigerant, low refrigerant pressure, high refrigerant pressure, reverse rotation, compressor starting and running over current, phase loss, phase imbalance, phase reversal, and loss of oil flow.
D. A menu driven digital display shall indicate operating data points including chilled water setpoint, current limit setpoint, leaving chilled water temperature, evaporator and condenser refrigerant pressures and temperatures. A diagnostic check shall be made and displayed when a problem is detected.

2.9 ACCESSORY EQUIPMENT
A. Provide factory mounted control power transformer.
B. A weighted sound pressure level shall not exceed 73 dba measured at 20 feet from chiller. Provide necessary sound attenuation equipment on chiller to meet these requirements.
C. Provide factory installed guards to prevent unauthorized access to compressors and other components.
D. Provide an interface with BACnet Building Management System (BMS) for monitoring of Chiller operations. (BACnet certified BACnet interface required.) Chiller microprocessor must be capable of receiving a BMS input signal for Remote Run/Stop, Leaving Chilled Water Temperature Reset and Load Shedding.

2.10 ACCEPTABLE MANUFACTURERS:
Furnish and install air-cooled water chilling units of the type, capacities and ratings shown on drawings. Carrier, Trane, Daikin, or York by Johnson Controls will be considered "as equal" provided they comply with the specifications and schedule.

PART 3 - EXECUTION

3.1 All equipment shall be installed in accordance with the manufacturer’s recommendations and printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer’s requirements.

END OF SECTION 23 64 23
SECTION 23 73 13 – MODULAR INDOOR CENTRAL STATION AIR HANDLING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED
   A. Central station air handling unit.

1.2 RELATED SECTIONS
   A. Section 23 02 00 – Basic Materials and Methods
   B. Section 23 05 16 – Expansion Fittings and Loops for Piping
   C. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
   D. Section 23 05 26 – Variable Frequency Motor Speed Control for HVAC Equipment
   E. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
   F. Section 23 07 13 – Duct Insulation
   G. Section 23 34 00 – HVAC Fans
   H. Section 23 41 00 – Air Filters
   I. Section 23 31 13 – Metal Ductwork
   J. Section 23 31 19 – Ductwork Accessories

1.3 QUALITY ASSURANCE
   A. Unit performance shall be certified in accordance with ARI Standard 430 for central station air handling units.
   B. Coil performance shall be certified in accordance with ARI Standard 410.
   C. Direct-expansion coils shall be designed and tested in accordance with ASHRAE 15 Safety Code for Mechanical Refrigeration.
   D. Insulation and insulation adhesive shall comply with NFPA 90A requirements or flame spread and smoke generation.

1.4 GENERAL DESCRIPTION
   A. Indoor mounted, central station air handling unit designed to provide air to a conditioned space as required to meet specified performance requirements for ventilation, heating, cooling, filtration, and distribution. Unit shall be assembled for horizontal/vertical application and arranged to discharge conditioned air as shown on the drawings. Units shall be supplied by the specified manufacturer.
1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.

C. Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, and gauges and finishes of materials.

D. Provide fan curves with specified operating point clearly plotted.

E. Submit product data of filter media, filter performance data, filter assembly, and filter frames.

F. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory installed and field installed wiring.

G. Submit manufacturer’s installation instructions under provisions of Division One.

H. Submit operation and maintenance data under provisions of Section 23 02 00.

I. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.6 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled in accordance with the unit manufacturer’s instructions.

1.7 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.

1.8 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.

2. Principle of how the equipment works.

3. Important parts and assemblies.

4. How the equipment achieves its purpose and necessary operating conditions.

5. Most likely failure modes, causes and corrections.

6. On site demonstration.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier: Model 39M or 39R

B. Trane: Performance Climate Changer

C. York: York Solution by Johnson Controls

D. Daikin: Vision

E. Temtrol: ITF or WF

F. Substitutions: Under provisions of Division One.

2.2 GENERAL DESCRIPTION

A. Unit shall be factory supplied, central station air handler suitable for the capacities and configurations as shown on drawings. Unit may consist of a fan and coil section with a factory installed chilled water or direct-expansion coil, heating coil section, electric heat section, face and bypass section, filter section, access section, mixing box or combination filter-mixing box, return fan, diffuser, or air blender as indicated on the drawings.

B. All sections, whether assembled into a unit or supplied as separate components, shall have mating flanges for bolted assembly. The flange shall extend around the complete perimeter of each section. The manufacturer shall supply bolts and sufficient closed cell gasket for full perimeter coverage.

2.3 CASING

A. All unit sections shall be supplied with 12-gauge galvanized steel structural perimeter base rail. Condensate drain connection will not penetrate the base rail. If external isolators are not used, provide 6-inch minimum height housekeeping pads or sufficient overall height to provide p-trap with 1 inch greater that unit total static pressure.

B. Unit panels for all sections shall be double wall construction and shall be constructed of minimum 16-gauge G90 mill galvanized steel. Casing panels shall be fully removable for easy access to the unit and shall be secured to structural frame with aluminized or cadmium plated screws. Removal of panels must not affect the structural integrity of the unit. All panels shall have a minimum of 1-inch thickness foam insulation or 2 inch thickness, 1-1/2 lb. per cubic feet density fiberglass insulation. All panels shall be completely gasketed prior to shipping.

C. Casing air leakage shall not exceed Leakage Class 6 per ASHRAE 111 at +/- 8” w.g. Engineer shall select one (1) unit at their discretion, to test in the field (manufacturer to carry leakage test cost for 1 unit). The selected unit shall be tested and documented to leak no more than 1%-unit design flow at +/- 8” w.g. Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for each unit in CFM,
as a percentage of supply air, and as an ASHRAE 111 Leakage Class in the submittal. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8” w.g., whichever is less, and shall not exceed 0.0042” per inch of panel span (L/240). Floor panels shall be double-wall construction and designed to support a 250 lb. load during maintenance activities and shall deflect no more than 0.0042” per inch of panel span.

D. Double wall hinged removable access doors with multiple handles shall be provided in the fan and filter sections on the drive side of the unit. Access doors must also be provided in all sections where the removal of sheet metal screws is required for unit access. Doors shall be of the same thickness and construction as the wall panels. A gasket shall be provided around the entire door perimeter.

2.4 FANS

A. Fan section shall be constructed of insulated galvanized steel and have formed channel base for integral mounting of fan assembly and casing panels. Fan scroll, wheel, shaft, bearings, drives, and motor shall be mounted on a structural steel assembly which shall be isolated from the outer casing with factory installed 2-inch deflection spring isolators and vibration absorbent flexible canvas connection between fan discharge and casing.

B. Fans shall be equipped with double width, double inlet centrifugal type wheels with forward curved blades or airfoil blades as required for stable operation.

C. Fan wheels shall be keyed to the shaft and shall be designed for continuous operation at the maximum rated fan speed and motor horsepower. Fan wheels and shafts shall be selected to operate at least 25% below the first critical speed and shall be statically and dynamically balanced as an assembly.

D. Fans shafts shall be solid steel coated with rust preventative oil.

E. Fans bearings shall be self-aligning, pillow block, re-greaseable ball or roller type selected for a minimum average life of 200,000 hours. Extend grease lubrication fittings to drive side of unit with plastic tube and fittings rigidly attached to casing.

F. A motor shall be mounted within the fan section casing on slide rails to permit adjustment of belt tension.

G. Fan drive shall be designed for a minimum 1.3 service factor and shall be adjustable pitch.

2.5 COILS

A. All coils shall be tested at 300 psig air pressure, under water.

B. All coils shall be installed on tracks for easy removal from the air handling unit. Units that require disassembly of the unit for coil removal are not acceptable.

C. Coils shall be aluminum plate fin type with belled collars and shall be bonded to 1/2 inch or 5/8-inch OD copper tubes by mechanical expansion. Coils shall have headers with steel MPT connections. Working pressure shall be 250 psig at 300°F.
D. Coils shall be drainable and have non-trapping circuits. Headers shall have drain and vent connections extended to the outside of the unit casing. Supply and return headers shall be clearly labeled on the outside of the unit. Provide grommets at all pipe penetrations through cabinet.

E. Main drain pan shall be double wall stainless steel with minimum 2-inch insulation, sloped toward drain fitting, with integral elbow for side discharge and FPT connection, and shall comply with ASHRAE Standard 62. A maximum of one drain shall be supplied for each cooling coil section. The unit design shall not require a drain pan in any downstream section to contain the coil condensate. Moisture shall not carry over past the coil. Moisture eliminators are not acceptable for moisture carryover prevention.

F. Direct expansion coils shall be furnished with a brass distributor with solder type connections. Suction and discharge connections shall be on the same end regardless of rows deep. Coils shall have intertwined circuits for equal operation on each circuit.

G. Maximum face velocity across cooling coils shall be 500 FPM, unless noted otherwise on equipment schedule.

H. Coils in series shall have a minimum of 6-inch space between coil casings.

2.6 FILTERS

A. Filter section shall accept 2 inch or 4-inch filters of standard sizes as indicated on drawings and shall be designed and constructed to house the type of filter specified. Section shall include side access slide rails.

B. A magnahelic differential pressure gauge shall be factory installed and flush mounted on drive side to measure the pressure drop across the filter.

2.7 ACCESSORIES

A. Mixing boxes and filter mixing boxes sections shall have opposed blades and interconnecting outside air and return air dampers. All mixing boxes shall have a double wall hinged access door on the drive side of the unit.

B. Face and bypass sections shall have opposed acting damper blades.

C. All damper blades shall be galvanized steel, double skin airfoil type, housed in a galvanized steel frame and mechanically fastened to a hex axle rod rotating in stainless steel bearings. Dampers shall be sectionalized to limit blade length to no more than 48 inches so as to minimize blade warpage. Blade seals are required to assure tight closure. The damper shall be rated for a maximum leakage rate of 1 percent of nominal airflow at 1 inch w.g.

D. Access sections shall be installed where indicated on the drawings and shall have a double walled hinged door.

E. Diffuser sections shall consist of casing as specified with an integral perforated aluminum plate placed on the discharge side of the supply fan to ensure even and uniform air distribution over the adjacent downstream component. Diffuser section is required if a filter section is directly following the fan.
PART 3 - EXECUTION

3.1 If floor mounted air handling units are furnished with internal vibration isolation option, provide 2" thick Amber/Booth type NRC ribbed neoprene pads or approved equal to address high frequency breakout and provide additional unit elevation with overall sufficient height to provide p-trap with one inch greater than the unit total static pressure. Ribbed neoprene pads shall be located in accordance with the air handling unit manufacturer’s recommendations. Condensate drain connection shall not penetrate the base air handling unit’s rail.

3.2 Install in accordance with manufacturer’s instructions.

3.3 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer’s requirements.

END OF SECTION 23 73 13
PART 1 - GENERAL

1.1 WORK INCLUDED
   A. Central station air handling unit.

1.2 RELATED SECTIONS
   A. Section 23 02 00 – Basic Materials and Methods
   B. Section 23 05 16 – Expansion Fittings and Loops for Piping
   C. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
   D. Section 23 05 26 – Variable Frequency Motor Speed Control for HVAC Equipment
   E. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
   F. Section 23 07 13 – Duct Insulation
   G. Section 23 34 00 – HVAC Fans
   H. Section 23 41 00 – Air Filters
   I. Section 23 31 13 – Metal Ductwork
   J. Section 23 33 00 – Ductwork Accessories

1.3 REFERENCES
   A. AHRI 260 – Sound Rating of Ducted Air Moving and Conditioning Equipment
   B. AHRI 410 – Forced-Circulation Air Cooling and Air Heating Coils
   C. AHRI 430 – Performance Rating of Central-Station Air Handling Units
   D. AMCA 99 – Standards Handbook
   E. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes
   F. AMCA 300 – Test Code for Sound Rating Air Moving Devices
   G. ASHRAE 62 – Ventilation for Acceptable Indoor Air Quality
   H. ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings

1.4 QUALITY ASSURANCE
   A. Unit performance shall be certified in accordance with AHRI Standard 430 for central station air handling units.
B. Coil performance shall be certified in accordance with AHRI Standard 410.

C. Direct-expansion coils shall be designed and tested in accordance with ASHRAE 15 Safety Code for Mechanical Refrigeration.

D. Insulation and insulation adhesive shall comply with NFPA 90A requirements or flame spread and smoke generation.

1.5 GENERAL DESCRIPTION

A. Outdoor mounted, central station air handling unit designed to provide air to a conditioned space as required to meet specified performance requirements for ventilation, heating, cooling, filtration, and distribution. Unit shall be assembled for horizontal/vertical application and arranged to discharge conditioned air as shown on the drawings. Units shall be supplied by the specified manufacturer.

1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.

C. Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, and gauges and finishes of materials.

D. Provide fan curves with specified operating point clearly plotted.

E. Submit product data of filter media, filter performance data, filter assembly, and filter frames.

F. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory installed and field installed wiring.

G. Submit manufacturer’s installation instructions under provisions of Division One.

H. Submit operation and maintenance data under provisions of Section 23 02 00.

I. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.7 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled in accordance with the unit manufacturer’s instructions.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, and fan has been test run under observation.

1.9 OPERATIONS PERSONNEL TRAINING
A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier: Model 39M
B. Trane: Performance Climate Changer
C. York: Solution
D. Daikin: Vision
E. Temtrol: ITF or WF
F. Substitutions: Under provisions of Division One.

2.2 GENERAL DESCRIPTION

A. Unit shall be factory supplied, central station air handler suitable for the capacities and configurations as shown on drawings. Unit may consist of a fan and coil section with a factory installed chilled water or direct-expansion coil, heating coil section, electric heat section, face and bypass section, filter section, access section, mixing box or combination filter-mixing box, return fan, diffuser, or air blender as indicated on the drawings.

B. All sections, whether assembled into a unit or supplied as separate components, shall have mating flanges for bolted assembly. The flange shall extend around the complete perimeter of each section. The manufacturer shall supply bolts and sufficient closed cell gasket for full perimeter coverage.

2.3 CASING

A. All unit sections shall be supplied with 12 gauge galvanized steel structural perimeter base rail. Condensate drain connection will not penetrate the base rail.

B. Unit panels for all sections shall be double wall construction and shall be constructed of minimum 18 gauge G90 mill galvanized steel. Casing panels shall be fully removable for easy access to the unit, and shall be secured to structural frame with aluminized or cadmium plated screws. Removal of panels must not affect the structural integrity of the unit. All panels shall have a minimum of 2-inch thick foam insulation (R-13). All panels shall be
C. Casing air leakage shall not exceed Leakage Class 6 per ASHRAE 111 at +/- 8” w.g. Engineer shall select one (1) unit at their discretion, to test in the field (manufacturer to carry leakage test cost for 1 unit). The selected unit shall be tested and documented to leak no more than 1% unit design flow at +/- 8” w.g. Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for each unit in CFM, as a percentage of supply air, and as an ASHRAE 111 Leakage Class in the submittal. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8” w.g., whichever is less, and shall not exceed 0.0042” per inch of panel span (L/240). Floor panels shall be double-wall construction and designed to support a 250 lb. load during maintenance activities and shall deflect no more than 0.0042” per inch of panel span.

D. Double wall hinged removable access doors with a single ganged latch shall be provided in the fan and filter sections on the drive side of the unit. Access doors must also be provided in all sections where the removal of sheet metal screws is required for unit access. Doors shall be of the same thickness and construction as the wall panels. A gasket shall be provided around the entire door perimeter.

E. The roof shall be sloped in at least one direction to prevent water from standing or pooling. It shall overhang the walls to prevent water from dripping into the door seams.

F. Unit shall be provided with a full perimeter curb which carries the stamp of a Licensed Professional Engineer to meet scheduled wind load ratings.

2.4 FANS

A. Units shall be provided with direct-driven, single-width, single-inlet (SWSI) airfoil plenum fans constructed per AMCA requirements for the duty specified. Class I fans are not acceptable. Fan wheels shall be aluminum construction and rated in accordance with and certified by AMCA for performance. All fans shall be selected to deliver the specified airflow quantity at the specified operating Total Static Pressure and specified fan/motor speed. The fan shall be selected to operate at a system Total Static Pressure that does not exceed 90% of the specified fan’s peak static pressure producing capability at the specified fan/motor speed. Each fan/motor assembly shall include a minimum 14 gauge spun steel fan inlet funnel, and a G90 galvanized steel motor support plate and fan base with internal vibration isolation.

B. Units delivering supply airflow rates of significant magnitude shall be equipped with multiple supply fans in an array configuration. Refer to scheduled values to verify motor quantity per unit. Where multiple fans are provided, backdraft dampers shall be mounted upstream of each fan for isolation and a single source power motor control panel shall be factory installed. All fans shall be factory-wired to motor control panel which shall consist of individual motor overload relays and on-off disconnect switch for power isolation.

C. All motors shall be premium efficiency, totally enclosed fan-cooled (TEFC), selected at the specified operating voltage, RPM, and efficiency as specified or as scheduled elsewhere. Motors shall meet the requirements of NEMA MG-1 Part 30 and 31, section 4.4.2. Motor HP shall not exceed the scheduled HP as indicated in the AHU equipment schedules.

2.5 COILS
A. All coils shall be tested at 300 psig air pressure, under water.

B. All coils shall be installed on tracks for easy removal from the air handling unit. Units that require disassembly of the unit for coil removal are not acceptable.

C. Coils shall be aluminum plate fin type with belled collars and shall be bonded to 1/2 inch or 5/8 inch OD copper tubes by mechanical expansion. Coils shall have headers with steel MPT connections. Working pressure shall be 250 psig at 300°F.

D. Coils shall be drainable and have non-trapping circuits. Headers shall have drain and vent connections extended to the outside of the unit casing. Supply and return headers shall be clearly labeled on the outside of the unit. Provide grommets at all pipe penetrations through cabinet.

E. Main drain pan shall be double wall stainless steel with minimum 2 inch insulation, sloped toward drain fitting, with integral elbow for side discharge and FPT connection, and shall comply with ASHRAE Standard 62. A maximum of one drain shall be supplied for each cooling coil section which shall extend at least 18” downstream of the coil. The unit design shall not require a drain pan in any downstream section to contain the coil condensate. Moisture shall not carry over past the coil. Moisture eliminators are not acceptable for moisture carryover prevention.

F. Direct expansion coils shall be furnished with a brass distributor with solder type connections. Suction and discharge connections shall be on the same end regardless of rows deep. Coils shall have intertwined circuits for equal operation on each circuit.

G. Maximum face velocity across cooling coils shall be 500 FPM, unless noted otherwise on equipment schedule.

H. Coils in series shall have a minimum of 12 inch space between coil casings.

I. In units larger than 10,000 cfm, coils shall be removable through a service panel without disassembly of the unit.

2.6 FILTERS

A. Filter section shall accept 2 inch or 4 inch filters of standard sizes as indicated on drawings and shall be designed and constructed to house the type of filter specified. Section shall include side access slide rails.

B. A magnahelic differential pressure gauge shall be factory installed and flush mounted on drive side to measure the pressure drop across the filter.

2.7 ACCESSORIES

A. Mixing boxes and filter mixing boxes sections shall have opposed blades and interconnecting outside air and return air dampers. All mixing boxes shall have a double wall hinged access door on the drive side of the unit.

B. Face and bypass sections shall have opposed acting damper blades.
C. All damper blades shall be galvanized steel, double skin airfoil type, housed in a galvanized steel frame and mechanically fastened to a hex axle rod rotating in stainless steel bearings. Dampers shall be sectionalized to limit blade length to no more than 48 inches so as to minimize blade warpage. Blade seals are required to assure tight closure. The damper shall be rated for a maximum leakage rate of 1 percent of nominal airflow at 1 inch w.g.

D. Access sections shall be installed where indicated on the drawings and shall have a double walled hinged door.

E. Provide integral piping vestibules with the AHU to incorporate the piping up through the roof and facilitate routing to the coil connections. Size the vestibule for the required pipe diameters and the actual pipe penetration locations.

PART 3 - EXECUTION

3.1 If floor mounted air handling units are furnished with internal vibration isolation option, provide 2" thick Amber/Booth type NRC ribbed neoprene pads or approved equal to address high frequency breakout and provide additional unit elevation with overall sufficient height to provide p-trap with one inch greater than the unit total static pressure. Ribbed neoprene pads shall be located in accordance with the air handling unit manufacturer’s recommendations. Condensate drain connection shall not penetrate the base air handling unit’s rail.

3.2 Install in accordance with manufacturer’s instructions.

3.3 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer’s requirements.

END OF SECTION 23 73 26
SECTION 23 81 23.16 – COMPUTER ROOM AIR CONDITIONERS, 1.0 THRU 8.0 TONS, FLOOR MOUNTED

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 – Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Floor mounted computer room air conditioning units with microprocessor based controls.

B. Outdoor remote mounted air cooled condensing units.

C. The system shall have a total cooling capacity and a sensible cooling capacity as indicated in the Mechanical Schedules.

D. The unit is to be supplied for operation on a power supply as indicated in the Mechanical Schedules and the Electrical drawings.

1.3 RELATED SECTIONS

A. Section 23 02 00 – Basic Materials and Methods

B. Section 23 05 29 – Hangers and Support for Piping and Equipment HVAC

C. Section 23 05 13 – Common Motor Requirements for HVAC Equipment

D. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment

E. Section 23 07 13 – Duct Insulation

F. Section 23 07 19 – HVAC Piping Insulation

G. Section 23 34 00 – HVAC Fans

H. Section 23 23 00 – Refrigerant Piping

I. Section 23 41 00 – Air Filters

J. Section 23 31 13 – Metal Ductwork

K. Section 23 31 19 – Ductwork Accessories

L. Section 23 05 93 – Testing, Adjusting, and Balancing

M. Section 23 21 19 – Hydronic Specialties
N. Section 23 21 13 – Above Ground Hydronic Piping

1.4 QUALITY ASSURANCE

A. The specified system shall be factory-tested before shipment. Testing shall include, but shall not be limited to: Quality Control Checks, “Hi-Pot” Test (two times rated voltage plus 1000 volts, per NRTL agency requirements), and Metering Calibration Tests. The system shall be designed and manufactured according to world-class quality standards. The manufacturer shall be ISO 9001 certified.

B. System shall be supplied with CSA Certification to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for “Heating and Cooling Equipment” and marked with the CSA c-us logo (60Hz only).

C. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators."

D. UL Compliance: Fans and components shall be UL listed and labeled.

E. Nationally Recognized Testing Laboratory Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

F. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

G. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

H. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.

I. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

B. Product data for selected models, including specialties, accessories, and 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 fan accessories.
4. Materials, gages and finishes, include color charts.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.
D. Coordination drawings, in accordance with Division 23, Section "Basic Materials and Methods", for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted within or above ceiling. Show the following:

1. Framing and support members relative to duct penetrations.
2. Ceiling suspension members.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

E. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer installed wiring and field installed wiring.

F. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.

G. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23, Section "Basic Materials and Methods".

1.6 DELIVERY, STORAGE, AND HANDLING

A. Equipment shall be stored and handled in accordance with the unit manufacturer’s instructions.

B. Lift and support units with the manufacturer's designated lifting or supporting points.

C. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

D. Deliver units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, refrigeration piping has been tested and charged and fan has been test run under observation.

1.8 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.
1.9 WARRANTY

A. Provide a manufacturer’s warranty for two years from date of shipment from defects in material and workmanship when used in a proper and normal manner. Manufacturer shall have the option to repair or replace the defective part including material and labor.

B. Provide a five year compressor, motor, parts, labor and refrigerant warranty, effective for five years from date of factory start-up and certification.

PART 2 - PRODUCTS

2.1 DX AIR-COOLED REFRIGERATION SYSTEM

A. Single refrigeration circuit shall include a liquid line filter drier, a refrigerant sight glass with moisture indicator, an expansion valve, pressure safety switches, and a liquid line solenoid valve. The indoor evaporator refrigerant piping shall be filled with a nitrogen holding charge and spun shut. Field relief of the Schrader valve shall indicate a leak-free system.

B. The direct-expansion, tilted-slab cooling coil shall be constructed of copper tubes and hydrophilic-coated aluminum fins. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. One stainless steel condensate drain pan shall be provided.

C. The system shall be designed for use with R-410A refrigerant, which meets the U.S. Clean Air Act for phase out of HCFC refrigerants.

D. The compressor shall be an R-410A scroll-type with variable capacity operation from 20-100%, commonly known as a digital scroll. The compressor solenoid valve shall unload the digital scroll compressor to provide variable capacity operation. The compressor shall have a suction gas cooled motor, EPDM Rubber vibration isolators, internal thermal overloads, automatic reset high pressure switch with lockout after three failure occurrences, rota-lock service valves, low pressure transducer, and crankcase heater. The compressor shall be removable and serviceable from the front of the unit. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles.

E. The compressor sound jacket shall reduce the level of sound emitted from the digital scroll compressor. It shall consist of a 3/8 inch closed cell polymeric 4.5 - 8.5 lb/ft³ density jacket that encloses the compressor.

F. The compressor shall be an R-410A scroll-type with a suction gas-cooled motor; EPDM vibration isolators, internal thermal overloads, and automatic reset high-pressure switch with lockout after three failure occurrences, rota-lock service valves, low-pressure transducer, and crankcase heater. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles. The compressor shall be serviceable and removable from the front of the unit.

G. An electronically-controlled expansion valve (EEV) shall precisely control the flow of liquid refrigerant entering the direct-expansion coil. The EEV shall be of stepper-motor type. The EEV shall maintain consistent superheat of the refrigerant vapor at the outlet of the evaporator coil over the unit's operating range. The valve shall be controlled by a separate electronic controller. Superheat shall be determined through the suction pressure-temperature method.
2.2 DUAL COOL: CHILLED WATER + AIR-COOLED REFRIGERATION

A. Two independent circuits shall be included. The dual-cooling source system shall consist of
an air cooled system with the addition of a free-cooling chilled water coil or free-cooling
chilled glycol coil, a modulating control valve, and a comparative temperature sensor. The
system shall be able to function as a modulating chilled water system, as a compressorized
system or as a combination of both. The primary cooling mode shall be chilled water. The
secondary refrigeration circuit shall include a liquid line filter drier, a refrigerant sight glass
with moisture indicator, an expansion valve, pressure safety switch and a liquid line solenoid
valve. The indoor evaporator refrigerant piping shall be filled with a nitrogen holding charge
and spun shut. Field relief of the Schrader valve shall indicate a leak-free system. Switchover
between the two cooling modes shall be performed automatically by the microprocessor
control.

B. The direct-expansion, tilted-slab cooling coil and the free-cooling chilled water coil shall be
constructed of copper tubes and hydrophilic-coated aluminum fins. The hydrophilic coating
shall significantly improve the speed of condensate drainage from the fins and shall provide
superior water carryover resistance. One stainless steel condensate drain pan shall be provided.

C. The system shall be designed for use with R-410A refrigerant, which meets the U.S. Clean
Air Act for phase out of HCFC refrigerants.

D. The compressor shall be an R-410A scroll-type with variable capacity operation from 20-
100%, commonly known as a digital scroll. The compressor solenoid valve shall unload the
digital scroll compressor to provide variable capacity operation. The compressor shall have a
suction gas cooled motor, EPDM Rubber vibration isolators, internal thermal overloads,
automatic reset high pressure switch with lockout after three failure occurrences, rota-lock
service valves, low pressure transducer, and crankcase heater. The compressor shall be
removable and serviceable from the front of the unit. The crankcase heater and a discharge
check valve shall be provided for additional system protection from refrigerant migration
during Off cycles.

E. The compressor sound jacket shall reduce the level of sound emitted from the digital scroll
compressor. It shall consist of a 3/8 inch closed cell polymeric 4.5 - 8.5 lb/ft3 density jacket
that encloses the compressor.

F. An electronically-controlled expansion valve (EEV) shall precisely control the flow of liquid
refrigerant entering the direct-expansion coil. The EEV shall be of stepper-motor type. The
EEV shall maintain consistent superheat of the refrigerant vapor at the outlet of the evaporator
coil over the unit's operating range. The valve shall be controlled by a separate electronic
controller. Superheat shall be determined through the suction pressure-temperature method.

G. The water circuit shall include a pre-piped three-way motorized ball valve. The controller shall
manage the non-spring return valve actuator movement to maintain the desired room
conditions for various entering water temperatures. Cooling capacity will be controlled by
bypassing chilled water around the coil.

H. The system shall be equipped with a microprocessor-controlled comparator sensor that permits
free-cooling operation whenever entering chilled water temperature is below return-air
temperature. The comparator sensor shall be factory-installed on a free-cooling three-way
valve.
I. The water circuit shall be designed for a pressure of 150PSI (1034kPa).

2.3 WATER/GLYCOL-COOLED REFRIGERATION SYSTEM

A. Single refrigeration circuit shall include a compressor, liquid line filter drier, and a refrigerant sight glass with moisture indicator, an expansion valve, a brazed-plate condenser, pressure safety switches, and a factory refrigerant charge. The water piping shall be filled with a nitrogen holding charge and spun shut. Field relief of the Schrader valve on the water piping shall indicate a leak-free system.

B. The direct-expansion, tilted-slab cooling coil shall be constructed of copper tubes and hydrophilic-coated aluminum fins. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. One stainless steel condensate drain pan shall be provided.

C. The system shall be designed for use with R-410A refrigerant, which meets the U.S. Clean Air Act for phase out of HCFC refrigerants.

D. The compressor shall be an R-410A scroll-type with variable capacity operation from 20-100%, commonly known as a digital scroll. The compressor solenoid valve shall unload the digital scroll compressor to provide variable capacity operation. The compressor shall have a suction gas cooled motor, EPDM Rubber vibration isolators, internal thermal overloads, automatic reset high pressure switch with lockout after three failure occurrences, rota-lock service valves, low pressure transducer, and crankcase heater. The compressor shall be removable and serviceable from the front of the unit. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles.

E. The compressor sound jacket shall reduce the level of sound emitted from the digital scroll compressor. It shall consist of a 3/8 inch closed cell polymeric 4.5 - 8.5 lb/ft³ density jacket that encloses the compressor.

F. An electronically-controlled expansion valve (EEV) shall precisely control the flow of liquid refrigerant entering the direct-expansion coil. The EEV shall be of stepper-motor type. The EEV shall maintain consistent superheat of the refrigerant vapor at the outlet of the evaporator coil over the unit's operating range. The valve shall be controlled by a separate electronic controller. Superheat shall be determined through the suction pressure-temperature method.

G. The condenser shall be an insulated, brazed-plate type. The plates are to be stainless steel material. The primary side shall be piped to a condenser water source, and the secondary side shall be connected to the refrigeration system. A factory-supplied strainer is to be field-installed upstream of the air conditioning unit, on the condenser water supply line. Water pressure rating of the condenser shall be 600 psig (4136kPa) design working pressure.

H. A pre-piped three-way motorized ball valve shall control the water/glycol flow passing through the insulated, brazed-plate condenser. The controller shall manage the non-spring return valve actuator movement to maintain the desired condensing temperature for various entering water temperatures.

I. The water/glycol circuit shall be designed for a pressure of 150PSI (1034kPa).

2.4 DUAL COOLING SOURCE SYSTEM: WATER/GLYCOL COOLED + ECONOMIZING COIL
A. Two independent circuits shall be included. The dual-cooling source system shall consist of a water/glycol cooled system with the addition of a free-cooling chilled water coil or free-cooling chilled glycol, a modulating control valve, and a comparative temperature sensor. The system shall be able to function either as a modulating chilled water system or as a compressorized system, or as a combination of the two. The primary cooling mode shall be chilled water. The secondary refrigeration circuit shall include a compressor, liquid line filter drier, a refrigerant sight glass with moisture indicator, an expansion valve, a brazed-plate condenser, pressure safety switches, and a factory refrigerant charge.

   The economizing coil piping shall be filled with a nitrogen holding charge and spun shut. Field relief of the Schrader valve shall indicate a leak-free system. Switchover between the two cooling modes shall be performed automatically by the microprocessor control. Four (4) pipe connections shall be included on water/glycol systems: economizing coil supply, economizing coil return, condenser supply and condenser return.

B. The direct-expansion, tilted-slab cooling coil and the Liebert Econ-O-Coil coil be constructed of copper tubes and hydrophilic coated aluminum fins. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. One stainless steel condensate drain pan shall be provided.

C. The system shall be designed for use with R-410A refrigerant, which meets the U.S. Clean Air Act for phase out of HCFC refrigerants.

D. The compressor shall be an R-410A scroll-type with variable capacity operation from 20-100%, commonly known as a digital scroll. The compressor solenoid valve shall unload the digital scroll compressor to provide variable capacity operation. The compressor shall have a suction gas cooled motor, EPDM Rubber vibration isolators, internal thermal overloads, automatic reset high pressure switch with lockout after three failure occurrences, rota-lock service valves, low pressure transducer, and crankcase heater. The compressor shall be removable and serviceable from the front of the unit. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles.

E. The compressor sound jacket shall reduce the level of sound emitted from the digital scroll compressor. It shall consist of a 3/8 inch closed cell polymeric 4.5 - 8.5 lb/ft3 density jacket that encloses the compressor.

F. An electronically-controlled expansion valve (EEV) shall precisely control the flow of liquid refrigerant entering the direct-expansion coil. The EEV shall be of stepper-motor type. The EEV shall maintain consistent superheat of the refrigerant vapor at the outlet of the evaporator coil over the unit's operating range. The valve shall be controlled by a separate electronic controller. Superheat shall be determined through the suction pressure-temperature method.

G. The condenser shall be an insulated, brazed-plate type. The plates are to be stainless steel material. The primary side shall be piped to a condenser water/glycol source, and the secondary side shall be connected to the refrigeration system. A factory-supplied strainer is to be field-installed upstream of the air conditioning unit, on the condenser water supply line. Water pressure rating of the condenser shall be 600 psig (4136kPa) design working pressure.

H. A pre-piped three-way motorized ball valve shall control the water/glycol flow passing through the insulated, brazed-plate condenser. The controller shall manage the non-spring return valve actuator movement to maintain the desired condensing temperature for various entering water temperatures.
I. The water circuit shall include a pre-piped three-way motorized ball valve. The controller shall manage the non-spring return valve actuator movement to maintain the desired room conditions for various entering water temperatures. Cooling capacity shall be controlled by bypassing chilled water around the coil.

J. The system shall be equipped with a microprocessor-controlled comparator sensor that permits free-cooling operation whenever entering chilled water/glycol temperature is below return-air temperature. The comparator sensor shall be factory-installed on a free-cooling three-way valve unit and field-installed on a continuous flowing pipe for a unit with a free-cooling two-way valve.

K. The water circuit shall be designed for a pressure of 150PSI (1034kPa).

2.5 CHILLED GLYCOL FLUID-COOLED ECONOMIZER AND DX REFRIGERATION SYSTEM

A. The unit shall have two independent cooling coils. The first cooling coil shall be a part of a chilled glycol circuit and shall be strategically located in the return-air stream to either pre-cool or totally cool the air before entering the refrigeration coil. The second cooling coil shall be part of a direct-expansion refrigeration circuit and shall include a compressor, liquid line filter drier, a refrigerant sight glass with moisture indicator, an expansion valve, a brazed-plate condenser, pressure safety switches, and a factory refrigerant charge. The controller shall control the activation/deactivation and modulation of the two cooling circuits allowing the system to function either as a modulating glycol economizer, a glycol refrigeration system, or a combination of both. This shall be a two-pipe system and shall require closed-loop water/glycol heat rejection, such as drycooler/pump or customer water tower using properly treated glycol solutions. Field relief of the Schrader valve shall indicate a leak-free system.

B. The unit shall have two independent cooling circuits, constructed of copper tubes with hydrophilic-coated aluminum fins. The first cooling circuit shall be a chilled glycol circuit and designed for closed-loop applications using properly treated glycol solutions. The second cooling circuit shall be a direct expansion refrigeration circuit. The coil shall be constructed into the tilted slab. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. The coil shall be provided with a stainless steel drain pan.

C. The system shall be designed for use with R-410A refrigerant, which meets the U.S. Clean Air Act for phase out of HCFC refrigerants.

D. The compressor shall be an R-410A scroll-type with variable capacity operation from 20-100%, commonly known as a digital scroll. The compressor solenoid valve shall unload the digital scroll compressor to provide variable capacity operation. The compressor shall have a suction gas cooled motor, EPDM Rubber vibration isolators, internal thermal overloads, automatic reset high pressure switch with lockout after three failure occurrences, rota-lock service valves, low pressure transducer, and crankcase heater. The compressor shall be removable and serviceable from the front of the unit. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles.

E. The compressor sound jacket shall reduce the level of sound emitted from the digital scroll compressor. It shall consist of a 3/8 inch closed cell polymeric 4.5 - 8.5 lb/ft³ density jacket that encloses the compressor.
An electronically-controlled expansion valve (EEV) shall precisely control the flow of liquid refrigerant entering the direct-expansion coil. The EEV shall be of stepper-motor type. The EEV shall maintain consistent superheat of the refrigerant vapor at the outlet of the evaporator coil over the unit's operating range. The valve shall be controlled by a separate electronic controller. Superheat shall be determined through the suction pressure-temperature method.

The condenser shall be an insulated, brazed-plate type. The plates are to be stainless steel material. The primary side shall be piped to a condenser glycol source, and the secondary side shall be connected to the refrigeration system. A factory-supplied strainer shall be field-installed upstream of the Liebert PDX, on the water/glycol supply line. Water pressure rating of the condenser shall be 600 psig (4136 kPa) design working pressure.

The chilled glycol cooling coil shall include a pre-piped, three-way motorized ball valve. The controller shall manage the non-spring return valve actuator movement to maintain the desired room conditions for various entering water temperatures.

A pre-piped three-way motorized ball valve shall control the water/glycol flow passing through the insulated, brazed-plate condenser. The controller shall manage the valve actuator movement to maintain the desired condensing temperature for various entering water temperatures.

The system shall be equipped with a factory-installed microprocessor-controlled comparator sensor that permits free-cooling operation whenever entering chilled glycol temperature is below return air temperature.

The chilled glycol cooling circuit shall be designed for a maximum system pressure of 150 PSI (1034 kPa).

Chilled Water System (Models 011, 017 and 029)

The system shall function as a modulating chilled-water system consisting of a modulating chilled-water valve and a coil designed to distribute water into the entire coil-face area.

The chilled-water tilted-slab cooling coil shall be constructed of copper tubes and hydrophilic-coated aluminum fins. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. One stainless steel condensate drain pan shall be provided. The water circuit shall be filled with a nitrogen holding charge and spun shut. Field relief of the Schrader valve shall indicate a leak-free system.

A pre-piped three-way motorized ball valve controls the chilled water flow passing through the cooling coil controller shall manage the non-spring return valve actuator movement to maintain the desired room conditions for various entering water temperatures. Cooling capacity shall be regulated by varying the chilled water flow.

The chilled water circuit shall be designed for a maximum system pressure of 150 PSI (1034 kPa).

FAN SECTION

The unit shall be equipped with one plug fan: integral direct driven fan with backward-curved blades and electronically commutated DC motor; commonly referred to as EC fan. The fan
speed shall be variable and automatically regulated by the controller through all modes of operation. The fan shall have a dedicated motor, fault monitoring circuitry, and speed controller, which shall provide a level of redundancy. The impeller shall be made of aluminum and dynamically balanced. The EC fan shall be located within the unit. The EC fan shall also provide greater energy savings than forward curved centrifugal fan and variable speed drives.

2.8 AIR FLOW CONFIGURATION

A. Upflow Supply with Front Air Return

1. The supply air shall exit from the top of the cabinet. The return air shall be through the front factory installed grilles. The EC fan shall be factory mounted in the upper portion of the unit. The fan shall be located to pull air through the filters and cooling coil to ensure even air distribution and maximum coil performance.

B. Upflow Supply with Rear Air Return

1. The supply air shall exit from the top of the cabinet. The return air shall be through the rear of the factory-supplied, 24" rear return, skirted floor stand assembly with air filters. The EC fan shall be factory mounted in the upper portion of the unit. The fan shall be located to pull air through the filter and cooling coil to ensure even air distribution and maximum coil performance.

C. Downflow Supply with Front Air Discharge

1. The supply air shall exit from the front of the cabinet opening. The EC fan shall be mounted in the bottom of the unit. The fan shall be located to draw air through the filters and cooling coil to ensure even air distribution and maximum coil performance.

D. Downflow Supply with Front and Right Side Air Discharge

1. The supply air shall exit from the front and right side cabinet openings. The EC fan shall be mounted in the bottom of the unit. The fan shall be located to draw air through the filters and cooling coil to ensure even air distribution and maximum coil performance.

E. Downflow Supply with Front Air and Left Side Air Discharge

1. The supply air shall exit from the front and left side cabinet openings. The EC fan shall be mounted in the bottom of the unit. The fan shall be located to draw air through the filters and cooling coil to ensure even air distribution and maximum coil performance.

F. Downflow Supply with Front, Right and Left Side Air Discharge

1. The supply air shall exit from the front, right and left side cabinet openings. The EC fan shall be mounted in the bottom of the unit. The fan shall be located to draw air through the filters and cooling coil to ensure even air distribution and maximum coil performance.

G. Downflow Supply with Discharge into Raised Floor
1. The supply air shall exit from the bottom of the unit directly into the raised floor. The EC fan shall be mounted in the bottom of the unit. The fan shall be located to draw air through the filter and cooling coil to ensure even air distribution and maximum coil performance.

2.9 CABINET CONSTRUCTION AND ACCESSIBILITY

A. The exterior panels shall be 20 gauge steel and powder-coated with RAL 7021 black color paint to protect against corrosion. The exterior panels shall be insulated with 1/2” to 1” (12.7 to 25.4mm), 1-1/2 lb. (0.68 kg) insulation. Front and side panels shall have captive, quarter-turn fasteners. The cabinet shall be designed so that all components are serviceable and removable using the front and right sides of the unit.

B. The exterior panels shall be internally lined with 20 gauge galvanized steel, sandwiching the insulation between the panels for easy cleaning.

C. A locking-type fused disconnect switch shall be mounted in the electrical panel and shall be capable of disrupting the flow of power to the unit. The locking type shall consist of a main unit switch operational from outside the unit. The electric panel compartment shall be accessible only with the switch in the Off position. The locking disconnect shall be lockable in support of lockout/tagout safety programs.

D. The electrical panel shall provide at least 65,000A SCCR. Short-circuit current rating (SCCR) is the maximum short-circuit current a component or assembly can safely withstand when protected by a specific overcurrent protective device(s) or for a specified time.

2.10 FILTRATION

A. The filter shall be an integral part of the system and located within the cabinet. The filter shall be deep-pleated, 2 in (51mm) thick with a MERV 11 rating efficiency based on ASHRAE 52.2-2007. A filter clog switch shall be included. Mesh type, cleanable filters shall be unacceptable.

B. Two extra sets of MERV 11 filters shall be provided per system.

2.11 [ELECTRIC REHEAT

A. The reheat shall be a low-watt density 304/304 stainless steel finned-tubular electric reheat. The reheat section shall include UL/CSA recognized safety switches to protect the system from overheating. The electric reheat shall be controlled in two stages. The reheat elements shall be accessible from the right side of the cabinet. Refer to equipment schedules for heater type.]

2.12 [SCR REHEAT-OPTIONAL ON NOMINAL 3.5 TON DX UNITS ONLY

A. The SCR (Silicon Controlled Rectifier) controller shall proportionally control the stainless steel reheat to maintain the selected room temperature. The SCR controller shall provide precise temperature control, and the lower element temperature shall improve heater life. Available only on air-cooled or water/glycol-cooled Nominal 3.5 ton DX units using digital scroll compressors. Refer to equipment schedules for heater type.]

2.13 [HOT WATER REHEAT ON CHILLED WATER UNITS ONLY
A. The hot water reheat coil shall have copper tubes and aluminum fins. The control system shall be factory pre-piped with a two-way motorized control valve. A cleanable Y-strainer should be field supplied and installed on the hot water supply line. Refer to equipment schedules for heater type.

2.14 [INFRARED HUMIDIFIER]

A. The humidifier shall be of the infrared type, consisting of high intensity quartz lamps mounted above and out of the water supply. The evaporator pan shall be stainless steel and arranged to be serviceable without disconnecting water supply lines, drain lines, or electrical connections. The complete humidifier section shall be pre-piped ready for final connection. The infrared humidification system shall use bypass air to prevent over-humidification of the controlled space. The auto flush system shall automatically flush deposits from the humidifier pan. The system shall be field adjustable to change the cycle time to suit local water conditions. A minimum 1 in. (25.4 mm) air gap within the humidifier piping assembly shall prevent back flow of the humidifier supply water. Refer to equipment schedules for heater type.

2.15 [STEAM GENERATING CANISTER HUMIDIFIER-OPTIONAL]

A. A canister-type steam generating humidifier shall be factory-installed in the cooling unit and operated by the controller. It shall be complete with disposable cylinder, all supply and drain valves, steam distributor, and electronic controls. The need to change the canister shall be indicated on the controller display. The humidifier is designed to operate with water conductivity from 330 to 670 microS/cm. System shall automatically fill and drain as well as maintain the required water level based on conductivity. A minimum 1 in. (25.4 mm) air-gap within the humidifier assembly shall prevent back flow of the humidifier supply water. Refer to equipment schedules for heater type.

2.16 [CONDENSATE PUMP]

A. The dual-float condensate pump shall be complete with integral primary and secondary float switches, pump, motor assembly and reservoir. The secondary float shall send a signal to the local alarm and shut down the unit upon high water condition. The condensate pump shall be factory-installed on upflow units and field-installed on downflow units.

2.17 MICROPROCESSOR CONTROL WITH 9 INCH COLOR TOUCHSCREEN

A. The unit controller shall be microprocessor-based with a 9" color touchscreen display and shall be mounted in an ergonomic, aesthetically pleasing housing. The display and housing shall be viewable while the front panel is open or closed. The controls shall be menu-driven. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in percentage of each function, date and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes. Service menus shall include setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards, and diagnostics/service mode.

1. Password Protection - The unit controller shall contain two unique passwords to protect against unauthorized changes. An auto hide/show feature shall allow the user to see applicable information based on the login used.
2. Unit Backup and Restore - The user shall be able to create safe copies of important
control parameters. The unit controller shall have the capacity for the user to automatically backup unit configuration settings to internal memory or USB storage drive. Configuration settings may be transferred to another unit for a more streamlined unit startup.

3. Parameter Download - The unit controller shall enable the user to download a report that lists parameter names, factory default settings and user programmed settings in .csv format for remote reference.

4. Parameter Search - The unit controller shall have search fields for efficient navigation and parameter lookup.

5. Setup Wizards - The unit controller shall contain step-by-step tutorials or wizards to provide easy setup of the control.

6. Context-Sensitive Help - The unit controller shall have an on-board help database. The database shall provide context-sensitive help to assist with setup and navigation of the menus.

7. Display Setup - The user shall be able to configure the display information based on the specific user's preference. Language, units of measure, screen contrast, home screen layout, back-light timer, and the hide/show of certain readouts shall be configurable through the display.

8. Additional Readouts - The display shall enable the user to configure custom widgets on the main screen. Widget options will include items such as fan speed, call for cooling, call for free-cooling, maintenance status, call for hot water reheat, call for electric reheat, call for dehumidification, call for humidification, airflow, static pressure, fluid flow rate and cooling capacity.

9. Status LEDs - The unit controller shall show the unit's operating status using an integral LED. The LED shall indicate if the unit has an active alarm; if the unit has an active alarm that has been acknowledged; or if the unit is On, Off or in standby status.

10. Event Log - The unit controller shall automatically store the last 400 unit-only events (messages, warnings, and alarms).

11. Service Contact Information - The unit controller shall be able to store the local service or sales contact information.

12. Upgradeable - unit controller upgrades shall be performed through a USB connection.

13. Timers/Sleep Mode - The menus shall allow various customer settings for turning the unit On or Off.

14. Menu Layout - The menus shall be divided into two main menus: User and Service. The User screen shall contain the menus to access parameters required for basic unit control and setup. The Service screen shall be designed for service personnel and shall provide access to advanced control setup features and diagnostic information.

15. Sensor Calibration - The menus shall allow unit sensors to be calibrated with external sensors.

16. Maintenance/Wellness Settings - The menus shall allow reporting of potential component problems before they occur.

17. Options Setup - The menus shall provide operation settings for the installed components.

18. Auxiliary Boards - The menus shall allow setup of optional expansion boards.

19. Various Sensors: The menus shall allow setup and display of optional custom sensors. The control shall include four customer accessible analog inputs for field-supplied sensors. The analog inputs shall accept a 4 to 20mA signal. The user shall be able to change the input to 0 to 5VDC or 0 to 10VDC. The gains for each analog input shall be programmable from the front display. The analog inputs shall be able to be monitored from the front display.

20. Diagnostics/Service Mode - The unit controller shall be provided with self-diagnostics
to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as On or Off at the front display. Control outputs shall be able to be turned On or Off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

B. All unit alarms shall be annunciated through both audio and visual cues, clearly displayed on the screen, automatically recorded in the event log and communicated to the customers Building Management System/Building Automation System. The unit controller shall activate an audible and visual alarm in event of any of the following conditions:

1. High Temperature
2. Low Temperature
3. High Humidity
4. Low Humidity
5. EC Fan Fault
6. Change Filters
7. Loss of Air Flow
8. Loss of Power
9. Compressor Overload (Optional)
10. Humidifier Problem
11. High Head Pressure
12. Low Suction Pressure
13. Custom Alarms
14. Leak Under Floor
15. Smoke Detected
16. Standby Unit On
17. Each alarm (unit and custom) shall be separately enabled or disabled, selected to activate the common alarm and programmed for a time delay of 0 to 255 seconds.

C. The unit controller shall be factory-set to allow precise monitoring and control of the condition of the air entering and leaving the unit. This control shall include predictive methods to control air flow and cooling capacity based control sensors installed. Proportional and Tunable PID shall also be user selectable options.

D. The unit controller shall be flexible in the sense that it shall allow for controlling the capacity and fan from multiple different sensor selections. The sensor selections shall be:

1. Cooling Capacity
   a. Supply
   b. Remote
   c. Return

2. Fan Speed
   a. Supply
   b. Remote
   c. Return
   d. Manual (for diagnostic or to receive a signal from the BMS through the Liebert remote monitoring devices or analog input)
   e. Static Pressure
E. The unit controller shall be able to adjust the capacity output based on supply and return temperature conditions to meet SLA guidelines while operating at highest efficiency.

F. Dew point and relative humidity control methods shall be available (based on user preference) for humidity control within the conditioned space.

2.18 MULTI-UNIT COORDINATION

A. Unit controller shall control multiple units in a parallel, independent and optimized format. The controller shall save energy by preventing multiple units in an area from operating in opposing modes. Teamwork allows the control to optimize a group of connected cooling units using the cooling unit manufacturer’s. There shall be three modes of teamwork operation:

1. Teamwork Mode 1 (Parallel): Is best in small rooms with balanced heat loads. The controlling temperature and humidity sensor readings of all units in operation (fan On) are collected to be used for an average or worst case sensor reading (user selectable). The master unit shall send the operating requirements to all operating units in the group. The control band (temperature, fan and humidity) is divided and shared among the units in the group. Each unit will receive instructions on how to operate from the Master unit based on how far the system deviates from the setpoints. Evaporator fans and cooling capacity are ramped in parallel.

2. Teamwork Mode 2 (Independent): The unit controller calculates the worse-case demand for heating, cooling humidification and dehumidification. Based on the greatest demand within the group, each unit operates independently, meaning that the unit may respond to the thermal load and humidity conditions based on the unit's controlling sensors. All sensor readings are shared.

3. Teamwork Mode 3 (Optimized Aisle): May be employed in large and small rooms with varying heat loads. Optimized Aisle is the most efficient teamwork mode that allows the unit to match cooling capacity with heat load. In the Optimized Aisle mode, the fans operate in parallel. Fans can be controlled exclusively by remote temperature or using static pressure with a secondary remote temperature sensor(s) as an override to ensure that the inlet rack temperature is being met. Cooling (Compressors or Economizer) is controlled through unit supply air conditions. unit controller calculates the average or worst-case sensor reading (user-selectable) for heating, cooling humidification and dehumidification. Based on the demand within the group, units will be allowed to operate within that mode until room conditions are satisfied. This is the best form of control for a room with an unbalanced load.

B. The Unit controller® shall allow scheduled rotation to keep equal run time on units and provide automated emergency rotation of operating and standby units.

C. The unit controller cascade option shall allow the units to turn On and Off based on heat load when utilizing Teamwork Mode 1, Independent mode or Teamwork Mode 3, Optimized Aisle mode with remote temperature sensors. In Teamwork Mode 1, Cascade mode will stage units on based on the temperature and humidity readings and their deviation from setpoint. In Teamwork 3 Mode, Cascade mode dynamically coordinates the fan speed to save energy and to meet the cooling demands. For instance, with a unit controller group of six units and only 50% of the heat load, the unit controller shall operate only four units at 80% fan speed and leave the other two units in standby. As the heat load increases, the unit controller shall automatically respond to the additional load and bring on another unit, increasing the units in operation to five. As the heat load shifts up or down, the control shall meet the needs by cascading units On or putting them into standby.
D. Each unit controller shall have one factory-supplied and connected supply air sensor that may be used as a controlling sensor or reference. When multiple sensors are applied for control purposes, the user shall be able to control based on a maximum or average temperature reading.

E. The control system architecture of shall allow for a virtual master that coordinates operation. The Virtual Master function shall provide smooth control operation if the group's communication is compromised. When the lead unit, which is in charge of component staging in teamwork, unit staging and standby rotation, becomes disconnected from the network, the Liebert iCOM shall automatically assign a virtual master. The virtual master shall assume the same responsibilities as the master until communication is restored.

2.19 [WALL-MOUNT LARGE GRAPHIC DISPLAY PANEL]

A. The Large Monochrome Graphic Display Kit shall include an ergonomic, aesthetically pleasing housing, a 320 x 240 dot-matrix graphical display, and a 120 V power supply. The wall-mount large graphic display shall be used to allow remote location of a “System View” display and all features of the Large Graphic User, Service, and Advanced menus for use with manufacturer’s controlled products connected the manufacturer’s communication network.]

2.20 [MANUFACTURER’S COMMUNICATION NETWORK AND HARDWARE]

A. The network switch shall be designed for connecting multiple Ethernet-ready devices. The unit shall have one or two eight-port switches, providing a total of eight or 16 Ethernet ports. The system shall have the capability to accept 100-240VAC single-phase input power for proper operation. A universal power supply (12V, 1.5A) shall be installed inside a steel enclosure secured with a key lock with a hard-wired connection for 120V or 230V operation. A Monochrome display shall be mounted on the front and shall permit interconnected units to communicate through two CAT5 or better network patch cables with RJ-45 connectors to connect devices to available ports.

B. The number of ports available for Ethernet-ready devices varies by the number of eight-port switches included. The Monochrome display provided with the manufacturer’s communication network uses one port for connection to the switch. The 16-port model uses two ports to interconnect the switches.]

2.21 [ADVANCED MONITORING USING EXISTING NETWORK]

A. The Critical Infrastructure Management software shall centrally monitor and manage distributed equipment using the customer's existing network infrastructure. The system shall provide the Critical Infrastructure Management and Monitoring for air conditioning (CRAC) systems, uninterruptible power supply (UPS) systems, power distribution units (PDUs), static transfer switches (STS), direct current power systems (DC), power distribution strips (PDUs), Alber® battery monitoring, rack enclosure intrusion monitoring, leak detection systems and other critical infrastructure systems as specified. The system shall have an architecture that allows up to 10,000 managed devices, including Liebert and third-party devices, in a single-server installation.

B. All material and equipment used shall be standard components, regularly manufactured and available and not custom-designed especially for this project. All systems and components shall have previously been thoroughly tested and proven in actual use before installation on this project.
C. The manufacturer will furnish or supply a site-specific Critical Infrastructure Management software system based on customer requirements. The system must be a software-only solution; no substitutions shall be accepted.

D. The system architecture shall consist of network interface cards that shall be installed in all critical infrastructures that, at a minimum, support HTTP and SNMP simultaneously.

E. The system shall receive SNMP traps from managed equipment and display the alarm notification in a graphical user interface.

F. The system shall be based on SNMP open protocols and shall integrate seamlessly with THE UNIT MANUFACTURER’S software suite and Network Management Systems.

G. Open protocol support shall include:
   1. HTTP(s)
   2. TCP/IP/v4, TCP/IP/v6
   3. SNMPv1, SNMPv2
   4. The system shall have the capability of being remotely monitored and managed 24 hours a day, 7 days a week by the manufacturer.
   5. The system shall have the ability to be deployed worldwide.
   6. The system shall operate as a client-to-server application.
   7. The Web interface of each managed device shall integrate directly into the system.
   8. The system shall support enterprise-level databases including Microsoft® SQL™.
   9. The system shall support exporting of all recorded parametric trend data.
   10. The system shall operate on a server determined by the customer. Specific server brand or function is not permissible.
   11. The system shall support virtual server environments by default.
   12. The system shall include, at no additional cost, one (1) year of Software Assurance.

H. The owner shall furnish the following system components:
   1. Network (LAN) hardware and software required to provide an Ethernet backbone to be used for transport of IP data packets from network interface cards installed in all equipment to the Critical Infrastructure server and to the Liebert Nform workstations. These components may include hubs, routers, cabling, network operating systems, firewalls, IP addresses, virtual private network (VPN) and other components as required. The owner shall supply network drops for the Critical Infrastructure server, workstation clients and all network-interfaced equipment.
   2. Dedicated Critical Infrastructure server meeting the following minimum requirements:
      b. Pentium™ 3.0GHz single processor or better (1.8GHz dual processor or better recommended)
      c. 4 GB of RAM (memory) or better
      d. 40 GB hard drive (SCSI recommended)
      e. 10/100 BaseT network port or better
      f. Monitor / keyboard and mouse port as required for setup
      g. Standard USB ports
h. CD or DVD-ROM drive for software installation (CD/DVD-RW suggested for installation and backup)
i. Critical Infrastructure server may be Virtual Environment compatible
j. Critical Infrastructure Workstation PCs meeting the following minimum requirements:
k. System should meet the minimum requirements for Microsoft® Windows® 7, XP, 2003, Windows Vista®, Windows® 8/8.1 Enterprise, Windows Server® 2008 (R2) or Windows Server® 2012 (R2) operating system.
l. Microsoft Internet Explorer® v9.0 or better
m. 2 GB RAM (or the minimum operating system requirement)
n. 20 GB hard disk (or the minimum operating system requirement)

3. The owner shall supply the following to facilitate system implementation:

   a. IP addresses and subnet masks and other information as required to configure network devices
   b. A person as the nominated system owner for administrator purposes
   c. Secure location for hardware and server

I. Critical Infrastructure System Vendor Responsibilities

1. Provide hardware and software as listed.

   a. Critical Infrastructure software and licenses for server and workstation installations.
   b. Software Assurance for the first year at no additional cost.
   c. 7 x 24 system application and service support through a toll-free telephone number.
   d. Warranty (parts and labor) per the manufacturer’s warranty statement.
   e. Vendor shall be ISO 9001 listed for design and manufacture of environmental control systems for Critical Monitoring and Control applications.

2.22 [POINT LEAK DETECTION SENSOR FOR REMOTE MOUNTING]

   A. A total of 1 (quantity) solid-state water sensor for each individual cooling unit with no moving parts and hermetically sealed to keep out dust and dirt shall be provided. The sensor shall provide a single-point detection of leaks. The point detection sensor shall have two gold-plated sensing probes to prevent corrosion resistance and to provide accurate readings. The sensor shall constantly monitor points for leaks, internal faults, and power failures and warn of any abnormal conditions. Mounting brackets shall allow for sensor height adjustment and leveling. The sensor shall provide two independent outputs to signal both a local alarm panel and a remote building management system or external equipment. The sensor shall be rated for 24VAC, 50/60Hz and 0.10 amps.

2.23 [ZONE LEAK DETECTION MODULE WITH CABLE KIT FOR REMOTE MOUNTING]

   A. A total of 1 (quantity) zone water sensor cables for every 400ft.² of conditioned floor area for raised floor applications only, with no moving parts and hermetically sealed to keep out dust and dirt shall be provided. The sensor and control module shall provide a zone detection of leaks. The sensor and control module shall constantly monitor points for leaks, internal faults, and power failures and warn of any abnormal conditions. LED’s shall provide status indication and also ensure the cable is properly installed and operational under raised floors. The sensor
and control module shall provide two independent outputs provide a signal to a local alarm panel, environmental unit, remote building management system, or external equipment.

B. The control module shall consist of a metal enclosure with a hinged top door providing access to the internal circuit board for wiring termination and configuration of DIP switches. The control module shall monitor up to 100 feet (30m) of connected leak detection cable. The control module shall be rated for 24VAC, 50/60Hz, and 0.12A.

C. The cable material and construction shall allow the cable to lie flat when used with hold-down clips. The sensor cable shall be plenum-rated and UL-listed for safe operation. Cables shall be available in lengths of 20, 25, 30, 35, and 45 feet (6, 7.6, 9, 10.6, and 13.7m).

2.24 [HIGH TEMPERATURE SENSOR

A. This sensor shall be factory-installed in the unit and shall be factory-set to 125°F (52°C). It shall immediately shut down the environmental control system when activated. The sensor shall be mounted with the sensing element in the return air. This sensor is not meant to replace any fire detection system that may be required by local or national codes.

2.25 [SMOKE SENSOR

A. The smoke sensor samples the return air, shuts down the unit upon activation, and sends visual and audible alarms. Dry contacts are available for a remote customer alarm. The smoke sensor includes a “supervision” contact closure. This smoke sensor is not intended to function as or replace any room smoke detection system that may be required by local or national codes.

2.26 [REMOTE TEMPERATURE/HUMIDITY SENSOR

A. This sensor shall allow the control of the unit based on temperature/humidity conditions remote to the unit. This sensor shall be field-mounted and wired to the unit control board and the unit shall not have a return-air temperature/humidity sensor mounted inside the unit.

2.27 [LOW-VOLTAGE TERMINAL PACKAGE

A. Factory-installed and factory-wired terminals shall be provided for customer connection:

1. Remote Shutdown Terminals - Two additional pairs of terminals provide the customer with additional locations to remotely shut down the unit by field-installed devices or controls.
2. Extra Common Alarm Contacts - Two additional pairs of terminals provide the customer with normally open contacts for remote indication of unit alarms.
3. Main Fan Auxiliary Switch - One set of normally open contacts wired to the EC fan motor contactor will close when EC fan operation is required. This set of dry contacts could also be used to initiate air economizer operation. Air economizer and associated devices by others.
4. Leak Detector Shutdown - One pair of dry contacts for the sensor signal will provide unit shut down.

2.28 [REMOTE HUMIDIFIER CONTACT-OPTIONAL

A. A pair of N/O contacts provided for connection to a remote humidifier that allows the unit's
humidity controller to control a humidifier outside the unit. Power to operate the remote humidifier does not come from the unit.]

2.29 [COMPRESSOR OVERLOAD-OPTIONAL

A. A factory-installed sensor designed to detect high compressor currents and provide signal input to shut down the compressor as a compressor protection feature.]

2.30 [Supply Air Floor Stand - Downflow Raised Floor (Upflow, Not Rear Return)

A. The floor stand shall be constructed of galvanized steel. The floor stand shall have adjustable legs with vibration isolation pads. The floor stand height shall match the raised floor height.]

2.31 [Return Air Floor Stand Assembly

A. The upflow unit with rear returns air configuration shall be supplied with a skirted-floor stand assembly. The floor stand assembly shall be constructed of galvanized steel with powder-coated panels and supplied with air filter. The floor stand assembly shall be 24-1/8 in. (613mm) high and have adjustable legs with vibration isolation pads. It shall provide a rear return duct flange and removable panel for filter access.]

2.32 [DISCHARGE AIR PLENUM

A. The exterior panels shall be 20 gauge steel and powder-coated with black color paint to protect against corrosion. The exterior panels are insulated with 1/2” to 1” (12.7 to 25.4mm), 1-1/2 lb. (0.68 kg) insulation. Front and side panels shall have captive, quarter-turn fasteners.

B. For ducted applications, the unit shall be supplied with a ducted air discharge plenum. The plenum shall be 18in. with top duct connection.

C. For non-ducted applications, the unit shall be supplied with a two-way air discharge plenum. The plenum shall be 18 in.) high. Provide two-way, three-way, or four-way discharge grilles per floor plan location of cooling units.]

2.33 AIR COOLED CONDENSER

A. The condenser shall be designed to reject waste heat to outdoor air and to control refrigerant head pressure as indoor equipment loading and outdoor ambient conditions change. The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings. Standard 60Hz units shall be CSA-certified to the harmonized U.S. and Canadian product safety standard “CSA C22.2 No 236/UL 1995 for Heating and Cooling Equipment” and shall be marked with the CSA c-us logo.

B. The air-cooled condenser shall be a factory-assembled unit, complete with integral electrical panel, designed for outdoor installation. The condenser shall be a draw-through design.

C. Condenser shall consist of microchannel condenser coil(s), propeller fan(s) direct-driven by individual fan motor(s), electrical controls, housing, and mounting legs. The Liebert air-cooled condenser shall provide positive refrigerant head pressure control to the indoor cooling unit by adjusting heat rejection capacity. Microchannel coils shall provide superior heat transfer, reduce air-side pressure drop, increase energy efficiency, and significantly reduce the system
refrigerant volume required. EC fans and fan operating techniques shall reduce sound levels. Various methods shall be available to match indoor unit type, maximum outdoor design ambient and maximum sound requirements.

D. Microchannel coils shall be constructed of aluminum microchannel tubes, fins, and manifolds. Tubes shall be flat and contain multiple, parallel flow microchannels and span between aluminum headers. Full-depth louvered aluminum fins shall fill spaces between the tubes. Tubes, fins, and aluminum headers shall be oven-brazed to form a complete refrigerant-to-air heat exchanger coil. Copper stub pipes shall be electric resistance-welded to aluminum coils and joints protected with polyolefin to seal joints from corrosive environmental elements. Coil assemblies shall be factory leak tested at a minimum of 300 psig (2068 kPag). Hot gas and liquid lines shall be copper and shall be brazed using nitrogen gas flow to the stub pipes with spun-closed ends for customer piping connections. Complete coil/piping assembly shall be then filled and sealed with an inert gas holding charge for shipment.

E. [Aluminum microchannel coil with E-coat shall provide a flexible epoxy coating to all coil surface areas without material bridging between fins. E-coat shall increase coil corrosion protection and shall reduce heat rejection capacity degradation to less than 10% after a severe 2000 hour 5% neutral salt spray test (ref. ASTM B117). The coating process shall ensure complete coil encapsulation, and the color shall be black.]

F. The fan motor/blade assembly shall have an external rotor motor, fan blades and fan/finger guard. Fan blades shall be constructed of cast aluminum or glass-reinforced polymeric material. Fan guards shall be heavy gauge, close-meshed steel wire, coated with a black corrosion resistant finish. Fan terminal blocks shall be in an IP54 enclosure on the top of the fan motor. Fan assemblies shall be factory-balanced, tested before shipment and mounted securely to the condenser structure.

G. The EC fan motors shall be electronically commutated for variable speed operation and shall have ball bearings. The EC fans shall provide internal overload protection through built-in electronics. Each EC fan motor shall have a built-in controller and communication module, linked via RS485 communication wire to each fan and the Premium Control Board, allowing each fan to receive and respond to precise fan speed inputs from the Premium Control Board.

H. Electrical controls and service connection terminals shall be provided and factory-wired inside the attached control panel section. Only high-voltage supply wiring and low voltage indoor unit communication/interlock wiring are required at condenser installation.

I. The EC fan/Premium Control System shall include an electronic control board, EC fan motor(s) with internal overload protection, refrigerant and ambient temperature thermistors, and refrigerant pressure transducers. The Premium Control Board shall communicate directly with the indoor unit's controller via field-supplied CANbus communication wires and via field-supplied low voltage interlock wires. The control board shall use sensor and communication inputs to maintain refrigerant pressure by controlling each EC fan on the same refrigerant circuit to the same speed. The Premium control board shall be rated to a temperature of -30°F to 125°F. The premium control shall be factory set for fan speed with low ambient kit control.

J. A Locking-Type disconnect switch shall be factory-mounted and wired to the electrical panel and be capable of disrupting the flow of power to the unit and controlled via an externally mounted locking and lockable door handle. The locking disconnect shall be lockable in support of lockout/tagout safety programs.
K. The electrical panel shall provide at least 65,000A SCCR.

L. The condenser cabinet shall be constructed of bright aluminum sheet and divided into individual fan sections by full width baffles. Internal structural support members, including coil support frame, shall be galvanized steel for strength and corrosion resistance. Panel doors shall be provided on two sides of each coil/fan section to permit coil cleaning. An electrical panel shall be contained inside a factory-mounted NEMA 3R weatherproof electrical enclosure.

M. Aluminum legs shall be provided to mount unit for vertical air discharge with rigging holes for hoisting the unit into position. Standard height is 18 in. (457mm).

N. Low Ambient Receiver Kit shall contain an insulated, heated receiver tank with sight glasses, mounting plate, mounting hardware, pressure relief valve, rota-lock valve for refrigerant charge isolation and piping assembly with head pressure operated three-way valve and check valve.

1. Components shall be field-assembled to the condenser. The three-way valve shall sense refrigerant head pressure and adjust the flooding charge in the condenser coil to adjust the condenser heat rejection capacity. The low ambient heater shall be 150W, shall include an integral thermostat to maintain refrigerant temperature at a minimum of 85°F (29°C) and shall require a separate power supply of 120V-1ph-60Hz.

2. The Low Ambient Kit shall function with variable speed fan motors and electronic controls that lower fan speed in lower outdoor ambient temperatures for maximum energy efficiency. This system shall allow system startup and positive head pressure control with ambient temperatures as low as 0°F.

3. Receiver Kit shall contain a painted, un-insulated receiver with integral fusible plug, formed copper pipe for ease of connecting condenser liquid line to receiver and mounting bracket. Additional full-length leg is shipped with condenser (18 in., 36 in. and 48 in.) or with 60 in. leg kit and should be secured to the mounting surface. One receiver kit shall be field installed per refrigerant circuit.

O. A fusible plug kit shall be field-installed on the liquid line for compliance with building codes requiring refrigerant relief during high temperature and building fire conditions.

P. IBC/OSHPD Seismic Certification and IBC Wind/Snow Load Compliant condensers shall be provided with any applicable bracing and field-installation instructions. Condensers shall bear a label certifying compliance with IBC/OSHPD requirements.

2.34 GLYCOL DRYCOOLER

A. The drycooler shall be designed to reject waste heat to outdoor air and to control glycol temperature as pumped glycol rates and outdoor ambient conditions change. The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings. Standard 60Hz units shall be CSA-certified to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for Heating and Cooling Equipment and shall be marked with the CSA c-us logo.

B. The drycooler shall be a factory-assembled unit, complete with integral electrical panel, designed for outdoor installation and vertical airflow only. The drycooler shall be a draw-through design.
C. The drycooler shall consist of drycooler coil(s), housing, propeller fan(s) direct-driven by individual fan motor(s), electrical controls, and mounting legs. The drycooler shall provide glycol temperature control to the indoor cooling unit by adjusting heat rejection capacity. Various methods shall be available to match indoor unit type, minimum outdoor design ambient and maximum sound requirements.

D. The manufactured coil shall be constructed of copper tubes in a staggered tube pattern. Tubes shall be expanded into continuous, corrugated aluminum fins. The fins shall have full-depth fin collars completely covering the copper tubes, which shall connected to heavy wall Type “L” headers. Inlet coil connector tubes shall pass through relieved holes in the tube sheet for maximum resistance to piping strain and vibration. Coil shall be split flow into multiple coil circuits, combined to yield a drycooler with the number of internal circuits that are required for scheduled unit capacity at actual project conditions. The supply and return lines shall be spun shut for units with 1-4 fans and brazed with a cap for units with 6 or 8-fans and shall include a factory-installed Schrader valve. Coils shall be factory leak-tested at a minimum of 300 psig (2068kPag), dehydrated, then filled and sealed with an inert gas holding charge for shipment. Field relief of the Schrader valve shall indicate a leak-free coil.

E. The drycooler housing shall be constructed of bright aluminum sheet and divided into individual fan sections by full-width baffles. Structural support members, including coil support frame, motor and drive support, shall be galvanized steel for strength and corrosion resistance. Aluminum legs shall be provided to mount unit for vertical air discharge and shall have rigging holes for hoisting the unit into position. An electrical panel shall be inside an integral NEMA 3R weatherproof section of the housing.

F. The propeller fan shall have aluminum blades secured to a corrosion protected steel hub. Fans shall be secured to the fan motor shaft by means of a keyed hub and dual setscrews. Fan diameter shall be 26” (660mm) or less. Fans shall be factory-balanced and run before shipment. Fan guards shall be heavy gauge, close-mesh steel wire with corrosion resistant PVC finish that shall be rated to pass a 675-hour salt spray test.

G. The fan motor shall be continuous air-over design and shall be equipped with a rain shield and permanently sealed bearing. Motors shall be rigidly mounted on die-formed galvanized steel supports.

H. Electrical controls, overload protection devices and service connection terminals shall be provided and factory-wired inside the integral electrical panel section of the housing. A locking disconnect switch shall be factory-mounted and wired to the electrical panel and controlled via an externally mounted locking door handle. An indoor unit interlock circuit shall enable drycooler operation whenever indoor unit compressors are active. Only supply wiring, indoor unit interlock wiring, and high voltage wiring to pumps when controlled by the drycooler shall be required at drycooler installation.

I. SPECIFIC DRYCOOLER CAPACITY CONTROL

1. [Fan Speed Control (DSF/DDF) Drycooler (1 Fan) with Integral pump control]
   a. The DSF/DDF drycooler shall have a fan speed controller that senses the leaving glycol temperature and varying the speed of a FSC duty motor in direct proportion to the heat rejection needs of the system. Fan speed controller shall be factory set to range of 70 to 100°F (21 to 38°C) for glycol-cooled applications. The fan speed control shall be field adjustable to a range of 30 to 60°F (2 to 7°C) for free-cooling...
applications. The motor shall be single-phase and include built-in overload protection. The motor shall have an ODP enclosure. The DSF/DDF drycooler shall control operation of glycol pumps powered from the electrical panel. The air-cooled drycooler shall have a 120 volt, 1 ph, 60 Hz power supply.]

2. **Fan Cycling Control FAN(DSO, DDO) Drycooler (All Fan Quantities) with Integral Pump Control**

   a. The DSO/DDO drycooler shall sense the leaving glycol temperature and cycle fixed speed fans to maintain glycol temperatures. Aquastats shall have field-adjustable set-points. The fixed speed motors shall be three-phase and have individual internal overload protection. Fixed speed motors shall have a TEAO enclosure. The DSO/DDO drycooler shall control operation of glycol pumps powered from the electrical panel. The air-cooled drycooler shall have a 230/460 volt, 3 ph, 60 Hz power supply.]

3. **Fan Cycling Control (DDNT/DNT) Drycooler (All Fan Quantities)**

   a. The DDNT/DNT drycooler shall sense the leaving glycol temperature and cycle fixed-speed fans to maintain glycol temperatures. Aquastats shall have field-adjustable setpoints. The fixed-speed motors shall be three-phase and have individual internal overload protection. Fixed-speed motors shall have a TEAO enclosure. The air-cooled drycooler shall have a 230/460 volt, 3 ph, 60 Hz power supply.]

4. **Main Fan Control (DDNL/DNL) Drycooler (All Fan Quantities)**

   a. The DDNL/DNL drycooler shall control fixed-speed fans when an external contact closure completes the internal 24VAC circuit. The fixed-speed motors shall be three-phase and have individual internal overload protection. Fixed-speed motors shall have a TEAO enclosure. The air-cooled drycooler shall have a 230/460 volt, 3 ph, 60Hz power supply.]

5. **No Fan Control (DDNC/DNC) Drycooler (All Fan Quantities)**

   a. The [D]DNC/DNC drycooler shall activate all fixed-speed fans when supply power is applied to the drycooler. The fixed-speed motors shall be three-phase and have individual internal overload protection. Fixed-speed motors shall have a TEAO enclosure. The air-cooled drycooler shall have a 230/460 volt, 3 ph, 60 Hz power supply.]

J. The drycooler shall be provided with manufacturer’s sound reduction package when called for on equipment schedules. The sound reduction package shall be available for DSO, DDO, DDNT, DDNL and DDNC control types. The fan motor(s) shall have a TEAO enclosure and provide individual overload protection for quiet operation.

K. Pump controls for a single glycol pump up to 7.5 hp (5.6kW) shall be incorporated into the same integral electrical panel as the drycooler fan controls and may include fuses or circuit breakers as required for the pump motor. Pump voltage, phase, and frequency shall be same as drycooler voltage, phase, and frequency. This system shall be provided with a centrifugal pump mounted in a weatherproof and vented enclosure. Refer to equipment schedules for pump capacities.
L. Pump controls for a dual glycol pump system up to 7.5 hp (5.6 kW) shall operate one pump as primary and the second pump shall operate as a standby pump. Pump controls shall be incorporated into the same integral electrical panel controlling drycooler fans. A factory-supplied, field-installed flow switch shall sense loss of flow and switch to the standby pump for continuous system operation. An internal switch shall allow manual selection of the primary (lead) pump. The dual pump package shall include pumps, enclosure, and field-mounted flow switch. The standby pump shall automatically start up on failure of the lead pump by drycooler pump controls or by a separate factory-wired control box and shall include a lead/lag switch for the pumps. Refer to equipment schedules for pump capacities.

M. Ancillary glycol loop items shall be provided including expansion tanks, fluid relief valves, air management, and other devices.

1. An expansion tank shall be provided for expansion and contraction of the glycol fluid due to temperature change in the closed system. The tank and air vents shall be field-installed at the system's highest elevation to allow venting of trapped air. A fluid pressure relief valve shall be provided for system safety. The system shall include tank-steel expansion, air separator, air vent, fluid pressure relief valve, pressure gages, flow switches, tempering valves, primary and standby pumps, supply and return piping).

2.35 MATED TANDEM DRYCOOLERS

A. Coil is constructed of copper tubes in a staggered tube pattern. Tubes are expanded into aluminum plate type fins. The fins have full depth fin collars that bond to the seamless copper tubes. Coils are installed to provide horizontal air inlet.

B. Fans shall be quiet, low speed centrifugal type, double width, double inlet, dynamically balanced to a vibration tolerance of two mils in any plane with lifetime lubricated self-aligning ball bearings rated at 100,000 hours. The open drip-proof fan motor operates at 1750 RPM for 60 HZ and is mounted on an adjustable slide base. A top or rear discharge location enables the draw-through design to provide even air distribution across the coil.

C. Fan drives Consist of one fixed pitch sheave keyed to the fan shaft and a variable pitch sheave keyed to the motor shaft. The sheaves are machined cast iron, double grooved, and are statically balanced. Dual V-belts, standard for extra protection, are super-grip or grip-notched type.

D. Cabinet and fixture shall be custom painted steel panels with 1" (25.4mm), 1 1/2 lb. (.68 kg) insulation. A hinged left end access panel opens to a second dead front panel which is a protection enclosure for all high voltage components. Frame is constructed of 14 gauge heliarc welded tubular steel.

E. Glycol pump is a single staged, end suction, close coupled, with ball bearing motors, bronze fitted construction, stainless steel pump shaft, high efficiency impellers, and designed for continuous service.

F. Air filter shall be deep pleated with a minimum efficiency rating of MERV8 (based on ASHRAE 52.2-2007) located within the cabinet inside the optional filter chamber positioned in front of the condenser coil, and serviceable from either end of the unit.

G. Locking type unit disconnect switch consisting of a non-automatic molded case circuit breaker
operational from the outside of the unit. Access to the high voltage electric panel compartment can be obtained only while the breaker is in the “off” position.

H. Floor stand is constructed of heliarc welded tubular steel provided in height to match height of raised floor, with vibration isolation pads provided on the adjustable legs.

I. Oversized blower and pump motors when required to meet unit scheduled performance.

J. Dual glycol pumps with automatic changeover control provide 100% redundancy of the glycol pump when scheduled.

K. [A manufacturer furnished glycol pump is not required when dry cooling unit is being connected to a central dedicated glycol condenser cooling units loop where the pumping system is centralized.]

PART 3 - EXECUTION

3.1 Install precision cooling units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

3.2 Install and connect electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor.

3.3 Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.

3.4 Start the system in accordance with manufacturer's startup instructions. Test controls and demonstrate compliance with requirements. These specifications describe requirements for a computer room environmental control system. The system shall be designed to maintain temperature and humidity conditions in the rooms containing electronic equipment.

The manufacturer shall design and furnish all equipment to be fully compatible with heat dissipation requirements.

3.5 Connect water supply and drains to air conditioning unit. Provide pitch and trap as manufacturer's instructions and local codes require.

3.6 Engage manufacturer's field service technician to provide warranty start-up supervision and assist in programming of unit(s) controls and ancillary panels supplied by them.

END OF SECTION 23 81 23.16
PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 – Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Floor mounted computer room air conditioning units with microprocessor based controls.

B. Outdoor remote mounted air cooled condensing units and water/glycol cooled condensers.

C. The system shall have a total cooling capacity and a sensible cooling capacity as indicated in the Mechanical Schedules.

D. The unit is to be supplied for operation on a power supply as indicated in the Mechanical Schedules and the Electrical drawings.

1.3 RELATED SECTIONS

A. Section 23 02 00 – Basic Materials and Methods

B. Section 23 05 29 – Hangers and Support for Piping and Equipment HVAC

C. Section 23 05 13 – Common Motor Requirements for HVAC Equipment

D. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment

E. Section 23 07 13 – Duct Insulation

F. Section 23 07 19 – HVAC Piping Insulation

G. Section 23 34 00 – HVAC Fans

H. Section 23 23 00 – Refrigerant Piping

I. Section 23 41 00 – Air Filters

J. Section 23 31 13 – Metal Ductwork

K. Section 23 31 19 – Ductwork Accessories

L. Section 23 05 93 – Testing, Adjusting, and Balancing

M. Section 23 21 19 – Hydronic Specialties
1.4 QUALITY ASSURANCE

A. The specified system shall be factory-tested before shipment. Testing shall include, but shall not be limited to: Quality Control Checks, “Hi-Pot” Test (two times rated voltage plus 1000 volts, per NRTL agency requirements), and Metering Calibration Tests. The system shall be designed and manufactured according to world-class quality standards. The manufacturer shall be ISO 9001 certified.

B. System shall be supplied with CSA Certification to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for “Heating and Cooling Equipment” and marked with the CSA c-us logo (60Hz only).

C. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators."

D. UL Compliance: Fans and components shall be UL listed and labeled.

E. Nationally Recognized Testing Laboratory Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

F. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

G. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

H. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.

I. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

B. Product data for selected models, including specialties, accessories, and 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 fan accessories.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Coordination drawings, in accordance with Division 23, Section "Basic Materials and
Methods", for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted within or above ceiling. Show the following: Framing and support members relative to duct penetrations.

2. Ceiling suspension members.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

E. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer installed wiring and field installed wiring.

F. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.

G. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23, Section "Basic Materials and Methods".

1.6 DELIVERY, STORAGE, AND HANDLING

A. Equipment shall be stored and handled in accordance with the unit manufacturer’s instructions.

B. Lift and support units with the manufacturer's designated lifting or supporting points.

C. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

D. Deliver units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, refrigeration piping has been tested and charged and fan has been test run under observation.

1.8 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

1.9 WARRANTY
A. Provide a manufacturer’s warranty for two years from date of shipment from defects in material and workmanship when used in a proper and normal manner. Manufacturer shall have the option to repair or replace the defective part including material and labor.

B. Provide a five year compressor, motor, parts, labor and refrigerant warranty, effective for five years from date of factory start-up and certification.

PART 2 - PRODUCTS

2.1 FRAME

A. The frame shall be MIG welded, formed sheet metal. It shall be protected against corrosion using the autophoretic coating process. The frame shall be capable of being separated into three parts in the field to accommodate rigging through small spaces.

2.2 Downflow Air-flow Configurations

A. Downflow Air Supply
   1. The supply air shall exit from the bottom of the unit.

B. Downflow Air, Under-floor discharge
   1. The supply air shall exit from the bottom of the unit.

C. Downflow Air, EC Fans Lowered into Floor Stand
   1. The supply air shall exit from all sides of the floor stand.

D. Downflow Air, Front Discharge
   1. The supply air shall exit from the front of the unit.

E. Downflow Air, Rear discharge
   1. The supply air shall exit from the rear of the unit.

F. Downflow Air Return
   1. The return air shall enter the unit from the top

2.3 Upflow Air-flow Configurations

A. Upflow Air Supply
   1. The supply air shall exit from the top of the unit.

B. Upflow Top Air Supply, Front Throw
   1. The supply air shall exit from the top of the cabinet (or plenum) with the air throw toward the front.

C. Upflow Top Air Supply, Rear Throw
1. The supply air shall exit from the top of the cabinet (or plenum) with the air throw toward the back.

D. Upflow Rear Air Supply

1. The supply air shall exit from the back of the cabinet.

E. Upflow Air Return, Front

1. The return air shall enter the unit from the front of the cabinet through factory-installed grilles. Grilles shall be painted black.

F. Upflow Air Return, Rear

1. The return air shall enter the unit from the back of the cabinet.

2.4 Exterior Panels

A. The exterior panels shall be insulated with a minimum 1 in. (25 mm), 1.5 lb. (0.68 kg) density fiber insulation. The main front panel shall have captive quarter turn fasteners. The exterior panels shall be internally lined with 20 gauge sheet metal, sandwiching the insulation between the panels.

2.5 FILTERS

A. For Downflow units, the filter chamber shall be located within the cabinet, and filters shall be removable from the top of the unit. Filters shall be arranged in a flat bank configuration.

B. For Upflow units, the filter chamber shall be located within the cabinet, and filters shall be removable from the front or rear of the unit. Filters shall be arranged in a horizontal bank configuration.

C. Filters shall be deep pleated 4 in. filters ASHRAE 52.2 MERV11 rating (60-65% ASHRAE 52.1).

D. 2 extra set(s) of filters shall be provided per system.

2.6 LOCKING DISCONNECT SWITCH

A. The manual disconnect switch shall be mounted in the high-voltage section of the electrical panel. The switch shall be accessible from the outside of the unit with the door closed, and shall prevent access to the high voltage electrical components until switched to the Off position.

2.7 ELECTRONICALLY COMMUTATED (EC) FAN (Direct Drive Models – Refer to Equipment Schedules)

A. The fans shall be plug/plenum type, single inlet and shall be dynamically balanced. The drive package shall be direct drive, electronically commutated and variable speed. The fans shall be located to draw air over the A-frame coil to ensure even air distribution and maximum coil performance. EC fans shall be available on downflow models, and fans may be lowered into a raised floor with a minimum height of 24 in. (610 mm). EC fans may operate within the
Liebert DS cabinet, instead of under the floor. EC fans shall be available on upflow models and fans shall operate outside the unit in a factory-provided plenum with a minimum height of 24 in. (610 mm).

1. 8 ton thru 12 ton units fan motor(s) shall be nominal 3.7 hp (2.8 kW) each with a maximum operating speed of 1230 rpm; the dual source cooling coil gets a 5.4 hp (4.0 kW) fan for 380 480V (maximum 1370 rpm).
2. 15 ton thru 22 ton units fan motors shall be nominal 4.0 hp (3.0 kW) each with a maximum operating speed of 1520 rpm; minimum two (2) fans.
3. 30 ton units fan motors shall be nominal 3.4 hp (2.5 kW) each, with a maximum operating speed of 1700 rpm; quantity, 3. (Power rating for 380-480V is 3.4 hp (2.5 kW); for 200-240V power is 3.6 hp 2.7kW; minimum three (3) fans.

2.8 FORWARD CURVED BLOWER (Belt Drive Models – Refer to Equipment Schedules)

A. The blower section shall be designed for capacity as indicated on the equipment schedules.
B. The fans shall be the centrifugal type, double-width and double-inlet, and shall be dynamically balanced as a completed assembly. The shaft shall be heavy-duty steel with self-aligning, permanently-sealed, pillow-block bearings with a minimum L3 life of 200,000 hours. The fans shall draw air through the coil to ensure even air distribution and maximum coil performance. Fan motor shall be capacity as indicated on the equipment schedules at 1750 rpm @ 60 Hz (1450 rpm @50 Hz), mounted to an automatic, spring tensioning base. The motor shall be removable from the front of the cabinet. The drive package shall be two-belt, variable speed, sized for 200% of the fan-motor horsepower. An auto-tension system shall provide constant tension on the belts. Belts, shaft, blower bearings, sheave, and pulley shall be warranted for 5 years (parts only).
C. The fan motor shall be Open Drip-Proof, Premium efficiency and shall meet NEMA Premium standard.
D. The motor shall be Totally Enclosed Fan Cooled for protection in harsh environments.
E. The motor sheave and fan pulley shall be double-width fixed pitch. Two belts, sized for 200% of the fan motor horsepower shall be provided with the drive package. An auto-tension system shall provide constant tension on the belts. Belts, shaft, blower bearings, sheave and pulley shall be warranted for five years (parts only).

2.9 HUMIDIFIER

A. A humidifier shall be factory-installed inside the unit. Bypass air slots shall be included to enable moisture to be absorbed into the air stream. The humidifier capacity shall be as indicated on the equipment schedules. The humidifier shall be removable from the front of the cabinet.

1. Infrared Humidifier - The humidifier shall be of the infrared type, consisting of high-intensity quartz lamps mounted above and out-of the water supply. The humidifier pan shall be stainless steel and arranged to be removable without disconnecting high-voltage electrical connections. The complete humidifier section shall be pre-piped, ready for field connection to the water supply. The humidifier shall be equipped with an automatic water-supply system and shall have an adjustable water-overfeed to prevent mineral precipitation. A high-water detector shall shut-down the humidifier...
to prevent overflowing. A 1 in. (24 mm) air-gap shall prevent back-flow of the humidifier supply water.

2.10 REHEAT

A. The environmental control unit shall include a factory-installed reheat to control temperature during dehumidification.

1. SCR Electric Reheat - The electric reheat coils shall be low watt density, 304/304 stainless steel fin tubular construction, protected by thermal safety switches, capacity as indicated on the equipment schedules controlled by multiple pulses to achieve tight temperature control. The reheat elements shall be removable from the front of the cabinet.

2.11 DUAL REFRIGERATION SYSTEM WITH DIGITAL SCROLL COMPRESSORS

A. Each unit shall include two (2) independent refrigeration circuits and shall include liquid line filter dryers, refrigerant sight glasses with moisture indicator, externally equalized expansion valves and liquid line solenoid valves. Compressors shall be located outside the air stream and shall be removable and serviceable from the front of the unit.

B. The compressor shall be scroll-type with a variable capacity operation capability. The compressor solenoid valve shall unload the compressor and allow for variable capacity operation. The compressor shall be suction gas cooled motor, vibration isolators, thermal overloads, automatic reset high-pressure switch with lockout after three failures, rotalock service valves, pump down low pressure transducer, suction line strainer and a maximum operating speed of 3500 rpm. Consult factory for 575V availability.

C. The compressors shall include crankcase heaters, powered from the indoor unit electric panel.

2.12 EVAPORATOR COIL

A. The evaporator coil shall be A-frame design on downflow units with offset orientation. It shall be constructed of rifled copper tubes and aluminum fins and shall have a maximum face velocity of 450 ft. per minute. A stainless-steel condensate drain pan shall be provided. Number of rows, fins and fin spacing to meet the scheduled project design requirements. The system shall be designed for use with R-407C refrigerant.

B. The dual-cooling source system shall consist of an air-cooled or water-cooled compressorized system with the addition of a chilled water coil, a modulating control valve and a comparative temperature sensor. The system shall be able to function either as a modulating chilled water system or as a compressorized system, or a combination of both. The primary cooling mode shall be chilled water. Switchover between the two cooling modes shall be performed automatically by the microprocessor control. Four (4) pipes shall be included on water/glycol systems: Dual Source Coil supply, Dual Source Coil return, condenser supply and condenser return. The water circuit shall include a three-way modulating valve. The microprocessor positions the valve in response to room conditions. Cooling capacity will be controlled by bypassing chilled water around the coil. The modulating valve travel for dehumidification shall be proportional.

2.13 WATER/GLYCOL COOLED CONDENSER SYSTEMS
A. The water-cooled condensers for each circuit shall be cleanable, shell-and-tube, counter-flow type. The heads shall be removable to allow for cleaning of the water tubes. Condensers shall be rated for a maximum refrigerant pressure of 400 psi at 200°F (2758 kPa at 93.3°C). The condenser shall be capable of operating with R 407C refrigerant. The unit capacity shall be as indicated on the equipment schedules.

B. The condenser shall be pre-piped with a 3-way regulating valve.

C. The condenser water circuit shall be designed for a pressure of 150 psi (1034 kPa).

2.14 CHILLED GLYCOL COOLING COIL

A. The chilled glycol cooling coil shall be constructed of copper tubes and aluminum fins. The coil shall be A-frame or V-frame to minimize air-pressure drop and shall be nested with the DX coil. The chilled glycol cooling coil shall be upstream of the DX coil to enable pre-cooling of the air. The chilled glycol cooling coil shall have a capacity as indicated on the equipment schedules. The total unit pressure drop shall not exceed 15 feet of water (kPa), when in the chilled glycol cooling coil mode of operation.

B. The chilled glycol cooling coil shall be equipped with a fully-proportional 3-way control valve. This motorized control valve shall control the amount of flow to the coil to control room temperature and relative humidity.

C. The chilled glycol cooling coil system shall be designed for a pressure of 350 psi (2413 kPa).

2.15 MICROPROCESSOR CONTROL WITH 9 INCH COLOR TOUCHSCREEN

A. The unit controller shall be microprocessor-based with a 9 in. color touchscreen display and shall be mounted in an ergonomic, aesthetically pleasing housing. The display and housing shall be viewable while the front panel is open or closed. The controls shall be menu-driven. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in percentage of each function, date and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes. Service menus shall include setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards and diagnostics/service mode.

1. Password Protection - The unit controller shall contain two unique passwords to protect against unauthorized changes. An auto hide/show feature shall allow the user to see applicable information based on the login used.

2. Unit Backup/Restore - The Backup function saves a copy of the settings in a file based on the system name assigned during startup. The backup can be used to restore only the unit where it was created and serve as a recovery if a display fails. The backup file includes network settings, the unit name, panel configuration and other details specific to the unit controller display. The Restore function copies the backup settings file to a unit controller/display so that it functions exactly as it did before the unwanted change or as it did on the unit controller that was replaced.

3. Unit Export/Import - The Export function makes a copy of the settings from the unit controller display that may be stored on a local disk or USB drive. The settings may be imported to a second unit controller, resulting in two systems with identical display properties. The unit controller will automatically recognize USB drives and display...
them in the relevant screens. Multiple backup files may be put on the same USB drive as long as each system name is unique. The Import function allows previously exported settings files to be loaded to a second unit controller. This allows display settings, including panel configurations and custom labels, to be copied from one display to another.

4. Parameter Download - The unit controller shall enable the user to download a report that lists parameter names, factory default settings and user programmed settings in .csv format for remote reference.

5. Parameter Search - The unit controller shall have search fields for efficient navigation and parameter lookup.

6. Parameter Directory - The unit controller shall provide a directory that lists all parameters in the control. The list shall provide Line ID numbers, parameter labels, and current parameter values.

7. Setup Wizards - The unit controller shall contain step-by-step tutorials or wizards to provide easy setup of the control.

8. Context-Sensitive Help - The unit controller shall have an on-board help database. The database shall provide context-sensitive help to assist with setup and navigation of the menus.

9. Display Setup - The user shall be able to configure the display information based on the specific user’s preference. Language, units of measure, screen contrast, home screen layout, back-light timer and the hide/show of certain readouts shall be configurable through the display.

10. Additional Readouts - The display shall enable the user to configure custom widgets on the main screen. Widget options will include items such as fan speed, call for cooling, call for free-cooling, maintenance status, call for hot water reheat, call for electric reheat, call for dehumidification, call for humidification, airflow, static pressure, fluid flow rate and cooling capacity.

11. Status LED’s - The unit controller shall show the unit’s operating status using an integral LED. The LED shall indicate if the unit has an active alarm; if the unit has an active alarm that has been acknowledged; or if the unit is On, Off or in standby status.

12. Event Log - The unit controller shall automatically store the last 400 unit-only events (messages, warnings, and alarms).

13. Service Contact Information - The unit controller shall be able to store the local service or sales contact information.

14. Upgradeable - unit controller upgrades shall be performed through a USB connection.

15. Timers/Sleep Mode – The menus shall allow various customer settings for turning the unit On or Off.

16. Menu Layout - The menus shall be divided into two main menus: User and Service. The User screen shall contain the menus to access parameters required for basic unit control and setup. The Service screen shall be designed for service personnel and shall provide access to advanced control setup features and diagnostic information.

17. Sensor Calibration - The menus shall allow unit sensors to be calibrated with external sensors.

18. Maintenance/Wellness Settings - The menus shall allow reporting of potential component problems before they occur.

19. Options Setup - The menus shall provide operation settings for the installed components.

20. Auxiliary Boards - The menus shall allow setup of optional expansion boards.

21. Various Sensors: The menus shall allow setup and display of optional custom sensors. The control shall include four customer accessible analog inputs for field-supplied sensors. The analog inputs shall accept a 4 to 20mA signal. The user shall be able to
change the input to 0 to 5VDC or 0 to 10VDC. The gains for each analog input shall be programmable from the front display. The analog inputs shall be able to be monitored from the front display.

22. Diagnostics/Service Mode - The unit controller control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as On or Off at the front display. Control outputs shall be able to be turned On or Off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

B. All unit alarms shall be annunciated through both audio and visual cues, clearly displayed on the screen, automatically recorded in the event log and communicated to the customers Building Management System/Building Automation System. The unit controller control shall activate an audible and visual alarm in event of any of the following conditions:

1. High Temperature
2. Low Temperature
3. High Humidity
4. Low Humidity
5. EC Fan Fault
6. Change Filters
7. Loss of Air Flow
8. Loss of Power
9. Compressor Overload (Optional)
10. Humidifier Problem
11. High Head Pressure
12. Low Suction Pressure
13. Custom Alarms
14. Leak Under Floor
15. Smoke Detected
16. Standby Unit On
17. Each alarm (unit and custom) shall be separately enabled or disabled, selected to activate the common alarm and programmed for a time delay of 0 to 255 seconds.

C. The unit controller shall be factory-set to allow precise monitoring and control of the condition of the air entering and leaving the unit. This control shall include predictive methods to control air flow and cooling capacity based control sensors installed. Proportional and Tunable PID shall also be user-selectable options.

D. Unit Controller shall be flexible in the sense that it shall allow for controlling the capacity and fan from multiple different sensor selections. The sensor selections shall be:

1. Cooling Capacity
   a. Supply
   b. Remote
   c. Return

2. Fan Speed
   a. Supply
   b. Remote
c. Return

d. Static Pressure

E. The unit controller shall be able to adjust the capacity output based on supply and return temperature conditions to meet SLA guidelines while operating to highest efficiency.

F. Dew point and relative humidity control methods shall be available (based on user preference) for humidity control within the conditioned space.

2.16 MULTI-UNIT COORDINATION

A. Unit controller shall control multiple units in a parallel, independent and optimized format. Teamwork shall save energy by preventing multiple units in an area from operating in opposing modes. Teamwork allows the control to optimize a group of connected using the cooling unit manufacturer’s network. There shall be three modes of teamwork operation:

1. Teamwork Mode 1 (Parallel): Is best in small rooms with balanced heat loads. The controlling temperature and humidity sensor readings of all units in operation (fan On) are collected to be used for an average or worst case sensor reading (user selectable). The master unit shall send the operating requirements to all operating units in the group. The control band (temperature, fan and humidity) is divided and shared among the units in the group.

2. Each unit will receive instructions on how to operate from the Master unit based on how far the system deviates from the setpoints. Evaporator fans and cooling capacity are ramped in parallel.

3. Teamwork Mode 2 (Independent): The unit controller calculates the worse-case demand for heating, cooling humidification and dehumidification. Based on the greatest demand within the group, each unit operates independently, meaning that the unit may respond to the thermal load and humidity conditions based on the unit’s controlling sensors. All sensor readings are shared.

4. Teamwork Mode 3 (Optimized Aisle): May be employed in large and small rooms with varying heat loads. Optimized Aisle is the most efficient teamwork mode that allows the unit to match cooling capacity with heat load. In the Optimized Aisle mode, the fans operate in parallel. Fans can be controlled exclusively by remote temperature or using static pressure with a secondary remote temperature sensor(s) as an override to ensure that the inlet rack temperature is being met. Cooling (Compressors or Economizer) is controlled through unit supply air conditions. unit controller calculates the average or worst-case sensor reading (user-selectable) for heating, cooling humidification and dehumidification. Based on the demand within the group, units will be allowed to operate within that mode until room conditions are satisfied. This is the best form of control for a room with an unbalanced load.

B. The unit controller shall allow scheduled rotation to keep equal run time on units and provide automated emergency rotation of operating and standby units.

C. The unit controller cascade option shall allow the units to turn On and Off based on heat load when utilizing Teamwork Mode 1, Independent mode or Teamwork Mode 3, Optimized Aisle mode with remote temperature sensors. In Teamwork Mode 1, Cascade mode will stage units On based on the temperature and humidity readings and their deviation from setpoint. In Teamwork 3 Mode, Cascade mode dynamically coordinates the fan speed to save energy and to meet the cooling demands. For instance, with a unit controller group of six units and only 50% of the heat load, the unit controller shall operate only four units at 80% fan speed and...
leave the other two units in standby. As the heat load increases, the unit controller shall automatically respond to the additional load and bring on another unit, increasing the units in operation to five. As the heat load shifts up or down, the control shall meet the needs by cascading units On or putting them into standby.

D. Each unit controller shall have one factory-supplied and connected supply air sensor that may be used as a controlling sensor or reference. When multiple sensors are applied for control purposes, the user shall be able to control based on a maximum or average temperature reading.

E. The control system architecture shall allow for a virtual master that coordinates operation. The Virtual Master function shall provide smooth control operation if the group’s communication is compromised. When the lead unit, which is in charge of component staging in teamwork, unit staging and standby rotation, becomes disconnected from the network, the unit controller shall automatically assign a virtual master. The virtual master shall assume the same responsibilities as the master until communication is restored.

F. To help maximize the life of the compressor(s), there shall be start-to-next start delay for each single compressor. The control shall monitor the number of compressor starts in an hour. If the compressor starts more than 10 times in 60 minutes, the local display and remote monitoring shall notify the user through a Compressor 1 or 2 Short Cycle event.

G. Units may be matched to a premium-efficiency condenser control with enhanced monitoring, alarming and diagnostics. The condenser control shall have an automated, low-noise mode and fan reversal for cleaning mode.

H. The auto restart feature shall automatically restart the system after a power failure. Time delay shall be programmable. An optional capacitive buffer may be provided for continuous control operation through a power failure.

I. On initial startup or restart after power failure, each operational load shall be sequenced with a minimum delay of one second to minimize total inrush current.

J. Units shall ship standard with low-pressure transducers for monitoring individual compressor suction pressure. If the pressure falls due to loss of charge or other mechanical cause, the corresponding circuit shall shut down to prevent equipment damage. The user shall be notified of the low-pressure condition through the local display and remote monitoring.

K. An adjustable software timer shall be provided to assist with compressor starting during cold weather. When the compressor starts, the low-pressure input shall be ignored for the period set in the user-adjustable timer. Once the time period has elapsed after the compressor start, the low-pressure input should remain in the normal state. If the low-pressure input does not remain in the normal state when the time delay has elapsed, the circuit shall lock out on low pressure. The low-pressure alarm shall be announced on the local display and communicated to remote monitoring systems.

L. Units shall ship standard with advanced freeze protection enabled. The advanced freeze protection shall monitor the pressure of each circuit using a transducer. The control shall interact with the fan and compressor to prevent the unit coil from freezing if circuit suction pressure drops. Applying fan speed to direct expansion systems requires limitations to avoid freezing condensate on the coil when the unit operates below 100% fan speed. The unit controller's advanced freeze protection provides the ability to predict freeze conditions and
correct this condition automatically by adjusting fan speed and compressor capacity. If a freeze condition is detected, the user shall be notified through the local display and remote monitoring systems.

M. When the compressor is initially activated, the system shall be monitored for high pressure. When high pressure is detected, the control shall alter the compressor operation and the condenser fans speed to reduce the system discharge pressure, preventing circuit shut down. If the unit is unsuccessful in correcting the problem through this interaction, an alarm shall occur and the affected compressor shall be immediately locked off. The control shall re-enable the compressor when the pressure returns to a safe level. This feature is standard on units equipped with liquid line transducers and these compressor types:

1. 4-Step
2. Digital Scroll
3. Tandem Digital

N. The control shall monitor the high-side and low-side refrigerant pressure transducers. If the control senses the transducer has failed, has been disconnected, has shorted or the reading has gone out of range, the user shall be notified through an event on the local display and remote monitoring. The corresponding circuit that the failure has occurred on shall be disabled to prevent unit damage.

O. The control shall monitor compressor operation and staging to ensure that liquid and hot gas velocity are maintained for proper oil return to the compressor.

P. The control shall monitor digital scroll temperature during unit operation. A compressor temperature limit shall be imposed to help prevent damage to the compressor. If the temperature reaches the maximum temperature limit, the compressor shall be locked out for 30 minutes and an alarm shall be annunciated on the local display and through monitoring. After the initial lockout, the control shall continue to monitor compressor temperature during the off-cycle and re-enable the circuit once a safe operating temperature is reached and the 30 minutes has elapsed. The control shall store the number of high temperature trips. The number of trips shall be accessible through the local display.

Q. The control shall monitor the status of the digital scroll sensor(s). If the control senses that the thermistor is disconnected, shorted or the reading goes out of range, the user shall be notified through an event on the local display and remote monitoring.

R. A user-selectable compressor sequencing parameter shall be provided and shall be accessible through the local display. This sequencing parameter shall present the user with three choices:

1. Always use Compressor 1 as the lead compressor.
2. Always use Compressor 2 as the lead compressor.
3. Auto: The unit shall automatically stage compressors to keep each unit’s run time within 8 hours of the other’s run time. The control shall not turn Off a compressor to equalize run time when it is needed to control the space.
   a. First priority: If the safety timings are acceptable for only one compressor, then it is the next to be started/stopped.
   b. Second priority: If both compressors are Off: The compressor with fewer working hours is the next to start.
   c. Third priority: If both compressors are in operation: the compressor that has
been operating longer since the last start is the next to be stopped.

S. The control shall monitor the return air to ensure that the compressor(s) are operated within the manufacturer’s defined window of operation. If the return air temperature deviates from the manufacturer’s window of operation, the unit controller shall automatically adjust to prevent damage to the cooling unit or reduction in its reliability.

T. The control shall log these compressor statistics:

- Number of compressor starts
- Run hours
- Average run time
- Starts per day
- Starts per day worst
- Number of high-pressure alarms
- Operating phase in which the high-pressure alarm occurred
- Number of low-pressure alarms
- Operating phase in which the low-pressure alarm occurred
- Number of compressor overloads
- Number of high-temperature alarms (scroll compressors)
- The user shall have the ability to monitor compressor operating temperature and pressure from the local display to be used as a diagnostic tool.

U. The user shall have the ability to disable compressor operation using a set of either normally open or normally closed dry contacts tied directly to the control or through remote monitoring. An additional enable/disable feature shall be provided to allow the user to permanently disable an individual compressor circuit for maintenance using the local display.

V. The user shall be able to operate each compressor(s) manually from the local display. The user shall be able to energize refrigeration components including liquid line solenoid valves, compressor contactors, electronic expansion valves and adjust capacity for troubleshooting or repair. The control shall monitor the compressor during manual operation and shall shut the compressor down if needed to prevent electrical or mechanical damage.

W. The control shall isolate each compressor through a dedicated circuit liquid line solenoid valve and/or electronic expansion valve. These devices, combined with a spring-closed discharge check valve and compressor crankcase heater (air-cooled models), shall help ensure refrigerant does not migrate/carry oil out of the compressor case during the off cycle.

X. The control shall permit the user to specify which compressor is used for dehumidification. The choices shall be 1st compressor, 2nd compressor, 1 or 2, or BOTH.

2.17 HIGH TEMPERATURE SENSOR

A. The high-temperature sensor shall immediately shut down the environmental control system when activated. The high-temperature sensor shall be mounted in the electrical panel with the sensing element in the return air.

2.18 SMOKE SENSOR

A. The smoke sensor shall immediately shut-down the environmental control system and activate the alarm system when activated. The smoke sensor shall be mounted in the electrical panel
with the sensing element in the return-air compartment. The smoke sensor is not intended to function as or replace any room smoke-detection system that may be required by local or national codes. The smoke sensor shall include a supervision contact closure.

2.19 CONDENSATE PUMP, DUAL FLOAT

A. The condensate pump shall have a minimum capacity of 145 GPH (548 l/h) at 20 ft. (58 kPa) head. It shall be complete with integral dual-float switches, pump-and-motor assembly and reservoir. The secondary float shall send a signal to the local alarm and shall shut down the unit upon high water condition.

2.20 REMOTE HUMIDIFIER CONTACT

A. Pair of N/O contacts provided for connection to a remote humidifier that allow the unit's humidity controller to control a humidifier outside the unit. Power to operate the remote humidifier does not come from the unit.

2.21 COMPRESSOR OVERLOAD

A. A pair of normally open contacts shall be factory-installed and factory-wired to each compressor to indicate Compressor Overload.

2.22 WIRED REMOTE SENSOR(S)

A. Each unit controller shall be provided with one additional remote room temperature sensor for control or reference. As part of the control network, those sensors shall be shared and used to control the units and provide greater flexibility, visibility and control using that to respond to changes in the data center. When the sensors are used for control, the user may set the control to be based off a maximum or average of a select highest temperature reading.

2.23 REMOTE MONITORING

A. A factory-installed communication card shall be provided for monitoring and/or control. The communication card shall be capable of connecting to Building Management System/Building Automation System using the following protocols:

1. BACnet IP—BACnet over Internet Protocol
2. BACnet MSTP—BACnet Master-Slave/Token-Passing (MSTP) communications protocol over a RS-485 serial network (also known as BACnet MSTP RS-485)
3. Modbus RTU—Modbus Remote Terminal Unit (RTU) communication protocol over a RS-485 serial network (also known as Modbus RTU RS-485)
4. Modbus TCP—Modbus Transmission Control Protocol over Internet Protocol (also known as Modbus TCP/IP)
5. SNMP
6. YDN23 - YD-T-1363 specification protocol (also known as YD/T 1363)

B. The communications card shall be capable of connecting to two of these protocols at once.

2.24 FLOOR STAND

A. The floor stand shall be constructed of a welded steel frame. The floor stand shall have adjustable legs with vibration isolation pads. The height of floor stand shall match the height
of the raised floor.

2.25 DISCHARGE AIR PLENUM FOR UPFLOW UNITS, WITHOUT DISCHARGE GRILLES
A. The air plenum shall be constructed of 20-gauge steel, powder-coated to match unit color. The plenum shall be 9 in. (mm) high. Air shall discharge from the top of the plenum.

2.26 AIR-COOLED CONDENSER
A. The indoor evaporator unit shall include refrigerant piping, with a factory holding charge of nitrogen. The hot-gas and liquid lines shall be spun shut and shall include a factory-installed Schrader valve. Field-relief of the Schrader valve shall indicate a leak-free system.

B. The condenser shall be designed to reject waste heat to outdoor air and to control refrigerant head pressure as indoor equipment loading and outdoor ambient conditions change. The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings. Standard 60 Hz units shall be CSA-certified to the harmonized U.S. and Canadian product safety standard “CSA C22.2 No 236/UL 1995 for Heating and Cooling Equipment” and shall be marked with the CSA c-us logo. The air-cooled condenser shall be a factory-assembled unit, complete with integral electrical panel, designed for outdoor installation. The condenser shall be a draw-through design.

C. Condenser shall consist of microchannel condenser coil(s), propeller fan(s) direct-driven by individual fan motor(s), electrical controls, housing and mounting legs. The Liebert air-cooled condenser shall provide positive refrigerant head pressure control to the indoor cooling unit by adjusting heat rejection capacity. Microchannel coils shall provide superior heat transfer, reduce air-side pressure drop, increase energy efficiency and significantly reduce the system refrigerant volume required. EC fans and fan operating techniques shall reduce sound levels. Various methods shall be available to match indoor unit type, maximum outdoor design ambient and maximum sound requirements.

D. Coils shall be constructed of aluminum microchannel tubes, fins and manifolds. Tubes shall be flat and contain multiple, parallel-flow microchannels and span between aluminum headers. Full-depth louvered aluminum fins shall fill spaces between the tubes. Tubes, fins and aluminum headers shall be oven-brazed to form a complete refrigerant-to-air heat exchanger coil. Copper stub pipes shall be electric resistance-welded to aluminum coils and joints protected with polyolefin to seal joints from corrosive environmental elements. Coil assemblies shall be factory leak tested at a minimum of 300 psig (2068 kPag). Hot-gas and liquid lines shall be copper and shall be brazed using nitrogen gas flow to the stub pipes with spun-closed ends for customer piping connections. Complete coil/piping assembly shall be then filled and sealed with an inert gas holding charge for shipment.

E. The fan motor/blade assembly shall have an external rotor motor, fan blades and fan/finger guard. Fan blades shall be constructed of cast aluminum or glass-reinforced polymeric material. Fan guards shall be heavy gauge, close-meshed steel wire, coated with a black, corrosion-resistant finish. Fan terminal blocks shall be in an IP54 enclosure on the top of the fan motor. Fan assemblies shall be factory-balanced, tested before shipment, and mounted securely to the condenser structure. The EC-fan motors shall be electronically commutated for variable-speed operation and shall have ball bearings. The EC fans shall provide internal overload protection through built-in electronics. Each EC-fan motor shall have a built-in controller and communication module linked via RS485 communication wire to each fan and the Premium Control Board, allowing each fan to receive and respond to precise fan speed
F. Electrical controls and service-connection terminals shall be provided and factory-wired inside the attached control panel section. Only high-voltage supply wiring and low-voltage indoor-unit communication/interlock wiring are required at condenser installation.

G. The EC fan/Premium Control System shall include an electronic control board, EC-fan motor(s) with internal overload protection, refrigerant and ambient temperature thermistors and refrigerant pressure transducers. The Premium Control Board shall communicate directly with the indoor unit's Liebert iCOM control via field-supplied CANbus communication wires and via field-supplied low-voltage interlock wires. The control board shall use sensor and communication inputs to maintain refrigerant pressure by controlling each EC fan on the same refrigerant circuit to the same speed. The Premium control board shall be rated to a temperature of –30°F to 125°F. The premium control shall be factory-set for (fan speed) (fan speed with Liebert Lee-Temp™) control.

H. A locking-type disconnect switch shall be factory-mounted and wired to the electrical panel and be capable of disrupting the flow of power to the unit and controlled via an externally-mounted locking and lockable door handle. The locking disconnect shall be lockable in support of lockout/tagout safety programs.

I. The electrical panel shall provide at least 65,000 A SCCR.

J. The condenser cabinet shall be constructed of bright aluminum sheet and divided into individual fan sections by full-width baffles. Internal structural support members, including coil support frame, shall be galvanized steel for strength and corrosion resistance. Panel doors shall be provided on two sides of each coil/fan section to permit coil cleaning. An electrical panel shall be contained inside a factory-mounted NEMA 3R weatherproof electrical enclosure.

K. Aluminum legs shall be provided to mount unit for vertical air discharge with rigging holes for hoisting the unit into position. Standard height is 18 in. (457 mm).

L. Low Ambient Receiver Kit shall contain an insulated, heated receiver tank with sight glasses, mounting plate, mounting hardware, pressure-relief valve, rota-lock valve for refrigerant charge isolation and piping assembly with head-pressure operated 3-way valve and check valve. Components shall be field-assembled to the condenser. The 3-way valve shall sense refrigerant head pressure and adjust the flooding charge in the condenser coil to adjust the condenser heat-rejection capacity. The low ambient heater shall be 150 W, shall include an integral thermostat to maintain refrigerant temperature at a minimum of 85°F (29°C) and shall require a separate power supply 120V 1 ph 60 Hz.

The Low Ambient Kit shall function with variable-speed fan motors and electronic controls that lower fan speed in lower outdoor ambient temperatures for maximum energy efficiency. This system shall allow system start-up and positive head-pressure control with ambient temperatures as low as 0°F.

M. A fusible plug kit shall be field-installed on the liquid line for compliance with building codes requiring refrigerant relief during high-temperature and building-fire conditions.

N. IBC/OSHPD Seismic Certification and IBC Wind/Snow Load Compliant condensers shall be provided with any applicable bracing and field-installation instructions. Condensers shall bear

inputs from the Premium Control Board.
a label certifying compliance with IBC/OSHPD requirements.

O. Condenser shall consist of condenser coil(s), housing, propeller fan(s) direct-driven by individual fan motor(s), electrical controls and mounting legs. The Liebert air-cooled condenser shall provide positive refrigerant head pressure control to the indoor cooling unit by adjusting heat-rejection capacity. Various methods shall be available to match indoor unit type, minimum outdoor design ambient and maximum sound requirements.

P. Coil shall be constructed of copper tubes in a staggered tube pattern. Tubes are expanded into continuous, corrugated aluminum fins. The fins have full-depth fin collars completely covering the copper tubes, which are connected to heavy wall Type “L” headers. Inlet-coil connector tubes pass through relieved holes in the tube sheet for maximum resistance to piping strain and vibration. Coil shall be dual circuit. The hot-gas and liquid lines shall be spun shut and shall include a factory-installed Schrader valve. Coils shall be factory leak-tested at a minimum of 300 psig (2068 kPag), dehydrated, then filled and sealed with a low-pressure inert gas holding charge for shipment. Field relief of the Schrader valve shall indicate a leak-free system.

Q. The condenser housing shall be constructed of bright aluminum sheet and divided into individual fan sections by full-width baffles. Structural support members, including coil support frame, motor and drive support, are galvanized steel for strength and corrosion resistance. Aluminum legs shall be provided to mount unit for vertical air discharge and have rigging holes for hoisting the unit into position. An electrical panel shall be inside an integral NEMA 3R weatherproof section of the housing.

R. Propeller fan shall have aluminum blades secured to corrosion-protected steel hub. Fans shall be secured to the fan motor shaft by means of the keyed hub and dual set screws. Fan diameter shall be 26 in. (660 mm) or less. Fans shall be factory-balanced and run before shipment. Fan guards shall be heavy gauge, close-meshed steel wire with corrosion-resistant polyester paint finish that shall be rated to pass a 1000-hour salt spray test.

S. Fan motor shall be continuous air-over design and shall be equipped with rain shield and permanently-sealed bearing. Motors shall be rigidly mounted on die-formed galvanized-steel supports.

T. Electrical controls, overload-protection devices and service-connection terminals shall be provided and factory-wired inside the integral electrical-panel section of the housing. A locking disconnect switch shall be factory-mounted and wired to the electrical panel and controlled via an externally-mounted, locking door handle. An indoor-unit interlock circuit shall enable condenser operation whenever indoor-unit compressors are active. Only supply wiring and indoor-unit interlock wiring are required at condenser installation.

U. Variable Frequency Drive (VFD) Condenser (1 to 4 Fan)

1. The winter control system for the air-cooled condenser shall be Variable Fan Speed Control. The VFD condenser shall have a variable frequency drive controlling one inverter-duty, variable-speed motor and On/Off fan motor(s) (for multiple-fan models only) to vary the air flow across the coil. The VFD shall use one or more pressure transducers to sense refrigerant pressure to adjust fan speed to a positive head-pressure control range. The inverter duty motor shall have permanently-lubricated, ceramic ball bearings. The variable-frequency-drive control system shall provide overload protection for the variable-speed motor. On/Off fan motor(s) shall have individual,
internal overload protection and shall be controlled by ambient-air thermostat(s) increasing/decreasing condenser capacity in stepped increments. Motors shall have a TEAO enclosure and a full speed of 1140 RPM @ 60 Hz (950 RPM @ 50 Hz). A disconnect switch shall be factory-mounted and wired to the condenser control panel, accessible from the exterior. An internal Surge Protective Device (SPD) shall protect the VFD from power surges. Alarm contacts for the SPD and VFD shall be provided for monitoring of system components.

2. The VFD Control system shall provide positive start-up and operation in ambient temperature as low as 0°F (–17.8°C) with low-ambient, VFD heater kit. The air-cooled condenser shall have a 230/460 volt, 3 ph 60 Hz power supply.

### 2.27 GLYCOL DRYCOOLER

A. The drycooler shall be designed to reject waste heat to outdoor air and to control glycol temperature as pumped glycol rates and outdoor ambient conditions change. The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings. Standard 60 Hz units shall be CSA-certified to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for Heating and Cooling Equipment and shall be marked with the CSA c-us logo.

B. The drycooler shall be a factory-assembled unit, complete with integral electrical panel, designed for outdoor installation and vertical air flow only. The drycooler shall be a draw-through design.

C. The drycooler shall consist of drycooler coil(s), housing, propeller fan(s) direct-driven by individual fan motor(s), electrical controls, and mounting legs. The air-cooled drycooler shall provide glycol temperature control to the indoor cooling unit by adjusting heat-rejection capacity. Various methods shall be available to match indoor unit type, minimum outdoor design ambient and maximum sound requirements.

D. The manufactured coil shall be constructed of copper tubes in a staggered tube pattern. Tubes shall be expanded into continuous, corrugated aluminum fins. The fins shall have full-depth fin collars completely covering the copper tubes, which shall connected to heavy wall Type “L” headers. Inlet-coil connector tubes shall pass through relieved holes in the tube sheet for maximum resistance to piping strain and vibration. Coil shall be split-flow into multiple coil circuits, combined to yield a drycooler with the number of internal circuits that are required for scheduled unit capacity at actual project conditions. The supply and return lines shall be spun shut for units with 1 to 4 fans, brazed with a cap for units with 6 or 8 fans and shall include a factory-installed Schrader valve. Coils shall be factory leak-tested at a minimum of 300 psig (2068 kPag), dehydrated, then filled and sealed with an inert-gas holding charge for shipment. Field relief of the Schrader valve shall indicate a leak-free coil.

E. The drycooler housing shall be constructed of bright aluminum sheet and divided into individual fan sections by full-width baffles. Structural support members, including coil support frame, motor, and drive support, shall be galvanized steel for strength and corrosion resistance. Aluminum legs shall be provided to mount unit for vertical air discharge and shall have rigging holes for hoisting the unit into position. An electrical panel shall be inside an integral NEMA 3R weatherproof section of the housing.

F. The propeller fan shall have aluminum blades secured to a corrosion-protected steel hub. Fans shall be secured to the fan-motor shaft by means of a keyed hub and dual set screws. Fan diameter shall be 26 in. (660 mm) or less. Fans shall be factory-balanced and run before
shipment. Fan guards shall be heavy gauge, close-mesh steel wire with corrosion resistant PVC finish that shall be rated to pass a 675-hour salt spray test.

G. The fan motor shall be continuous air-over design and shall be equipped with a rain shield and permanently-sealed bearings. Motors shall be rigidly mounted on die-formed galvanized steel supports.

H. Electrical controls, overload-protection devices and service-connection terminals shall be provided and factory-wired inside the integral electrical-panel section of the housing. A locking disconnect switch shall be factory-mounted and wired to the electrical panel and controlled via an externally-mounted, locking door handle. An indoor-unit interlock circuit shall enable drycooler operation whenever indoor-unit compressors are active. Only supply wiring, indoor-unit interlock wiring and high-voltage wiring to pumps when controlled by the drycooler shall be required at drycooler installation.

I. Specific Drycooler Capacity Control

1. Fan Cycling Control (DSO, DDO) Drycooler (All Fan Quantities) with Integral Pump Control
   a. The DSO/DDO drycooler shall sense the leaving glycol temperature and cycle fixed-speed fans to maintain glycol temperatures. Aquastats shall have field-adjustable setpoints. The fixed-speed motors shall be 3 phase and have individual, internal overload protection. Fixed-speed motors shall have a TEAO enclosure. The DSO/DDO drycooler shall control operation of glycol pumps powered from the electrical panel. The air-cooled drycooler shall have a 230/460 volt, 3 ph, 60 Hz power supply.

J. Drycoolers (All Fan Quantities)

1. The drycooler shall be provided with the manufacturer’s sound reduction package when called for on the equipment schedules. The sound reduction package shall be available for DSO, DDO, DDNT, DDNL and DDNC control types. The fan motor(s) shall have a TEAO enclosure and provide individual overload protection for quiet operation.

PART 3 - Execution

3.1 GENERAL

A. Install Thermal Management units in accordance with manufacturer’s installation instructions. Install units plumb and level, firmly anchored in locations indicated and maintain manufacturer’s recommended clearances.

3.2 ELECTRICAL WIRING

A. Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer’s electrical connection diagram submittal to electrical contractor.

3.3 PIPING CONNECTIONS
A. Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer’s piping connection diagram submittal to piping contractor.

3.4 SUPPLY AND DRAIN WATER PIPING

A. Connect water supply and drains to air-conditioning unit. Provide pitch and trap as manufacturer's instructions and local codes require.

3.5 FIELD QUALITY CONTROL

A. Start the system in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. These specifications describe requirements for a computer-room environmental-control system. The system shall be designed to maintain temperature and humidity conditions in the rooms containing electronic equipment.

B. The manufacturer shall design and furnish all equipment to be fully compatible with heat-dissipation requirements.

3.6 WARRANTY START-UP AND CONTROL PROGRAMMING

A. Engage manufacturer's field service technician to provide warranty start-up supervision and assist in programming of unit(s) controls and ancillary panels supplied by them.

END OF SECTION 23 81 23 .19
PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 230200, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

1.3 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 23 09 63 – Energy Management and Control System

1.4 RELATED SECTIONS

A. Section 23 02 00 – Basic Materials and Methods

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment

C. Section 23 05 26 – Variable Frequency Motor Speed Control for HVAC Equipment

D. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

E. Section 23 05 93 – Testing, Adjusting, and Balancing

F. Section 23 09 63 – Energy Management and Control System

G. Section 23 33 00 - Ductwork Accessories

H. Section 23 41 00 – Air Filters

1.5 QUALITY ASSURANCE

A. NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems.


C. AHRI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard.


F. ANSI/UL 465 - Central Cooling Air Conditioners Standard for safety requirements.

G. AMCA 300 - Reverberant room method for sound testing of fans.

H. ANS S1.32 - Precision methods for the determination of sound power levels of discrete frequency and narrow band noise sources in reverberation rooms.

1.6 SUBMITTALS

A. Submit Shop drawings and product data under provisions of Division One.

B. Shop drawings shall indicate components, dimensions, weights, required service clearances, and location and sizes of field connections. Indicate equipment, piping and connections and valves required for complete system.

C. Product data shall include rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

D. Provide fan curves with specified operating point clearly identified.

E. Submit manufacturer's installation instructions.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit operation data.

B. Include start-up instructions, maintenance data, controls, and accessories. Include trouble-shooting guide.

C. Submit maintenance data.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site. Comply with manufacturer's installation instructions for rigging, unloading and transporting units.

B. Accept products on site and inspect for damage.

C. Protect units from physical damage. Factory shipping covers and skids shall be kept in place until installation. Store in a clean dry place and protect from weather and construction traffic.

1.9 WARRANTY

A. Provide a full parts and labor warranty for one year from start-up or 18 months from shipment, whichever occurs first.

B. Provide five-year warranty for compressors materials and labor.

1.10 OPERATIONS PERSONNEL TRAINING
A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

PART 2 - PRODUCTS

2.1 ROOFTOP UNIT

A. Rooftop unit shall be packaged and include electric cooling and electric heat with capacity and modulating cooling and heating as shown on the drawings.

B. Unit shall be factory-charged and tested, shall be UL-labeled and ARI-certified by Standard 210 and 270, and shall be AGA-certified.

C. Unit casing shall be heavy-gauge galvanized steel or heavy-gauge aluminum with protective coat of baked enamel. Weatherproof access panels shall be provided for access to all parts requiring service.

D. Compressor(s) shall be hermetic scroll type and shall be resiliently mounted to avoid vibration and noise. Compressor shall be provided with anti-slugging protection, crankcase heater, and time delay on recycling of the compressor. Two internal compressor motor thermal cutouts and a hot gas cutout shall protect the compressor in addition to high-pressure and low-pressure safeties. Standard controls shall permit operation down to 35 deg. F (2 deg. C) and compressor shall be locked out below this temperature.

E. Condenser fan(s) shall be direct-driven on the shaft of the slow-speed motor, which shall be designed to operate exposed to the weather.

F. Condenser coils shall have a sub-cooling section.

G. Refrigerant circuit shall include filter dryer, moisture indicator, sight glass, and gauge ports.

H. Filter rack shall be provided for filters 2 in. thick and shall filter both outdoor air and return air. See Section 234100 of these Specifications for type of filters and the number of filter changes to be furnished with the equipment.

I. Evaporator fan shall be quiet-type centrifugal blower, directly connected to an adjustable-speed motor or belt driven with an adjustable-pitch pulley on the motor.
J. Electric heat section shall be installed in the unit and served by the same power source as the rest of the unit. Only one power feed shall be required for the unit.

2.2 ACCESSORY EQUIPMENT

A. Unit shall be provided with hot gas reheat option for dehumidification. Hot gas reheat coil shall be located on the leaving air side of the evaporator coil and fully piped and circuited at the factory.

B. Condenser coil hail guards shall be provided.

C. A prefabricated heavy gauge galvanized steel, mounting curb shall be provided for field assembly on the roof decking prior to unit shipment. The roof curb shall be a full perimeter type with complete perimeter support of the air handling section and condensing section. The curb shall be a minimum of 14" high and include a nominal 2" x 4" wood nailing strip. Gasket shall be provided for field mounting between the unit base and roof curb.

D. Provide "power saver" dampers and controls to provide "free cooling" from 0 to 100% outdoor air (OA) when the outside air humidity and temperature are acceptable. Provide OA, return air, and relief air dampers in a factory-provided enclosure. All air shall be filtered and bird screen shall be installed.

E. A solid state enthalpy changeover control shall determine the capability of the outside air to provide free cooling. The control package shall include a differential enthalpy sensor in the return air duct to compare the enthalpy of the outside air and return air and use the air with the lowest enthalpy for free cooling or assisting the mechanical cooling. The cooling control sequence is as follows:

1. The changeover control determines if the outdoor air is suitable for free cooling.
2. The space thermostat determines if cooling is needed in the building. If so:
3. The actuator modulates the outdoor air and return air dampers to maintain the desired mixed air temperature.
4. The second cooling stage of the space thermostat energizes the compressor to assist the economizer if required.
5. If the outdoor air is not suitable for free cooling, the outdoor air damper remains in the minimum ventilation position and the compressor is energized when space cooling is required.

F. Provide a warm-up thermostat to prevent the OA dampers from opening if the return air temperature is below the set point (65 deg. F) (18 deg. C).

G. Provide necessary controls for operation of the compressor below the normal temperature of the compressor cutout. Operation shall be permitted down to temperature specified on drawings.

H. Provide factory-trained service person to check out the system, calibrate the controls, and see that the RTU is operating properly. The service person making the settings shall make a
written report to the engineer and the owner with all set points listed for future reference.

I. Rooftop units mounted on slabs or other fixed locations shall be provided with adapters for end discharge and return to the unit.

J. Provide programmable combination thermostat/humidistat and other controls required to produce the control functions called for.

K. Manufacturer shall provide BACnet interface card for communication with EMCS.

2.3 ACCEPTABLE MANUFACTURERS

A. Roof top unit shall be the make and model number shown on the schedule on the drawings, or acceptable equivalents are Carrier, Lennox, Trane, York or Daikin.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the curb as required by the job conditions and as recommended by the manufacturer, and install proper flashing and counterflashing. See details on the drawings.

B. Set the unit in place, taking care to protect the adjacent roofing, and connect the supply and return ductwork.

C. Make electrical connections, taking care that these do not block access to any part of the equipment requiring service.

D. Have the factory service person check out the unit and make a written report. Place the unit in service.

E. Connect full size condensate drain pipe to roof top unit and extend to nearest drain, pipe shall be schedule 40 galvanized with malleable iron fittings.

3.2 BALANCING AND TEST

A. Operate the roof top unit and check for proper supply air quantity, noise, and proper operation.

B. Report the airflow, static pressure, voltage and current draw of each item, refrigerant pressure readings, etc., as required by Section 23 05 93 of these Specifications. This system is not complete until these readings have been made, submitted to the engineer, and accepted.

END OF SECTION 23 81 36
SECTION 23 82 19 - FAN COIL UNIT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

1.3 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

PART 2 - PRODUCTS

2.1 FAN COIL UNITS

Fan coil units shall be factory built, manufactured as scheduled on Drawings. Carrier, York, Trane or Daikin shall be considered as equal, if they comply with the specifications and schedule. Special Note: Contractor shall field verify exact clearances required for fan coil units. Units shall be field located as required and shop drawings shall indicate final location for approval by Architect/Engineer.

A. Furnish and install fan coil units of the type, capacities, ratings and drive motor horsepower shown on the Drawings.

B. Units shall be factory fabricated, draw-thru type, and shall have fan section, cooling coil section, condensate drain pan, adjustable blower drive with motor on resilient mounted base, vee-belts with guard, filter section, and mixing box (if scheduled) assembled as integrated fan coil units.
C. REQUIREMENTS:

1. Mill-galvanized steel, rigidly framed, braced, and reinforced; access panels each side of unit; minimum panel ga. - 18; minimum weight formed framing member 14 ga.

2. Fan section, cooling coil section, and outlet frame throats shall be internally insulated at the factory with 1" thick, 3/4 PCF density, Neoprene coated fiberglass cemented in place with waterproof adhesive, having fire-retardant characteristics in accordance with NFPA 90A.

3. Drain pan shall not be lighter than 14 ga.; extend completely under the coil section and be all-galvanized, foam insulated pan with drain connections.

4. When the fan coil unit is installed above an accessible ceiling, the unit shall incorporate a secondary drain pan. The secondary pan shall be fabricated from galvanized sheet metal, 16 gauge minimum with cross breaking sloped towards a drain. The sides shall be a minimum 2" tall and the corners shall be soldered watertight. The top edge shall have a 1/4" hem to provide additional rigidity and the secondary pan shall be supported at a minimum of six points. The pan shall extend on all sides a minimum of 3" beyond the sides of the unit casing. Route the secondary drain piping to a conspicuous location or install a float switch at the low point in the secondary pan. The secondary pan should be sloped a minimum of 1/8" per foot and supported so that the unit is not in contact with the bottom of the secondary pan.

5. The fan section, including wheels, shafts, bearings, drive, etc., shall be statically and dynamically balanced as an assembly, and the shaft shall not pass through the first critical speed, while accelerating from rest to operating speed. Submittal data shall state the first critical shaft speed. Shaft bearings shall be of vacuum de-gassed steel and shall be selected for 200,000 hours average life.

6. Coil shall be as hereinafter specified.

2.2 COILS

A. Cooling coils shall be cartridge type and, when mounted in fan coil units, shall be removable from either end. Coils shall be constructed of copper tubes with aluminum fins and shall be designed for even distribution of air across the face of the coils; air shall not pass around coil frames: Coils shall have same end connection for DX or chilled water piping.

B. DX refrigerant coils shall be counter-flow refrigerant to air; shall have inlet and outlet connections permanently marked; shall have thermostatic expansion valves with adjustable super heat.

C. Maximum face velocity across cooling coils shall be 500 FPM, unless noted on schedule.

PART 3 - EXECUTION

3.1 All HVAC equipment shall be installed as per manufacturers printed installation instructions.

3.2 All items required for a complete and proper installation are not necessarily indicated on the Drawings or in the Specifications. Provide all items required as per manufacturer’s requirements.

END OF SECTION 23 82 19
SECTION 26 02 00 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted to the Architect for approval as soon as practicable. No such departures shall be made without the prior written approval of the Architect.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form the complete and functioning systems in all of its various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The contractor shall review all pertinent drawings, including those of other contracts prior to commencement of Work.

B. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Electrical items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

E. All discrepancies within the Contract Documents discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.
F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning heating, ventilating and air conditioning system shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. Contractor shall participate in the commissioning process; including but not limited to meeting attendance, completion of checklists and participation in functional testing.

1.3 RELATED SECTIONS

A. General Conditions
B. Supplementary Conditions
C. Division One

1.4 COOPERATION WITH TRADES:

A. Cooperation with trades of adjacent, related, or affected materials or operations shall be considered a part of this work in order to affect timely and accurate placing of work and bring together in proper and correct sequence, the work of such trades.

1.5 REFERENCES

A. National Electrical Code (NEC)
B. American Society for Testing and Materials (ASTM)
C. Underwriter's Laboratories, Inc. (UL)
D. Insulated Cable Engineer's Association (ICEA).
E. National Electrical Manufacturer's Association (NEMA).
F. Institute of Electrical and Electronic's Engineers (IEEE).
H. National Fire Protection Association (NFPA).
1.6 COMPLETE FUNCTIONING OF WORK:

A. All work fairly implied as essential to the complete functioning of the electrical systems shown on the Drawings and Specifications shall be completed as part of the work of this Division unless specifically stated otherwise. It is the intention of the Drawings and Specifications to establish the types of the systems, but not set forth each item essential to the functioning of the system. In case of doubt as to the work intended, or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for supplementary instructions, Drawings, etc.

B. Contractor shall review all pertinent Drawings and adjust his work to all conditions shown there on. Discrepancies between Plans, Specifications, and actual field conditions shall be brought to the prompt attention of the Architect.

1. Approximate location of transformers, feeders, branch circuits, outlets, lighting and power panels, outlets for special systems, etc., are indicated on the Drawings. However, the Drawings, do not give complete and accurate detailed locations of such outlets, conduit runs, etc., and exact locations must be determined by actual field measurement. Such locations will, at all times, be subject to the approval of the Architect.

2. Communicate with the Architect and secure his approval of any outlet (light fixture, receptacle, switch, etc.) location about which there may be the least question. Outlets obviously placed in a location not suitable to the finished room or without specific approval, shall be removed and relocated when so directed by the Architect. Location of light fixtures shall be coordinated with reflected ceiling plans.

C. Additional coordination with mechanical contractor may be required to allow adequate clearances of mechanical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.7 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the approved shop drawings.

1.8 CONTRACTOR’S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:

1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.

2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

3. Perform work by persons qualified to produce workmanship of specified quality. Persons performing electrical work shall be required to be licensed. Onsite supervision, journeyman shall have minimum of journeyman license. Helpers, apprentices shall have
1.9 DATE OF FINAL ACCEPTANCE

A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the architect, owner and contractor.

1.10 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 1.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean
"Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its subcontractor or Sub-contractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances) or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by 1993 ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct properly protected from incidental damage and weather damage.

C. Damaged equipment shall be promptly removed from the site and new, undamaged equipment shall be installed in its place promptly with no additional charge to the Owner.
1.12 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty-day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

1. A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.

2. An index page with a listing of all data included in the Submittal.

3. A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.

4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.

5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of $\frac{1}{4}'' = 1'-0''$, as required to demonstrate that the alternate or substituted product will fit in the space available.

6. Identification of each item of material or equipment matching that indicated on the Drawings.

7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.

8. Additional information as required in other Sections of this Division.
9. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 1 for additional information on shop drawings and submittals.

C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

1. REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.

2. REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.

3. NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not approved, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.

4. REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.

5. CONTRACTOR’S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor’s stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.
6. **MANUFACTURER NOT AS SPECIFIED:** Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

H. Furnish detailed shop drawings, descriptive literature, physical data and a specification critique for each section indicating "compliance" and/or "variations" for the following items:

- Distribution Panelboards
- Panelboards
- Wiring Gutters
- Heavy Duty Disconnect Switches
- Lighting Fixtures
- Lighting Contactors
- Time Clocks
- Lighting Control System
- Photocells
- Wiring Devices and Plates
- Conduit and Fittings
- Wire
- Switchboards
- General Purpose Dry Type Transformers
- Harmonic Mitigating Type Transformers
- Emergency Generator
- Automatic Transfer Switches
- Fire Alarm System
- Surge Protection Device (SPD)
- Lightning Protection

I. Refer to each specification section for additional requirements.

1.13 **OPERATION AND MAINTENANCE MANUALS**

A. Prepare maintenance manuals in accordance with Division 1 and in addition to the requirements specified in Division 1, include the following information for equipment items:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

1.14 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:
   a. Wall and type locations.
   b. Clearances for installing and maintaining insulation.
   c. Locations of light fixtures and sprinkler heads.
   d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
   e. Equipment connections and support details.
   f. Exterior wall and foundation penetrations.
   g. Routing of storm and sanitary sewer piping.
   h. Fire-rated wall and floor penetrations.
   i. Sizes and location of required concrete pads and bases.
   j. Valve stem movement.
   k. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the
installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 RECORD DRAWINGS

A. Maintain a continuous record during the course of construction of all changes and deviations in the work from the contract drawings. Upon completion of the work, purchase a set of "Auto Positive Tracings" on vellum and make corrections as required to reflect the electrical systems as installed. Location and size of all conduit shall be accurately shown to dimension. Submit three prints of the tracings for approval. Make corrections to tracings as directed and deliver "Auto Positive Tracings" to the Architect. Record drawings shall be furnished in addition to shop drawings. Symbols on the Record drawings shall correspond to the identification symbols on the contract drawings and equipment identification plates and tags.

B. The Contractor shall maintain a set of clearly marked black line record "AS-BUILT" prints on the job site on which he shall mark all work details, alterations to meet site conditions and changes made by "Change Order" notices. These shall be kept available for inspection by the Owner, Architect or Engineer at all times.

C. Refer to Division 1 for additional requirements concerning record drawings. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect. Mark the drawings with a colored pencil. Delivery of as-built prints and reproducibles is a condition of final acceptance.

D. The record prints shall be updated on a daily basis and shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents which are required for coordination. All dimensions shall include at least two dimensions to permanent structure points.

E. Submit three prints of the tracings for approval. Make corrections to tracings as directed and delivered "Auto Positive Tracings" to the architect. "As-Built" drawings shall be furnished in addition to shop drawings.

F. When the option described in paragraph F., above is not exercised then upon completion of the work, the Contractor shall transfer all marks from the submit a set of clear concise set of reproducible record "AS-BUILT" drawings and shall submit the reproducible drawings with corrections made by a competent draftsman and three (3) sets of black line prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The reproducible record "AS-BUILT" drawings shall have the Engineers Name and Seal removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS
DATE:

(NAME OF GENERAL CONTRACTOR)

BY:_______________________________
(SIGNATURE)

(NAME OF SUBCONTRACTOR)
BY:_______________________________
(SIGNATURE)

1.16 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 26.

1.17 MAINTENANCE MANUALS

A. Coordinate with Division 1 for maintenance manual requirements, unless noted otherwise bind together in “D ring type” binders by National model no. 79-883 or equal, binders shall be large enough to allow ¼” of spare capacity. Three (3) sets of all approved shop drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and labeled for easy reference and shall utilize the individual specification section numbers shown in the Electrical Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 26 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

B. Prepare maintenance manuals in accordance with Special Project Conditions, in addition to the requirements specified in Division 26, include the following information for equipment items:

1. Identifying names, name tags designations and locations for all equipment.
2. Fault Current calculations and Coordination Study.

3. Reviewed shop drawing submittals with exceptions noted compliance letter.

4. Fabrication drawings.

5. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.

6. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

7. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.

8. Equipment name plate data.


10. Exploded parts views and parts lists for all equipment and devices.

11. Color coding charts for all painted equipment and conduit.

12. Location and listing of all spare parts and special keys and tools furnished to the Owner.

13. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

C. Refer to Division 1 for additional information on Operating and Maintenance Manuals.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer a minimum of 14 working days prior to the beginning of the operator training period.

1.18 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include 12 hours of onsite training in three 4-hour shifts.

B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.
C. Refer to other Division 26 Sections for additional Operator Training requirements.

1.19 SITE VISITATION

A. Visit the site of the proposed construction in order to fully understand the facilities, difficulties and restriction attending the execution of the work.

B. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

C. Understand the existing utilities from which services will be supplied; verify locations of utility services and determine requirements for connections.

D. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.20 WARRANTY

A. The undertaking of the work described in this Division shall be considered equivalent to the issuance, as part of this work, of a specific guarantee extending one year beyond the date of completion of work and acceptance by Owner, against defects in materials and workmanship. Materials, appliances and labor necessary to effect repairs and replacement so as to maintain said work in good functioning order shall be provided as required. Replacements necessitated by normal wear in use or by Owner's abuse are not included under this guarantee.

B. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, freight/shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service call required to diagnose warranty problems.

1.21 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner’s risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney’s fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data’s creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.
C. When transferring documents in electronic media format, Engineer makes no representations as to the long-term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be Contractor’s sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect’s written consent.

1. It is agreed that “MEP” hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The contract documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.

2. If the client, Architect or Owner of the project requires electronic media for “record purposes”, then AutoCAD/ Revit documents will be prepared by Engineer on electronic media such as removable memory devices, flash drives or CD’s. These documents can also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

3. At the Architect/Owner’s request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a “.rvt” or “.dwg” format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. The names and manufacturers and model numbers have been used in the Contract documents to establish types of equipment and standards of quality. Where more than one manufacturer is named for a specific item of equipment, only one of the specified manufacturers will be considered for approval. Where only one manufacturer is mentioned with the phrase "or approved equal", Contractor may submit an alternate manufacturer for consideration, provided the following conditions are met:

1. Submit alternate equipment with complete descriptive data in shop drawing form. Provide sample of equipment upon request for review by Architect. Samples will be returned if requested in writing.

2. Alternate equipment must be equal from the standpoint of materials, construction and performance.
3. Alternate submittal must be presented to the Engineer/Architect ten (10) days prior to bid date for approval.

B. The Architect and Engineer shall be the sole judge of quality and equivalence of equipment, materials and methods.

2.2 All materials and products used on this project shall be listed by Underwriters' Laboratories.

2.3 ACCESS DOORS

A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:

1. Plaster Surfaces: Milcor Style K.

2. Ceramic Tile Surfaces: Milcor Style M.

3. Drywall Surfaces: Milcor Style DW.

4. Install panels only in locations approved by the Architect.

2.4 EQUIPMENT PADS

A. Provide 4-inch-high concrete pads for indoor floor mounted equipment. Pads shall conform to the shape of the equipment with a minimum of 6 inch beyond the equipment. Top and sides of pads shall be troweled to a smooth finish, equivalent to the floor. External corners shall be bullnosed to a 3/4" radius, unless shown otherwise.

B. Provide 6-inch-high concrete pads for all exterior mounted equipment. Pads shall conform to the shape of the equipment with a minimum of 6 inch beyond the equipment. Provide a 4-foot monolithic extension to the pad in front of the equipment for service when mounted on a non-finished area (i.e. landscape, gravel, clay, etc.) Top and sides of pads shall be troweled to a smooth finish. External corners shall be bullnosed to a 3/4" radius, unless shown otherwise.

C. Provide a minimum 6-inch-high, steel reinforced concrete pad for generators. Pads shall be sized 6” larger that the outside perimeter dimensions. Provide a 4-foot monolithic extension to the pad around the equipment for service when mounted on a non-finished area (i.e. landscape, gravel, clay, etc.). Refer to structural details. Top and sides of pads shall be troweled to a smooth finish. External corners shall be bullnosed to a 3/4" radius, unless shown otherwise. The generator shall be bolted to the concrete pad per the manufacturers details.

D. Provide steel reinforced concrete pad for utility transformers. Pads shall comply with Utility Company Standards.

2.5 ESCUTCHEONS

A. Provide heavy chrome or nickel-plated plates, of approved pattern, on conduit passing through walls, floors and ceilings in finished areas. Where conduit passes through a sleeve, no point of the conduit shall touch the building construction. Caulk around such conduit with sufficient layers of two hour rated firesafing by Thermafiber 4.0 P.C.F. density,
U.S.G. fire test 4/11/78 and seal off openings between conduit and sleeves with non-hardening mastic prior to application of escutcheon plate. Escutcheons shall be Gravler Sure-Lock or approved equal.

2.6 SPACE LIMITATIONS

A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with Code requirements. Physical dimensions and arrangement of equipment shall be subject to the approval of the Architect.

2.7 PAINTING

A. All factory assembled equipment for electrical work, except light fixtures, that normally is delivered with a factory applied finish shall be delivered with a hard surface factory applied finish such as baked-on machinery enamel which will not require additional field painting. The finish shall consist of not less than 2 coats of medium gray color paint USA No. 61 Munsell Notation 8-3G, 6.10/0.54 enamel. This Contractor shall protect this finish from damage due to construction operations until acceptance of the building. He shall be responsible for satisfactorily restoring any such finishes or replacing equipment that becomes stained or damaged.

2.8 ELECTRICAL SYSTEM IDENTIFICATION

A. Conduit Systems: Provide adequate marking of major conduit which is exposed or concealed in accessible spaces to distinguish each run as either a power or signal/communication conduit. Except as otherwise indicated, use orange banding with black lettering. Provide self-adhesive or snap-on type plastic markers. Indicate voltage for that raceway. Locate markers at ends of conduit runs, on pull boxes, on junction boxes, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors, or enters non-accessible construction and at spacings of not more than 50 feet along each run of conduit. Switch-leg conduit and short branches for power connections do not have to be marked, except where conduit is larger than ¾ inch. Branch circuit conduits, junction boxes and pull boxes shall be marked with a permanent marker indicating panel name and branch circuit numbers.

B. Underground Cable Identification: Bury a continuous, preprinted, bright colored plastic ribbon cable marker with each underground cable (or group of cables), regardless of whether conductors are in conduit, duct bank, or direct buried. Locate each directly over cables, 6 to 8 inches below finished grade.

C. Identification of Equipment:

1. All major equipment shall have a manufacturer’s label identifying the manufacturer’s address, equipment model and serial numbers, equipment size, and other pertinent data. Care shall be taken not to obliterate this nameplate in any way.
2. A black-white-black laminated plastic engraved identifying nameplate shall be secured by stainless steel screws to each automatic transfer switch, switchboard, distribution panel, motor control center, motor starter panels and panelboards.
   a. Identifying nameplates shall have ¼ inch high engraved letters and shall contain the following information:
      1) Name
      2) Voltage
      3) Phase
      4) “3” or “4” wire, and
      5) Where it is fed from.
   b. An example of a panelboard nameplate is:
      Center Panel – 1HB
      480/277 volt, 3 phase, 4 wire
      Center Fed from DP2
   c. An example of an automatic transfer switch nameplate is:
      Center ATS #2
      480/277 volt, 3 phase, 4 wire, 4 pole
      Center Fed from MSB and DPE

3. Each feeder device in a switchboard, distribution panel, and motor control center device shall have a nameplate showing the load served in ½ inch high engraved letters.

4. A black-white-black laminated plastic engraved identifying nameplate shall be secured by screws to each safety switch, disconnect switch, individual motor starter, enclosed circuit breaker, wireway, and terminal cabinet.
   a. Identifying nameplates shall have ¼ inch high engraved letters and shall indicate the equipment served.
   b. An example if a disconnect switch is:  AHU-1.

5. Prohibited Markings: Markings which are intended to identify the manufacturer, vendor, or other source from which the material has been obtained are prohibited for installation within public, tenant, or common areas within the project. Also, prohibited are materials or devices which bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters’ Laboratories, Inc.), and approval

6. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.

7. Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical system, provide tags of plasticized card stock, either preprinted or hand printed. Tags shall convey the message, example: “DO NOT OPEN THIS SWITCH WHEN BURNER IS OPERATING.”
PART 3 - EXECUTION

3.1 EXCAVATING AND BACKFILLING

A. Trenching and backfilling and other earthwork operations required to install the facilities specified herein shall conform to the applicable requirements of Division 2 (95% of maximum standard density). Where trenching or excavation is required in improved areas, the backfill shall be compacted to a condition equal to that of adjacent undisturbed earth and the surface of the area restored to the condition existing prior to trenching or excavating operations. Provide a minimum of 3” of sand underneath all conduits. The plans indicate information pertaining to surface and sub-surface obstructions; however, this information is not guaranteed. Should obstructions be encountered whether or not shown, the Contractor shall alter routing of new work, reroute existing lines, remove obstructions where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of new work and leave existing surfaces and structures in a satisfactory and serviceable condition. All work shall comply with OSHA Standards.

3.2 WORKMANSHIP AND CONCEALMENT

A. The work of this Section shall be performed by workman skilled in their trade. Installation shall be consistent in completeness whether concealed or exposed. Each item of electrical work shall be concealed in walls, chases, under floors and above ceilings except:

1. Where shown to be exposed.
2. Where exposure is necessary to the proper function.

3.3 SLEEVES, CUTTING AND PATCHING

A. This section shall be responsible for placing sleeves for all conduit passing through walls, partitions, sound walls, beams, floors, roof, etc. Sleeves through below-grade walls shall use water-tight fitting manufactured by O-Z/Gedney.

B. All cutting, and patching will be done under another Division, but this Section will be responsible for timely performance of this work and layout of holes and setting sleeves.

C. All un-used sleeves shall be sealed with 2-hour UL approved fire sealant manufactured by “3M” or approved equal.

D. Refer to 26 05 33 for additional requirements.

3.4 ELECTRICAL GEAR

A. Install all electrical equipment in accordance with the National Electrical Code and as shown on the drawings.

B. Lighting contractors, time clocks, disconnect switches, etc. mounted in mechanical/electrical rooms shall be mounted at a working height not requiring a ladder, when wall space is available. Installation of these devices at greater elevations shall be approved by the Engineer. Contractor shall provide a coordination sketch of each
mechanical/electrical room noting locations and mounting heights of all electrical devices (note bottom and top elevations) shown to be installed. Sketches shall be provided to the Engineer for review and the general contractor for coordination with other trades working in these rooms.

3.5 CLEANING

A. Clean lighting fixtures and equipment.

B. Touch-up and refinish scratches and marred surfaces on panels, switches, starters, and transformers.

3.6 CORROSIVE AREAS

A. In areas of a corrosive nature, which include but are not limited to the following: pool equipment rooms, cooling towers and areas subject to salt air, etc., provide NEMA 4 X stainless steel or fiberglass reinforced enclosures for contactors, panel boards, controllers, starters, disconnects and materials used as supporting means (i.e. plastibond unistrut, pipe, fittings). The use of spray on coating may be acceptable in some applications.

3.7 TESTS AND INSPECTIONS

A. Tests and inspection requirements shall be coordinated with Division I.

B. Date for final acceptance test shall be sufficiently in advance of completion date of contract to permit alterations or adjustments necessary to achieve proper functioning of equipment prior to contract completion date.

C. Conduct re-tests as directed by Architect on portions of work or equipment altered or adjusted as determined to be necessary by final acceptance test. No resultant delay or consumption of time as a result of such necessary re-test beyond contract completion date shall relieve Contractor of his responsibility under contract.

D. Put circuits and equipment into service under normal conditions, collectively and separately, as may be required to determine satisfactory operation. Demonstrate equipment to operate in accordance with requirements of these specifications. Perform tests in the presence of Architect. Furnish instruments and personnel required for tests.

E. Final Inspection:

1. At the time designated by the Architect, the entire system shall be inspected by the Architect and Engineer. The contractor or his representative shall be present at this inspection.

2. Panelboards, switches, fixtures, etc., shall be cleaned and in operating condition.

3. Certificates and documents required hereinbefore shall be in order and presented to the Architect prior to inspection.

4. Panel covers, junction box covers, etc., shall be removed for visual inspection of the wire, bus bars, etc.
5. After the inspection, any items which are noted as needing to be changed or corrected in order to comply with these specifications and the drawings shall be accomplished without delay.

F. The contractor shall provide a thermographic test using an independent testing laboratory using an infrared scanning device. This test shall include but not limited to all switchboards, distribution panelboards, panelboards, automatic transfer switches and other electrical distribution devices. This test shall be conducted to locate high temperature levels. This test shall be conducted between 3 to 8 months after occupancy, but not beyond the one-year warranty period. Submit test to the architect and engineer using test reporting forms. All unacceptable conditions shall be corrected prior to the end of the warranty period.

END OF SECTION 26 02 00
SECTION 26 05 19 - WIRE, CABLE AND RELATED MATERIALS

PART 1 - GENERAL

1.1 SCOPE

A. Provide 600-volt building wire, cable and connectors and 300-volt wire, cable and connectors.

B. WORK INCLUDED: Include the following Work in addition to items normally part of this Section.
   1. Wiring for lighting and power.
   2. Automatic Control Wiring.
   3. Connection of equipment shown.
   5. Mineral Insulated Cable (MI)

C. WORK SPECIFIED ELSEWHERE:
   1. Heating, ventilating, and air conditioning equipment.
   2. Structured cabling system.
   3. Coaxial cables

1.2 STANDARDS

A. UL83

B. ASTM B-3

C. All wire cable and connectors shall be UL approved.

1.3 ACCEPTABLE MANUFACTURERS

A. 600 VOLT WIRE AND CABLE
   1. Southwire
   2. Encore
   3. Cerro

B. 300 VOLT WIRE AND CABLE
1. Westpenn
2. Beldon
3. Alpha
4. Tappan - Southwire

C. FLEXIBLE CABLE SYSTEMS
1. AFC Modular Cable Systems

D. CONNECTORS
1. Ilsco
2. Cooper
3. AMP – TYCO
4. Burndy
5. Ideal
6. 3M
7. O.Z. Gedney
8. Thomas & Betts
9. Buchanan

1.4 SUBMITTALS
A. Shop drawings shall include, but not limited to:

1. Cutsheets of wire, cable and connectors to indicate the performance, fabrication procedures, product variations, and accessories.

1.5 REQUIREMENTS OF REGULATORY AGENCIES WORK IN ACCORDANCE WITH:
A. National Electrical Code.
B. Local, municipal, or state codes that have jurisdiction.
PART 2 - PRODUCTS

2.1 WIRING

A. All wire shall be new and continuous without weld, splice, or joints throughout its length. It must be uniform in cross-section, free from flaws, scales and other imperfections.

B. WIRE MATERIAL: Conductors shall be soft drawn, annealed copper. Aluminum wiring is not acceptable unless otherwise noted on drawings.

C. TYPES:

1. Provide type THHN/THWN-2” insulation for all buried feeders and service entrance conductors.

2. Provide type “THHN/THWN-2” insulation for all branch circuits and above grade feeders.

3. All wire No. 8 and larger shall be stranded. All wire No. 10 and smaller shall be stranded or solid.

4. Provide type "XHHW" or other 90 degrees insulation wiring for branch circuit wiring installed through continuous rows of fluorescent fixture bodies.

5. All 300-volt cable including but not limited to telephone, fire alarm, data, CATV and security shall be UL listed for use in return air plenums.

D. CONDUCTOR SIZES

1. Feeder conductors shall be sized for a maximum of 2% drop in rated voltage at scheduled load.

2. Branch circuit conductors shall be sized for a maximum 3% drop in the rated voltage to the longest outlet on the circuit.

3. Minimum wire shall be No. 12, unless otherwise shown on Drawings or required by Code.

E. COLOR CODING: No. 6 or larger shall use tape for color coding. No. 8 and smaller wire shall be color coded in accordance with the governing authority requirements or as follows:

<table>
<thead>
<tr>
<th>120/208 Volt</th>
<th>277/480 Volt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral: White</td>
<td>Neutral: Gray</td>
</tr>
<tr>
<td>Phase A: Black</td>
<td>Phase A: Brown</td>
</tr>
<tr>
<td>Phase B: Red</td>
<td>Phase B: Purple</td>
</tr>
<tr>
<td>Phase C: Blue</td>
<td>Phase C: Yellow</td>
</tr>
<tr>
<td>Ground: Green</td>
<td>Ground: Green</td>
</tr>
</tbody>
</table>

2.2 GROUNDING

Permanently connect all conduit work, motors, starters, and other electrical equipment to grounding system in accordance with the National Electrical Code.
2.3 METAL CLAD CABLE - TYPE MC

At the contractor’s option, metal clad cable (MC) may be used if approved by the authority having jurisdiction. The cable shall contain an insulated green grounding conductor (3 wire) and shall be the same size as the phase conductor. Conductors shall be solid copper and the armor shall be flexible galvanized steel.

2.4 ARMORED CABLE - TYPE AC

At the contractor’s option, armored cable (BX) may be used if approved by the authority having jurisdiction. The cable shall contain an insulated green grounding conductor (3 wire) and shall be the same size as the phase conductor. Conductors shall be solid copper.

PART 3 - EXECUTION

3.1 WIRE

A. Do not pull wire into conduit until Work of an injurious nature is completed. Where two or more circuits run to a single outlet box, each circuit shall be properly tagged. Wyreze or approved equal may be used as a lubricant where necessary.

B. Splices shall be fully made up in outlet boxes with compression crimp-on type splice connectors.

C. Joints and splices will not be permitted in service entrance or in feeders. Joints in branch circuits will be permitted where branch circuits divide, and then shall consist of one through-circuit to which the branch shall be spliced. Joints shall not be left for the fixture hanger to make. Connect joints and splices with Buchanan Series "2000" solderless connectors complete with insulating caps or properly sized twist on wire nuts. “Wago” push-in connectors are not acceptable.

D. All stranded conductors shall be furnished with lugs or connectors.

E. Connectors furnished with circuit breakers or switches shall be suitable for copper wire termination.

F. “Sta-Cons” shall be used to terminate stranded conductors on all switches and receptacles.

G. Metal Clad Cable - Type MC

1. Metal clad cable shall not be used for homeruns. Metal clad cable shall only be used for branch circuit drops from ceiling mounted junction boxes to outlets and for horizontal runs in a common wall from outlet to outlet. Do not route to outlets to adjacent walls. Metal clad cable may be looped from outlet to outlet in areas where non-accessible ceilings are used. Metal clad cable shall only be used in air-conditioned areas and shall not be run exposed.

2. Metal clad cable shall be UL approved connectors and shall be used and installed per Article 334 of the National Electrical Code. The cable shall be supported at intervals not exceeding 6 feet and within 12 inches of every box.

3. Provide anti-short bushing at cable ends.
4. Refer to electrical details for additional information and restrictions.

5. Metal clad cable shall not be installed in concrete.

H. Armored Cable - Type AC

   1. Armored cable shall not be used for homeruns. Armored cable shall only be used for branch circuit drops from ceiling mounted junction boxes to outlets and for horizontal runs in a common wall from outlet to outlet. Do not route to outlets to adjacent walls. AC cable may be looped from outlet to outlet in areas where non-accessible ceilings are used.

   2. Armored cable shall be UL approved connectors and shall be used and installed per Article 333 of the National Electrical Code. The cable shall be supported at intervals not exceeding 4-1/2 feet and within 12 inches of every box.

I. All stranded #10 and small conductors shall be terminated with an approved solderless terminal if the device or light fixture does not have provisions for clamp type securing of the conductor.

J. The jacket for all travelers used on 3-way and 4-way switches shall be pink.

3.2 BALANCING SYSTEM

The load on each distribution and lighting panel shall be balanced to within 10% by proper arrangement of branch circuits on the different phase legs. Provide written documentation showing results. Submit with O & M manuals.

3.3 LOW VOLTAGE WIRING

   A. Low voltage wiring shall be plenum rated. All wiring in mechanical rooms, electrical rooms, drywall ceiling, inaccessible areas, underground, plaster ceiling, inside concealed walls areas exposed to occupant view, and other areas subject to physical damage shall be run in conduit.

   B. Low voltage wiring shall be routed in separate raceways from power wiring systems.

   C. Sleeves shall be placed in the forms of concrete, masonry and fire rated walls, floor slabs and beams, for the passage of wiring. Sleeves should be set in place a sufficient time ahead of the concrete work so as not to delay the work. Sleeves shall be rigid galvanized steel.

   D. Provide Caddy J-hooks supported independently from other system to support cable at 4-foot on center or closer if required by manufacture.

3.4 CABLE SUPPORTS

   A. Provide cable supports in all vertical raceways in accordance with Article 300-19 of the NEC.

3.5 DEFECTS

   A. Defects shall include, but are not to limited to, the following:

      1. Tripping circuit breakers under normal operation.
2. Improperly connected equipment.

3. Damaged, torn, or skinned insulation.

END OF SECTION 26 05 19
SECTION 26 05 26 - GROUNDING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS
   A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 SCOPE
   A. WORK COMBINED WITH OTHER SECTIONS: Combine the work specified herein with the following Sections to form a single responsibility for the Work:
      1. Electrical.
      2. Basic materials and methods.
   B. Provide electrical service, equipment and wiring device grounding as shown, scheduled and as specified.
   C. The types of grounding include, but not limited to, the grounding bonding of all equipment devices, building steel piping, and as required by the National Electrical Code, Local Inspection Department and Power Company.

1.3 STANDARDS
   A. NATIONAL ELECTRICAL CODE (NFPA-70)
   B. Local municipal and State codes that have jurisdiction.
   C. NECA

1.4 ACCEPTABLE MANUFACTURES
   A. Provide grounding products manufactured by Copperweld and Cadweld.

1.5 SUBMITTALS
   A. Shop drawings shall include, but not limited to the following:
      1. Cut sheets of ground rods, clamps and connectors.
      2. Grounding system diagram.

PART 2 - PRODUCTS
   A. GENERAL: Provide all materials required to construct a complete grounded electrical system.
   B. GROUND RODS: Ground rods shall be 3/4" inch diameter by 10 feet long construction with copper
jacket and a steel core.

C. CLAMPS: Ground clamps shall be copper except for steel or iron pipes in which the clamps shall be galvanized iron.

D. CONDUCTORS: Conductors shall be connected by means of an approved pressure connector or clamp.

PART 3 - EXECUTION

3.1 INSTALLATION

A. GENERAL: Install grounding system as shown and specified to ensure a properly grounded system.

B. SERVICE ENTRANCE GROUNDING SYSTEM: Provide a main bonding jumper between the neutral and ground bus of each switchboard. Route a separate grounding electrode conductor in conduit from each switchboard to the ground rod grid, incoming cold-water piping system, and to the "lightning protection system" (250 - 106 of NEC) underground bonding loop. Provide a bonding jumper around water meter. The grounding electrode conductor shall be stranded copper, 98% conductivity and shall be run continuous without splices or joints and installed at least 12" below grade.

C. BUILDING STEEL AND PIPING SYSTEM: Install a bonding jumper between building steel and metallic piping systems to bond them to the electrical grounding system.

D. NEUTRAL: The neutral shall be grounded only at the service entrance and other separately derived systems. The neutral shall be kept separate from the grounding system and shall not be used as a ground.

E. GROUNDING SEPARATELY DERIVED ALTERNATING CURRENT SYSTEM

1. TRANSFORMERS: The center point (neutral) of each wye connected transformer shall be bonded to the case and a grounding electrode conductor shall be connected to a ground rod or building steel.

2. STANDBY EMERGENCY GENERATOR: The generator neutral shall be bonded to the generator when a 4-pole switched neutral automatic transfer switch is specified.

F. GROUNDING CONDUCTOR: A grounding conductor and metallic conduit system shall bond all equipment served by the electrical system. Provide a flexible bonding jumper for isolated metallic piping and ductwork and around expansion fittings and joints.

G. CONDUIT GROUNDING BUSHING:

Conduit terminating in equipment that has a ground bus such as switchboards, panelboards, etc., shall have grounding bushings installed. Ground each conduit by means of a grounding bushing and to the ground bus in the equipment.

H. MOTORS: The frame of all motors shall be grounded.

I. SPECIAL GROUNDING: Provide a #6 AWG copper grounding conductor for each telephone
board, television system, etc. Terminate the grounding conductor on ground bus and to the building electrical grounding system. Refer to 800-40(d) and 820-40(d) of the NEC.

J. REMOTE PANELBOARDS: Provide a grounding electrode conductor all remote panels as required by the NEC and shown on drawings.

K. LIGHTING FIXTURES: Flexible fixture whips containing a green grounding conductor shall be used to connect light fixtures. Flexible fixture whips shall not exceed ten feet.

L. RECEPTACLES: All receptacles shall be grounded using the branch circuit grounding conductor. Receptacles shall use an approved grounding yoke.

3.2 TESTING: Perform a ground resistance test using a biddle analog or digital portable earth/ground resistance tester. The system resistance shall not exceed 5 OHMS. Provide additional electrodes as required (refer to 250-84 of the NEC or the most current edition 250-56). Test shall not be conducted following wet weather. Provide personal instruments to conduct these tests and submit certified test for review. Test shall be verified by Engineer.

END OF SECTION 26 05 26
SECTION 26 05 33 - RACEWAYS

PART 1 - GENERAL

1.1 SCOPE

A. Provide electrical raceways and fittings as shown, scheduled and specified.

B. The types of raceways and fittings required are as follows:
   1. Rigid hot-dipped galvanized steel conduit (GRC) (RMC)
   2. Electrical metallic tubing (EMT)
   3. PVC (Sch. 40 & 80)
   4. Flexible metal conduit (FMC)
   5. Liquid-tight flexible metal conduit (LFMC)
   6. PVC coated rigid galvanized steel conduit

1.2 STANDARDS

A. ANSI, C80.1 & C80.3

B. NEMA FB-1

C. NEMA TC3

D. UL, 6, 797 & 1242

1.3 ACCEPTABLE MANUFACTURERS

A. Raceways

1. Allied
3. Republic
2. Prime Conduit (Carlon)
3. Wheatland Tube
4. Cantex
5. Western Tube
6. Robroy Industries

B. Fittings

1. Appleton
2. Crouse Hinds
3. Steel City
4. O.Z. Gedney
5. Carlon
6. Raco, Inc.
7. Bridgeport

C. Boxes
1. RACO
2. Thomas and Betts
3. EATON
4. Crouse-Hinds
5. Appleton

D. Surface
1. Hubbell
2. Wiremold

1.4 SUBMITTALS
A. Product data shall include but not be limited to:
   1. Cutsheets for raceways, fitting, solvents, primers, etc.

1.5 REQUIREMENTS OF REGULATORY AGENCIES WORK IN ACCORDANCE WITH:
A. National Electrical Code.
B. Local, municipal, or state codes that have jurisdiction.

PART 2 – PRODUCTS

2.1 CONDUIT AND FITTINGS
A. Rigid Galvanized Steel Conduit.
   1. Hot-dip galvanized rigid steel conduit, galvanized after fabrication. Products shall comply with UL6 and ANSI C80.1. All threads shall be galvanized after cutting. A uniform zinc coating shall be applied to the inner and outer walls.

   2. Fittings shall be threaded and shipped with thread protectors.

B. PVC Coated Rigid Galvanized Steel Conduit.
   1. Conduit shall be same as rigid metal conduit with a factory-applied 40-mil-thick covering of polyvinyl chloride (PVC) bonded to the metal.

   2. Fittings shall be the same as rigid metal conduit fittings with a factory-applied, 40-mil-thick covering of polyvinyl chloride (PVC) bonded to the metal.

C. Electrical Metallic Tubing (EMT).
   1. EMT shall be made of hot-dip galvanized strip steel. The interior shall be coated with a corrosion-resistant lubricant for ease of wiring pulling.
D. Rigid Nonmetallic Conduit (PVC).
   1. Conduit shall be schedule 40 or 80 polyvinyl chloride (PVC), UV stabilized, rated for 90°C conductors.
   2. Fittings shall be solvent weld socket type.

E. Flexible Metal Conduit (Greenfield).
   1. Spirally wound continuously interlocked zinc coated strip steel.
   2. Fittings shall be one screw for smaller than 1-1/2-inch, two screw for 1-1/2-inch and larger, double clamp steel or malleable iron, either cadmium plated or hot-dip galvanized.

F. Liquid-Tight Flexible Steel Conduit (Seal Tite).
   1. Spirally wound continuously interlocked zinc coated strip steel with a UV stabilized polyvinyl chloride (PVC) outer jacket bonded to the conduit.
   2. Fittings shall be compression type, malleable iron, with insulated throat, either cadmium plated or hot-dip galvanized.

2.2 PULL BOXES
A. Exterior in-ground pull boxes shall be concrete or polymer as manufactured by Brooks, Dalworth, Hubbell Quazite, or approved equivalent. Covers shall include identification of systems contained.

2.3 WIREWAYS
A. Wireways shall be made of not less than 16-gauge sheet steel for 4 inch and 6 inch square sizes and 14 gauge steel for 8 inch and 12 inch square sizes. Couplings end plates, and knockouts shall be furnished as required. Each section of wireways shall be rigidly supported.

B. The finish shall be ANSI-49 gray epoxy paint applied by a cathodic electrode position paint process over a corrosion resistant phosphate preparation for NEMA 1 wireways. Provide galvanized steel for NEMA 3R wireways. NEMA 3R wireways and auxiliary gutters are for horizontal mounting only.

2.4 FITTINGS
A. Couplings for rigid steel or intermediate conduit shall be hot dipped galvanized steel. Set screw type is not acceptable.

B. Steel or malleable iron fittings shall be used on all other raceway types except for PVC. Die-cast fittings are not allowed.

C. Couplings for aluminum raceways shall be threaded aluminum.

D. EMT systems shall utilize steel insulated throat, set screw connectors and steel set screw couplings in all indoor conditioned spaces. EMT system shall utilize steel insulated throat, threadless, watertight compression type connectors and steel threadless watertight compression type coupling in all non-conditioned spaces.
E. Coupling and connectors accessories and fittings for PVC coated rigid galvanized steel shall be PVC coated.

F. Liquidtight Flexible Metal Conduit (LFMC) fittings shall be steel. Plastic is not acceptable.

G. Provide nylon bushing on end of all low voltage cabling system conduits (sleeves, rough-ins, etc.).

PART 3 - EXECUTION

3.1 PROVIDE CONDUIT AS FOLLOWS:

A. GENERAL

The Drawings are diagrammatic and are intended to show the general location of outlets, devices, fixtures, and arrangement and control of circuits. The Contractor shall determine exact locations by actual measurement of the building or by reference to the Architectural Drawings.

B. Except as noted or otherwise specified, all wiring shall be installed in galvanized rigid steel, rigid aluminum conduit or electrical steel tube (EMT) of the proper size to contain the number of conductors required in accordance with the latest edition of the N.E.C. Where conduit sizes are shown on the drawings, these shall take preference. Contractor shall epoxy coat galvanized rigid steel conduit for use in natatoriums.

C. Raceways shall not be routed below or within slab-on-grade, foundations, or below grade of suspended slab structures, unless specifically noted or indicated otherwise on plan.

D. EMT in sizes up to 4 inches when concealed or not exposed to damage and located indoors only. (EMT is not acceptable in wet and damp location.)

E. PVC coated rigid galvanized steel shall be used for all penetrations of slab on grade.

F. Rigid galvanized steel where embedded in concrete or masonry construction, mechanical yard or in exterior/interior applications where subject to damage.

G. Rigid aluminum shall be used in exterior applications. (i.e. roof, top of canopies)

H. PVC schedule 40 and 80 may be utilized underground, in or below slab where shown on the construction documents.

I. MINIMUM SIZE: 3/4 inch. All homeruns shall be 3/4" minimum. ½” conduit may be used for drops down walls to a single receptacle or switch.

J. PVC coated rigid galvanized steel conduit shall be coated inside and outside.

K. PVC coated rigid galvanized steel conduit shall be used at cooling towers, corrosive areas and pool pump rooms.

L. Fixture whips: Refer to 26 51 00 for additional information.

M. Flexible metal shall be used for connecting rotating equipment installed in conditioned spaces.
N. Liquidtight Flexible Metal Conduit (LFMC) shall be used for connecting rotating equipment installed in non-conditioned spaces and outside.

O. Of such size, and so installed that conductors may be drawn in without injury or excessive strain.

P. Where entering panels, pull boxes, junction boxes, or outlet boxes, shall be secured in place with lock nuts inside and outside, and insulated bushings inside.

Q. Have Red seal type VCC or approved equal cable supports in risers, as required by N.E.C.

R. Have ends reamed after cutting and application of die.

S. Keep conduit corked and dry during construction and swab out before conductors are pulled.

T. Have bends and offsets made with approved tools. Bends or offsets in which the pipe is crushed or deformed shall not be installed.

U. Where not embedded in concrete or masonry, be firmly secured by approved clamps, half-straips or hangers.

V. Have O.Z. Gedney or approved equal expansion fittings where crossing building expansion joints.

W. Except in the mechanical equipment rooms, run conduit concealed, and by the shortest practicable route between outlets. Install risers, drops, and offsets necessary to avoid conflict with ductwork, piping, structural members, and similar items.

X. Install exposed conduit in mechanical rooms, and elsewhere as indicated, parallel to horizontal and vertical lines of walls, ceilings, and floors.

Y. Fixtures in finished areas having suspended acoustical ceilings shall be connected to outlet boxes of lighting grid by flexible metal conduit; length not to exceed ten feet (six feet if using 3/8” manufactured fixture “whips”).

Z. Outlet boxes in partitions shall never be set back to back. They shall be offset to prevent undue noise transmission from room to room.

AA. Concealed conduit shall run in as direct manner as possible using long bends. Exposed conduit shall be run parallel with or at right angles to the lines of the building; and all bends shall be made with standard conduit elbows or conduit benders. Not more than equivalent of four quarter bends shall be used in any run between terminals and cabinet, of between outlet or junction boxes. Approved condulets shall be used in lieu of conduit elbows where ease of installation and appearance warrants their use and approved by the engineer. Conduit joints shall be made with approved couplings and unions.

BB. Conduits shall be continuous from outlet to outlet and from outlets to cabinets, junction or pull boxes and shall be electrically continuous throughout. Terminals of all conduits shall be provided with double lock nuts and bushing or terminated on conduit hubs. Use of running threads is prohibited.

CC. Each entire conduit system shall be installed complete before any conductors are drawn in. Every run of conduit shall be finished before covering up to guard against obstructions and omissions.

DD. Sleeves shall be placed in the forms of concrete, masonry and fire rated walls, floor slabs and beams, for the passage of conduits. Sleeves should be set in place a sufficient time ahead of the concrete
work so as not to delay the work. Sleeves shall be rigid galvanized steel with a minimum thickness of 1.07MM and set to extend 4" above slab.

EE. All pipe penetrations through walls and concrete floors shall be fire rated by applying USG Thermafiber in the space between the concrete and the pipe. The fire rating shall be additionally sealed by using 3M brand model CP 25 or 303 fire barrier caulk and putty. All fire rating material shall be installed in accordance with manufacturer's printed instructions.

FF. All conduit shall be cleaned and swabbed to remove all foreign matter and moisture prior to pulling wire and cable. All boxes in which conduits terminate shall be cleaned of all concrete mortar and other foreign matter.

GG. Provide #30 nylon pulling line in all conduits in which permanent wiring is not installed.

HH. All conduit shall be securely fastened and supported using hot galvanized malleable iron one-hole pipe straps, clamps, hanger or other means approved by the engineer. Supports shall be as required per NEC. Tie wire shall not be used as support or securing means. Support conduit independently of ceiling hanger wire. Use all thread rods to support outlet boxes, junction boxes and conduit.

II. When PVC conduit is routed underground, all stub-up's and bends 15° and greater shall be PVC coated rigid galvanized steel. Use PVC coated rigid galvanized steel when penetrating concrete on grade.

JJ. Flexible and liquid-tight flexible steel conduit shall be used for final connections to utilization equipment. Liquid-tight flexible steel conduit shall be used for all exterior locations and all interior locations subject to moisture, vibrations, rotating equipment and dry-type transformers. Refer to Section 26 02 00 for additional information concerning flexible steel conduit.

KK. Contact the Architect and Engineer for an installation review before covering any below grade or above grade conduit.

LL. All new outlets shall be flush mounted. In remodeled areas where wall construction prohibits flush mounting, provide Hubbell 2400 series, unless noted otherwise. Verify exact location and routing with architect before installation.

MM. Contractor shall not penetrate water proof barriers without using proper fitting to maintain barriers. This shall include exterior walls and slabs. Coordinate with Architect for proper methods.

3.2 CONDUIT CORROSION PROTECTION

A. Branch circuit conduits installed in concrete slabs on fill or grade shall be positioned in a manner to ensure complete concrete cover. In no case shall such conduits be exposed below or above the slab surfaces or penetrate the waterproof membrane.

B. At locations where metallic conduits pass through slabs on grade or transitions below grade, PVC coated rigid galvanized conduit shall be used. Contractor may use 3M corrosive protective tap on rigid galvanized conduit in lieu of PVC coated rigid galvanized conduit.

C. Conduit installed in the air gap between the water-resistant barrier and finish brick shall not exceed 2ft in length.

3.3 EXPANSION JOINTS

A. Install approved expansion fitting in all conduit runs in excess of 150 feet or when crossing building...
expansion joints.

3.4 OUTLET AND JUNCTION BOXES

A. Provide an approved galvanized outlet box with adequate volume for number of conductors installed.

B. Provide standard galvanized switch boxes of the required number of gangs. Switch boxes where conduit is exposed shall be handy boxes or approved equal.

C. Outlet boxes for receptacles shall be similar to Universal 52151 with suitable raised cover. Receptacle boxes where conduit is exposed shall be handy boxes or approved equal.

D. Weatherproof boxes shall be FS or FD. Provide these boxes in all non-conditioned areas, exterior areas and natatoriums.

E. Outdoor boxes shall be NEMA 3R, with conduit connections made by Myers Hubs.

F. See notes and details on Drawings for special box requirements.

G. Provide junction boxes required to facilitate installation of the various conduit systems. Provide support boxes required for risers, each complete with approved cable supports as described elsewhere in this Division.

H. Outlet boxes for drywall shall be standard galvanized 4" square boxes with the appropriate device cover. Secure all outlet boxes with a backing brace connected to two adjacent studs. Mounting brackets with a single ear to rest against the backing sheet rock are not acceptable.

I. Provide floor outlet fittings for telephone to match fittings for duplex floor receptacles.

J. Provide 3-1/2" deep gangable masonry boxes in all masonry wall (CMU). Steel City GW-135-G or approved equal.

K. Provide shallow 4"x4" boxes in all demountable partitions.

L. Metallic boxes located in fire rated walls or partitions shall be separated by a minimum horizontal distance of 24 in. This minimum separation distance between metallic boxes may be reduced when “Wall Opening Protective Materials” (CLIV) are installed according to the requirements of their Classification. Metallic boxes shall not be installed on opposite side of walls or partitions of staggered stud construction unless “Wall Opening Protective Materials” are installed with the metallic boxes in accordance with Classification requirements for the protective materials.

M. Junction, pull boxes, condulets, gutters, disconnects, contactors, etc., above 2-foot x 2-foot grid ceilings shall be mounted within 18-inches of ceiling grid. Above 2-foot x 4 – foot grid ceiling they shall be mounted within 30-inches of ceiling grid. All junction box, pull box, gutter openings shall be side or bottom accessible.

3.5 THRU-WALL SEALS

A. Provide O.Z. Gedney “Thru-wall” seals for all conduits passing through concrete structure below grade, above grade, and floor penetrations below grade. These prevent moisture from entering the
building.

B. Straight sleeves are not acceptable.

3.6 PULL BOXES

A. Interior Pull boxes shall be provided for conduit systems as required and shall be constructed of galvanized steel of not less than gauge and size specified by National Electrical Code. Size pull boxes per NEC 314.28.

B. Where two or more feeders pass through a common pull box, they shall be tagged to indicate clearly their electrical characteristics, circuit number, and panel designation.

C. Exterior in-ground pull boxes shall have open bottoms with sand and rock beds below box for drainage of water. Provide closed bottom boxes where specified. Closed bottom boxes shall be provided with sumps for portable pump to allow for extracting water. Refer to details on the drawings.

D. Pull boxes mounted in pole bases shall be coordinated with the pour of the pole base and shall be flush with finished footing.

3.7 WIREWAYS

A. Wireways shall be installed as indicated or required and locations shall be coordinated with architect.

B. Wiring in wireways shall be neatly bundled, tied and suitably tagged.

3.8 UNDERGROUND DUCTBANK SYSTEM

A. DUCT SYSTEM

1. The duct system shall consist of Schedule 40 PVC or type 1-EB PVC conduits encased in red concrete as detailed on the drawings. Use rigid conduit for stub-ups and the last ten feet at the end of each ductbank. Duct lines shall be laid to a minimum grade of 4 inches per 100 feet and shall be free from either horizontal or vertical waves. Duct lines shall be straight unless otherwise noted on the drawings. Duct lines shall be installed so that the top of concrete in encased duct lines is not less than 24 inches below finished grade or finished paving at any point. Changes in direction or runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 5 feet. The long sweep bends may be made up of one or more curved or straight sections and/or combinations thereof using five-degree angle couplings. Conduit shall be thoroughly cleaned before using or laying. During construction and after the duct line is completed, the ends of the conduit shall be plugged to prevent water washing mud into the conduits. Particular care shall be taken to keep the conduits clean of concrete, dirt, and any other substance during the course of construction.

2. Each single conduit of the duct bank shall be completely encased in steel reinforced concrete as indicated. The thickness of concrete encasement indicated is the minimum thickness and may be increased to fit the actual shape of trench.

3. Concrete for duct bank envelopes shall be standard 2000 psi concrete mix as described in Division 03, [and be colored deep red for permanent marking of underground electrical work. The concrete red pigment shall be pure inorganic natural metallic base pigment,
approved by the Engineer before use. Organic pigments will not be permitted. The approved pigments shall be mixed four pounds per yard of cement].

a. Envelopes may be poured directly against sides of trenches if the "cut" is clean, even and free of loose material. All loose dirt and extraneous material shall be removed from the trenches before and during the pouring of concrete to ensure sound envelopes. Concrete shall be carefully spaded during pouring to eliminate all voids under and between the conduit and honeycombing of the exterior surfaces. Power driven tampers of agitators shall not be used, unless specifically designed for the application, in order to ensure that the water-tightness of the conduits is not destroyed.

b. Generally, each run of envelopes shall be poured in one continuous operation. Where more than one pour is necessary, each pour shall terminate in a vertical plane. Partial pours shall not terminate in horizontal or angular planes.

B. For normal underground installation see Section 26 02 00, paragraph 3.01 for Excavating and Backfilling.

END OF SECTION 26 05 33
SECTION 26 05 73 - SHORT-CIRCUIT/COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall furnish short-circuit and protective device coordination studies as prepared by the equipment manufacturer.

B. The Contractor shall furnish short-circuit and protective device coordination studies for the electrical power system, including all existing and newly installed electrical equipment. The analysis and study shall include all distribution branches and begin at the main building disconnect switch.

C. Provide a complete short circuit study, equipment interrupting or withstand evaluation, and protective device coordination study for the power distribution system. Normal operating method, alternate operation, and operations which could result in maximum fault conditions shall be thoroughly addressed in the study. The study shall assume all motors operating at rated voltage and speed. Electrical equipment bus impedance shall be assumed as zero. Short circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at the switchboard busses.

D. A protective device coordination study shall be performed to determine appropriate relay settings. The study shall include all distribution switchboards and panel board main circuit breakers. Panel board branch circuit devices need not be considered. The phase over current and ground fault protection shall be included as well as setting for all other adjustable protective devices.

E. An equipment evaluation study shall be performed to determine the adequacy of circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the available fault currents.

F. Any problem areas or inadequacies shall be promptly brought to the ENGINEERS attention.

G. The Contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems

2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis


6. IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures

3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis


C. The National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code, latest edition

2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.3 SUBMITTALS FOR REVIEW/APPROVAL

A. The short-circuit and protective device coordination studies shall be submitted to the design Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.4 SUBMITTALS FOR CONSTRUCTION

A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies, where required, shall be provided on CD in PDF format.

B. The report shall include the following sections:

1. One-line diagram

2. Descriptions, purpose, basis and scope of the study
3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection
5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout
6. Incident energy and flash protection boundary calculations
7. Recommendations for system improvements, where needed
8. Executive Summary.
9. Equipment manufacturer’s information used to prepare study
10. Assumptions made during study.

1.5 QUALIFICATIONS
A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies. The Registered Professional Electrical Engineer shall be a full-time employee of the Engineering Services Organization.

PART 2 - PRODUCT

2.1 STUDIES
A. The Contractor shall furnish short-circuit and protective device coordination studies as prepared by the equipment manufacturer.

B. The Contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

2.2 DATA COLLECTION
A. The Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination may include present and future motors and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.
D. Include fault contribution of existing motors in the study, with motors <100 hp grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141-1993.

B. Transformer design impedances shall be used when test impedances are not available.

C. Provide the following:
   1. Calculation methods and assumptions
   2. Selected base per unit quantities
   3. One-line diagram of the system being evaluated
   4. Source impedance data, including electric utility system and motor fault contribution characteristics
   5. Typical calculations
   6. Tabulations of calculated quantities
   7. Results, conclusions, and recommendations.

D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
   1. Electric utility’s supply termination point
   2. Incoming switchgear
   3. Low voltage switchgear
   4. Motor control centers
   5. Branch circuit panelboards
   6. Other significant locations throughout the system.

E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

F. Protective Device Evaluation:
   1. Evaluate equipment and protective devices and compare to short circuit ratings
2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses

3. Adequacy of transformer windings to withstand short-circuit stresses

4. Cable and busway sizes for ability to withstand short-circuit heating

5. Notify Owner in writing of any new or existing circuit protective devices improperly rated for the calculated available fault current.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

A. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.

B. Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.

D. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the curve sheets, where applicable for this project:

1. Electric utility’s protective device

2. Medium and low voltage fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands

3. Low voltage equipment circuit breaker trip devices, including manufacturer’s tolerance bands

4. Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters

5. Conductor damage curves

6. Ground fault protective devices, as applicable

7. Pertinent motor starting characteristics and motor damage points

8. Other system load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor control center.

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.5 ARC FLASH HAZARD ANALYSIS
A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.

C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

D. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 75 kVA.

E. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².

F. The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

G. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.

H. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.

2.6 REPORT SECTIONS

A. Input Data:
   1. Short-circuit reactance of rotating machines
   2. Cable and conduit materials
   3. Transformers
   4. Circuit resistance and reactive values.

B. Short-Circuit Data:
   1. Source fault impedance and generator contributions
   2. X to R ratios
   3. Asymmetry factors
4. Motor contributions

5. Short circuit kVA


C. Recommended Protective Device Settings:

1. Phase and Ground Relays:
   a. Current transformer ratio
   b. Current setting
   c. Time setting
   d. Instantaneous setting
   e. Specialty non-overcurrent device settings
   f. Recommendations on improved relaying systems, if applicable

2. Circuit Breakers:
   a. Adjustable pickups and time delays (long time, short time, ground)
   b. Adjustable time-current characteristic
   c. Adjustable instantaneous pickup
   d. Recommendations on improved trip systems, if applicable.

D. Incident energy and flash protection boundary calculations

1. Arcing fault magnitude

2. Device clearing time

3. Duration of arc

4. Arc flash boundary

5. Working distance

6. Incident energy

7. Hazard Risk Category

8. Recommendations for arc flash energy reduction

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

A. The Contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
C. Notify Owner in writing of any required major equipment modifications.

D. Following completion of all studies, acceptance testing and startup by the field engineering service division of the equipment manufacturer, a 2-year warranty shall be provided on all components manufactured by the engineering service parent manufacturing company.

3.2 ARC FLASH WARNING LABELS

A. The vendor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. The label shall have an orange header with the wording, “WARNING, ARC FLASH HAZARD”, and shall include the following information:

1. Location designation
2. Nominal voltage
3. Flash protection boundary
4. Hazard risk category
5. Incident energy
6. Working distance
7. Engineering report number, revision number and issue date.

C. Labels shall be machine printed, with no field markings.

D. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

1. For each 600, 480 and applicable 208-volt panelboards, one arc flash label shall be provided.
2. For each motor control center, one arc flash label shall be provided.
3. For each low voltage switchboard, one arc flash label shall be provided.

E. Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.3 ARC FLASH TRAINING

A. The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces, shall be provided in the equipment manuals. The
training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET).

END OF SECTION 26 05 73
SECTION 26 08 00 – COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract Documents, including General and Supplementary Conditions and Division 01 Specifications, apply to this section.

B. Related SECTIONS:

1. SECTION 01 91 00 - GENERAL COMMISSIONING REQUIREMENTS

1.2 SUMMARY

A. The commissioning of the lighting system and associated controls shall be performed by an impartial technical firm hired by the owner or shall be performed by the installing contractor if the owner has not hired a commissioning firm. The commissioning provider shall be certified under one or more of the following certifications:

1. CxA – Certified Commissioning Authority – ACG
2. CBCP – Certified Building Commissioning Professional – AEE
3. CCP – Certified Commissioning Professional – BCA
4. CPMP – Certified Process Management Professional – ASHRAE
5. BSC – Building System Commissioning Certification – NEBB

B. The commissioning provider (Commissioning authority) shall be responsible for leading the entire construction team through the commissioning process including, but not limited to, conducting the commissioning kick-off meeting, preparing the commissioning plan, preparing pre-functional checklists, preparing functional test scripts, participation in functional testing and preparation of required documentation and reports.

1.3 RESPONSIBILITIES

A. Contractor: Responsibilities of the Contractor as relate to Commissioning Process include, but are not limited to the following:

1. Facilitate coordination of Commissioning work by Commissioning authority.
2. Attend Commissioning meetings or other meetings called by Commissioning authority to facilitate the Commissioning Process.
3. Review Functional Performance Test procedures for feasibility, safety, and impact on warranty, and provide Commissioning authority with written comment on same.
4. Provide all documentation relating to manufacturer’s recommended performance
testing of equipment and systems.

5. Provide Operations & Maintenance data to Commissioning authority for preparation of checklists and training manuals.

6. Provide As-built drawings and documentation to facilitate Testing.

7. Assure and facilitate participation and cooperation of Sub Contractors and equipment suppliers as required for the Commissioning Process.

8. Certify to Commissioning authority that installation work listed in Pre-Functional Checklists has been completed.

9. Install systems and equipment in strict conformance with project specifications, manufacturer’s recommended installation procedures, and Pre-Functional Checklists.

10. Provide data concerning performance, installation, and start-up of systems.

11. Provide copy of manufacturers filled-out start-up forms for equipment and systems.

12. Ensure systems have been started and fully checked for proper operation prior to arranging for Testing with Commissioning authority. Prepare and submit to Commissioning authority written certification that each piece of equipment and/or system has been started according to manufacturer’s recommended procedure, and that system has been tested for compliance with operational requirements.
   a. Contractor shall carry out manufacturer’s recommended start-up and testing procedures, regardless of whether or not they are specifically listed in Pre-Functional Checklists.
   b. Contractor is not relieved of obligation for systems/equipment demonstration where performance testing is required by specifications, but a Functional Performance Test is not specifically designated by Commissioning authority.

13. Coordinate with Commissioning authority to determine mutually acceptable date of Functional Performance Tests.

14. Provide qualified personnel to assist and participate in Commissioning.

15. Provide test instruments and communications devices, as prescribed by Commissioning authority, required for carrying out Testing of systems.

16. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process. Proprietary test equipment shall become the property of the Owner upon completion of commissioning.

17. Ensure deficiencies found in the Commissioning Issues Log are corrected within the time schedule shown in the Commissioning Plan.

18. Provide Commissioning authority with all submittals, start-up instructions manuals, operating parameters, and other pertinent information related to
Commissioning Process. This information shall be routed through Architect.

19. Prepare and submit to Commissioning authority proposed Training Program outline for each system.

20. Coordinate and provide training of Owner’s personnel.

21. Prepare Operation & Maintenance Manuals and As-Built drawings in accordance with specifications; submit copy to Commissioning authority in addition to other contractually required submissions. Revise and resubmit manuals in accordance with Design Professionals and Commissioning authority’s comments.

22. Commissioning requires participation of this Division Subcontractors to ensure that systems are operating in manner consistent with Contract Documents. All costs associated with the participation of Contractor, Sub-Contractors, Design Professionals, and Equipment Vendors in the Commissioning Process shall be included as part of the Construction Contract.

B. Subcontractors and vendors shall prepare and submit to Commissioning Agent proposed Startup procedures to demonstrate proper installation of systems, according to these specifications and checklists prepared by Commissioning authority.

C. Electrical contractor shall provide a letter certifying the installed lighting controls meet documented performance criteria specified in the commissioning plan within 90 days of substantial completion.

1.4 COMMISSIONING PLAN

A. Commissioning Process tasks and activities:

1. Commissioning kick-off meeting: Conducted by commissioning authority and attended by construction team and design team.

2. Pre-functional checklists: Prepared by the commissioning authority and filled out by subcontractors performing the work that is applicable.

3. Site visits to review installation of applicable systems and progress of checklist documentation performed and reported by commissioning authority.

4. Functional testing: Commissioning authority shall conduct functional testing with assistance of applicable subcontractors and document successful results as well as deficiencies (issues). Functional performance testing shall demonstrate the installation and operation of components, systems, and system-to-system interfacing in accordance with plans and specifications.

5. Preliminary commissioning report: Commissioning authority shall issue a preliminary commissioning report to the owner that has results of the first round of functional testing including deficiencies discovered.

6. Systems manual: Commissioning authority shall compile the systems manual using submittal data provided by the general contractor and applicable
subcontractors.

7. Final commissioning report: Commissioning authority shall issue final commissioning report documenting the entire process and final results of functional testing. Report shall include final testing and balancing report.

B. Electrical System Equipment to be tested

1. Occupancy sensors.

2. Time switch controls.

3. Daylighting controls.

C. Testing functions and conditions

1. Daylighting control devices
   1. Verify the devices have been calibrated, properly located and adjusted.
   2. Loads adjust to light level set points in response to daylight.
   3. Location of calibration equipment is accessible to authorized personnel only.

2. Time switches
   1. Verify schedule, time, date and programming is accurate.
   2. Verify override time limit is set, battery is installed and switch operates the lights that are specified in the design documents.
   3. All specified lights can be turned on and off by area control switch.
   4. Manual override switch allows only the lights in the space where the switch is located turn on or remain on until next scheduled shut off.

3. Occupant sensors:
   1. Certify the sensor has been located and aimed in accordance with manufacturer recommendations.
   2. For projects with fewer than seven sensors, each sensor shall be tested.
   3. Fore projects with more than seven occupant sensors, testing shall be done for each unique combination of sensor type and space geometry. Where multiples of each combination are provided not less than 10 percent shall be tested.
   4. Verify correct operation of status indicators.
   5. Controlled lights turn off or down to the permitted level with in the required time.
   6. For auto-on sensor, the lights turn-on to the permitted level when an occupant enters space.
   7. Verify the lights are not incorrectly turned-on by movement in adjacent areas or by HVAC operation.

D. Performance criteria

1. Daylighting controls shall maintain specified light levels within 5% of design.

2. All time switches shall be accurate to time on cellular network devices.
PART 2 – PRODUCTS

2.1 NO PRODUCTS SUPPLIED

PART 3 – EXECUTION

3.1 GENERAL

A. This Division has startup responsibilities and are required to complete sub-systems so COMPLETE SYSTEMS are fully functional. Insuring they meet design requirements of Contract Documents. Commissioning procedures and testing do not relieve or lessen this responsibility or shift this responsibility, in whole or in part, to Commissioning Agent or Owner.

B. Coordinate with other Sub-Contractors and equipment vendors to set aside adequate time to address Pre-Functional Checklists, Functional Performance Tests, Operations & Maintenance Manual creation, Owner Training, and associated coordination meetings.

C. Commissioning authority will also conduct site inspections at critical times and issue Cx Field Reports with observations on installation deficiencies so that they may be issued by Architect as deemed appropriate.

3.2 WORK PRIOR TO COMMISSIONING

A. Complete all phases of the work so the systems can be started, adjusted, balanced and otherwise tested.

B. See pertinent specification sections in this Division, which outline responsibilities for start-up of equipment with obligations to complete systems, including all sub-systems so that they are fully functional.

C. Assist Commissioning Agent with all information pertaining to actual equipment and installation as required complete the full commissioning scope.

D. Contractor shall prepare startup procedures to demonstrate compliance with pre-functional checklists, and coordinate scheduling for completion of these checklists.

E. A minimum of 7 days prior to date of system startup, submit to Commissioning Agent for review, detailed description of equipment start-up procedures which contractor proposes to perform to demonstrate conformance of systems to specifications and Checklists.

3.3 PARTICIPATION IN COMMISSIONING

A. Attend meetings related to the Commissioning Process; arrange for attendance by personnel and vendors directly involved in the project, prior to testing of their systems.

B. Provide skilled technicians to startup and test all systems, and place systems in complete and fully functioning service in accordance with Contract Documents.

C. Provide skilled technicians, experienced and familiar with systems being commissioned, to assist Commissioning authority in commissioning process.
3.4 WORK TO RESOLVE DEFICIENCIES

A. Complete corrective work in a timely manner to allow expeditious completion of Commissioning Process. If deadlines pass without resolution of identified problems, Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs thus incurred will be Contractor’s responsibility.

3.5 PRE-FUNCTIONAL CHECKLISTS (PFC)

A. Contractor shall complete Pre-Functional Checklists to validate compliance with Contract Documents installation and start-up requirements, for this Division’s systems.

B. Refer to commissioning plan for detailed list of equipment to be commissioned.

3.6 FUNCTIONAL PERFORMANCE TESTING (FPT)

A. Contractor, in cooperation with Commissioning Agent, shall conduct Functional Performance Testing to validate compliance with Contract Documents.

C. Refer to commissioning plan for detailed list of equipment to be commissioned.

B. Assist Commissioning authority in Functional Testing by removing equipment covers, opening access panels, etc. Furnish ladders, flashlights, meters, gauges, or other inspection equipment as necessary.

3.7 TRAINING

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specifications manual.

B. Contractor shall be responsible for training coordination and scheduling, and ultimately to ensure that training is completed.

C. The training agenda (plan) shall include, at a minimum, the following elements:
   1. Purpose of equipment.
   2. Principle of how the equipment works.
   3. Important parts and assemblies.
   4. How the equipment achieves its purpose and necessary operating conditions.
   5. Most likely failure modes, causes and corrections.
   6. On site demonstration.

D. Commissioning Agent shall be responsible for overseeing and approving content and adequacy of training of Owner personnel for all installed systems. Provide Commissioning Agent with training plan two weeks before planned training.
3.8 OPERATIONS & MAINTENANCE MANUALS

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specifications manual.

B. Contractor shall compile and prepare documentation for equipment and systems specified in this Division, and shall deliver documentation to Contractor for inclusion in Operation & Maintenance Manuals, in accordance with requirements of Division 01, prior to training Owner personnel.


D. Operation and maintenance manuals shall include, service agency contact information, maintenance requirements, controls system settings and a narrative of how each system is intended to operate, including set points.

3.9 DOCUMENTATION

A. Commissioning authority shall provide documentation of process as follows:

1. Preliminary commissioning report including test procedures, results of testing, itemization of deficiencies, deferred tests and climatic conditions required for performance of deferred tests. Preliminary commissioning report shall be issued to owner to demonstrate the first pass of testing has occurred and to demonstrate compliance with applicable codes.

2. Final commissioning report shall include the final test and balance report, final results of functional testing, disposition of deficiencies discovered during testing, including the details of corrective measures used and functional testing procedures used for repeatability of testing in the future.

END OF SECTION 26 08 00
SECTION 26 22 22 – LOW VOLTAGE HARMONIC DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SCOPE

A. Provide 480 – 208Y/120-volt 3 phase, 4 wire transformers as shown, scheduled and as specified.

B. The type of transformers required are dry-type harmonic mitigating transformers.

1.2 STANDARDS

A. Products shall be designed, manufactured, tested and installed in compliance with applicable ANSI/IEE and NEMA standards.

B. All low voltage transformers shall be UL listed and labeled.

C. All low voltage transformers 15 kVA and larger shall meet or exceed post-January 1, 2016 U.S. DOE efficiency requirements Energy, 10 C.F.R. §431.196(a)(2) (2015)]regardless of whether transformer date of manufacture is pre or post January 1, 2016.


1.3 ACCEPTABLE MANUFACTURERS

A. Provide the following manufacturer:


1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:

1. Cutsheets of transformers with sound and load ratings, dimensions, weights, impedance rating, insulation type, temperature rise, phase displacement and tap configurations.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. National Electrical Code.

B. Local, municipal, and/or state codes that have jurisdiction.

1.6 DESIGN OBJECTIVES

A. The design of the electrical distribution system, as described by this specification and detailed in the accompanying electrical drawings, provides for control of the harmonic currents that are generated by non-linear electronic loads. These design objectives, and the various standards that apply, are detailed herein as follows:
1. To reduce the ‘penalty losses’ that are produced by harmonic currents, which would otherwise result in an increase in the cost-of-power, apparatus heating and the cost of air-conditioning, within economic limits.

2. To limit harmonic current injection into the Point of Common Coupling (PCC), as required in (ANSI) IEEE Std. 519-1992, Section 10.4, Table 10.3.

3. To limit positive, negative and zero sequence harmonic currents in the distribution system so that the Individual Harmonic Distortion of Voltage (IHDv) levels do not exceed 3% at the loads and the Total Harmonic Distortion of Voltage (THDv) levels do not exceed 5% at the loads, as recommended in (ANSI) IEEE Std. 519-1992, Section 6.6, Paragraph 2.

4. To limit zero sequence harmonic currents in the neutral conductors so that their ratings are not exceeded and Common Mode Noise (CMN) [neutral-ground voltage] levels do not exceed 5 volts at the loads, as recommended by CBEMA. Where computers and/or audio/visual devices are interconnected into a communications ‘network’, to limit the difference in CMN to < 2 volts at all loads, as recommended by EPRI.

1.7 FACTORY TESTING

B. The manufacturer shall provide linear and non-linear efficiency test on each transformer. Transformers not meeting the following criteria will not be used on this job. The data shall be included in the Operations and Maintenance Manuals. The tests shall be conducted between 0% and 100% full load and shall be plotted for each transformer.

1. Linear Load Efficiency: Transformer shall [meet or exceed] post-January 1, 2016 U.S. DOE efficiency requirements [Energy, 10 C.F.R. §431.196(a)(2) (2015)] regardless of whether transformer date of manufacture is pre or post January 1, 2016. Proof of compliance Type Tests, for each transformer type and rating, must be based on U.S. DOE test methods [Energy, 10 C.F.R. §431, Subpart K, Appendix A (2015)]. Type Test are required with each submission.

2. Non-Linear Load Efficiency: This requirement is defined as meeting the efficiency requirements of NEMA TP1-2002 under non-linear loading, which has 100% THD\(_i\) and a harmonic profile that is based on IEEE Std. 519-1992, Table 4.3 – ‘Spectrum of Typical Switch Mode Power Supplies’. Proof of compliance Type Tests, for each transformer type and rating, must be based on the Voltage and Current Difference Loss Measurement Method using laboratory grade CTs and 0.1% accuracy Wattmeters OR shall be calculated in accordance with IEEE Std. C57.110. Type Tests are required with each submission. The Power In – Power Out Measurements Method is not an acceptable test method due to the limitations associated with CT, PT and WattMeter accuracy.

1.8 FACTORY NAME PLATES

1. Provide two (2) – name plates per transformer indicating all code required items (i.e. kVA voltage, phase etc.). Name plates shall also include, phase shift and a name as indicated on transformer schedule or one-line diagram. The name plates shall be located on a non-
removable section of the outer shell.

1.9 ALTERNATES

A. In the event the contractor wishes to propose an alternative to the specified Harmonic Mitigating Transformers and/or Zero Sequence Harmonic Filters, the contractor shall provide the engineer with a detailed alternate Harmonic Mitigation Plan, which includes a schedule of proposed replacement devices that will meet all of the requirements described in this specification. The equipment proposal from the non-specified vendor(s) shall include the following information:

1. Evidence of significant relevant application experience.
2. Quantitative performance data including before/after effect on voltage distortion at the loads that demonstrates the vendor’s capability to achieve the harmonic treatment called for in this specification.
3. Product technical specification and installation wiring diagram.
4. Pertinent product application information.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Type ‘DV’, Single Output, Harmonic Filtering Distribution Transformers (Dry Type) shall be provided for all transformers indicated with a zero (0), thirty (30), fifteen (15), forty-five (45), twenty (20) and forty (40) degree primary to secondary phase shifts.

B. Harmonic mitigating transformers with Wye configured primary windings are not acceptable.

C. Harmonic mitigating transformers without zig-zag configured secondary windings that completely cancel zero-sequence flux under balanced load conditions are not acceptable.

2.2 PRODUCT DESCRIPTION

A. The design of the harmonic filtering transformers, described in this Specification, shall be optimized for harmonic rich environments that are characterized by high neutral currents. These transformers shall:

1. Provide an ultra-low zero sequence impedance path for all load-generated zero sequence harmonic currents, including \( I_3, I_9, I_{15}, I_{21}, \) etc.

2. Provide for the cancellation of the 5\(^{th}\), 7\(^{th}\), etc. positive and negative sequence harmonic currents, at the units’ primary bus, when 0\(^{\circ}\) and 30\(^{\circ}\) (15\(^{\circ}\) and 45\(^{\circ}\)) phase-shifting units are used in combination.

3. Provide for the cancellation of the 5\(^{th}\), 7\(^{th}\), 11\(^{th}\), 13\(^{th}\), etc. positive and negative sequence harmonic currents, at the units’ primary bus, when 0\(^{\circ}\), 20\(^{\circ}\) and 40\(^{\circ}\) phase-shifting units are used in combination.
4. Provide for the cancellation of 5th, 7th, 11th, 13th, 17th, 19th, etc. positive and negative sequence harmonic currents, at the units’ primary bus, when 0°, 15°, 30° and 45° phase-shifting units are used in combination.

5. Harmonic cancellation shall be by electromagnetic means only. No capacitors or electronics shall be used.

6. Reduce voltage and current distortion and imbalance at the primary terminals of the unit.

7. Reduce current crest factor at the primary terminals of the unit.

8. Reduce average and peak phase current on the primary terminals of the unit.

9. Reduce system losses.

10. Improve system power factor.

11. Reduce voltage distortion in the secondary sub-system.

2.3 DEVICE CONFIGURATION

A. Type: ANN

B. Insulation Class: 220°C

C. Temperature Rise: 150°C

D. System Frequency: 60 Hertz

E. Primary Voltage: 480 Volts Delta (Wye configured primary is not acceptable)

F. Secondary Voltage: 208/120 Volts Zig-Zag with two (2) windings per core leg for 0-degree phase shift and 208/120 Volt modified zig-zag with three (3) windings per core leg for 30, 15, 45, 20 and 40 degree phase shifts.

G. Phase: Three Phase

H. Rating: as scheduled on drawings

I. Primary-Secondary Phase-Shift: as scheduled on drawings

2.4 TRANSFORMER CHARACTERISTICS

A. Key Requirements

1. Positive & negative sequence impedance: standard %

2. Zero sequence reactance at 60Hz: < 0.3 %

3. Zero sequence impedance at 60Hz: < 0.9 %
4. Crest Factor suitability: 5
5. BIL: 10,000 Volts (windings 1000V)
6. Capability to deliver full nameplate kVA to loads of K-factor up to: 30
7. Neutral connection shall be rated at two times the ampacity of the secondary phase current.

B. Basic Requirements:
2. Three-phase, common core construction
3. Convection air-cooled
4. Copper or Aluminum Windings
5. Insulation Class: R(200 degree C)
6. Magnetic field at 1.5 feet: max. 0.1 Gauss
7. Full load Efficiency at 170°C
8. Magnetizing Inrush Current: max. 10 times full load rating
9. Taps: 2 x ± 2.5%
10. Sound level: per C57.12.91
11. Enclosure: ventilated, drip-proof NEMA-1 [totally enclosed]
12. Finish: PQI white power coat
13. Anti-vibration pads shall be used between the core and the enclosure

2.5 VENDOR INFORMATION
A. Evidence of significant relevant application experience.
B. Quantitative performance data including before/after effect on voltage distortion at load panels that demonstrates the capability to achieve the harmonic mitigation called for in this specification.
C. Product technical specification.
D. Pertinent product application information.
PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install transformer in accordance with manufacturer's written instructions, and recognized industry practices.

B. Housekeeping Pad: Provide a nominal 3-1/2" high, 2500 PSI (28 Day) concrete reinforced pad with number 6 welded wire mesh. The pad shall conform to the shape of the transformer and extend at least 3 inches beyond the length and width of the transformer. All corners of the pad shall be rounded.

C. Mounting: Install floor mounted transformers on properly sized rubber-in-shear vibration isolators. Trapeze mounted transformers shall use rubber-in-shear hangers. Wall mounted transformers shall not be mounted directly to the wall without vibration isolation.

D. Connection: Route conductors in a minimum of 2 feet of flexible steel conduit to transformer enclosure. Provide grounding conductor sized per NEC, connected to the building grounding electrode system.

3.2 FIELD TESTING

A. Insulation, Tests: Prior to energization, check transformers windings for continuity and test the insulation resistance. Tests shall be made using a Biddle Megger or equivalent test instrument, per manufacturers’ recommendations.

B. Tap Setting: Measure current and voltage under load conditions to provide correct tap settings.

C. Receptacle Tests: At the furthest receptacle from each panel serving a computer or copier, a harmonic analyzer shall be used to determine the following:

1. Voltage
2. Current
3. Current Distortion
4. Common Mode Noise (Neutral to ground voltage)
5. Voltage Distortion

Conduct all tests 3 to 6 months after building occupation. Submit all tests for Engineer’s review.

END OF SECTION 26 22 22
SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SCOPE
   A. Provide switchboards as shown, scheduled and as specified herein.

1.2 STANDARDS
   A. Products shall be designed, manufactured, tested and installed in compliance with applicable standards.
   B. Products shall conform to all applicable UL standards and shall be UL-labeled.
   C. NEMA PB2

1.3 ACCEPTABLE MANUFACTURERS
   A. Provide one of the following manufacturers:
      1. General Electric Company/ABB
      2. Square D Company

1.4 SUBMITTALS
   A. Shop drawings shall include, but not be limited to:
      1. Cut sheets of all enclosures, instrumentation, fusible switches, bussing, rating, capacities, features, wiring and bussing diagrams, schedules, coordination study and all accessories clearly labeled.
      2. Manufacturer of electrical gear shall provide Fault Current, Selective Coordination and Arc Flash Study in order to provide breaker settings, confirm interrupting ratings, and confirm selective coordination compliance for the electrical system. Submit interrupting ratings for all switchboards in submittals. Emergency systems as defined in NEC 700 and 701 shall have overcurrent protection devices that are selectively coordinated to the emergency sources. The switchboard shall be fully rated.
      3. Manufacturer to include in the submittal all trip curves and all literature indicating the interrupting rating characteristics of equipment being supplied.

1.5 REQUIREMENTS OF REGULATORY AGENCIES
   A. WORK IN ACCORDANCE WITH:
2. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General:

Furnish and install the service entrance switchboard as herein specified and shown on the associated electrical drawings. The switchboard shall meet the latest Underwriters' Laboratories standard #891 & NEMA PB2 and be furnished with an Underwriters' Laboratories label. The service to the switchboard will be as shown on the plans.

B. Enclosure Construction:

The switchboard shall be dead front with front. The switchboard framework shall consist of steel channels bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting. The framework is to be formed of code gauge steel, rigidly welded and bolted together to support all cover plates, bussing and component devices. Each switchboard shall have an open bottom for installation and termination of conduit. Bottom conduit areas are to be clearly shown and dimensioned on the shop drawings. The wireway front covers shall be hinged to permit easy access to the branch device load side terminals. All front covers shall be screwed on and removable. The entire switchboard enclosure shall be painted. The paint finish shall be medium light gray, ANSI 61 or #49, applied by the electrode position process over an iron phosphate pre-treatment. The switchboard shall be nominal 90 inches high mounted on 1-1/2 inches high by 3 inches deep steel channel running under the front rear and center horizontal depth. Provide NEMA 1 enclosure when installed indoors, unless otherwise noted. Provide NEMA 3R enclosures when installed outside.

C. Bussing:

The switchboard bussing shall be of sufficient cross-sectional area to meet UL Standard 891 temperature rise. The bus shall be plated copper or aluminum plated by the Alstan 70 process. The phase and neutral through bus shall have an ampacity as shown on the plans and shall be braced to have a short circuit current rating of 65,000 RMS symmetrical amperes. Tapered bus is not acceptable. The horizontal bus shall be fully rated for the entire switchboard length. The vertical shall be sized for a minimum of 2000 amperes (or sized to match the horizontal bus if the service is less than 2000A) and as required to comply with UL891 14.31. Full provisions for the addition of future sections shall be provided. Vertical buss for distribution shall be full height for future breaker additions. Bussing shall include all necessary hardware to accommodate splicing for future additions. The through bus supports, connections and joints are to be bolted with grade 5 minimum hex heads bolts and Belleville washers to minimize maintenance requirements. Provide a full length ground bus.

D. Short Circuit Current Rating:

Each switchboard, as a complete unit, shall be given a single short circuit current rating by the manufacturer. Such rating shall be established by actual tests by the manufacturer, in
accordance with UL specifications, on equipment constructed similarly to the subject switchboard. The switchboard shall be rated for 65,000 amperes minimum fault current.

E. Main Lugs Only – Indoor Switchboard:

1. The incoming service lateral/feeder shall enter the switchboard from below unless otherwise noted on the drawings. The incoming main lugs shall be mechanical type for copper conductors and compression type for Aluminum conductors. They shall be sized for multiple sets of the incoming cables to terminate the conductors to meet the wire sizes and ampacity shown.

F. Main Circuit Breaker Lugs – Outdoor Main Circuit Breaker Section:

1. The incoming service lateral/feeder shall enter the Main Service Disconnect Switch (Nema 3R) from below unless otherwise noted on the drawings. The incoming conductors shall be terminated using mechanical type lugs for copper conductors and compression type for Aluminum conductors. They shall be sized for multiple sets of the incoming cables to terminate the conductors to meet the wire sizes and ampacity shown.

G. Overcurrent Devices:

1. General: All protective devices shall be individually or group mounted, arranged for stationary mounting.

2. Main Circuit Breakers shall be molded case for sizes less than 1600 amps and insulated case for larger sizes. Main breakers shall be stationary mounted. The circuit breaker shall be 100% rated (unless otherwise noted on drawings), 3-pole device with ampere rating as shown on the drawings and additional features as listed below.
   a. The breaker case shall be constructed from high dielectric strength, glass-reinforced insulating material. All breakers shall be provided with padlock capabilities to facilitate lockout/tag-out procedures.
   b. Insulated Case breakers shall be manually operated using a two-step store energy device and shall be provided with a handle for charging the spring mechanism. Provide on/off push buttons for opening and closing the circuit breaker.
   c. The breaker shall be equipped with a solid-state programmer, flux shift trip device, and current sensors to control the breaker operation under overload and fault conditions. The solid-state electronic programmer shall have the following features and tripping functions.
      1) Adjustable current setting
      2) Adjustable long-time delay
      3) Adjustable short-time pickup and delay
      4) Adjustable ground fault pick-up
      5) Adjustable ground fault delay
      6) Fault trip indicators for ground fault, overloads and short circuits
      7) Digital ammeter

3. Molded Case Circuit Breakers 800 amps or larger: The circuit breaker shall be 100% rated (unless otherwise noted on drawings), 3 pole device with ampere rating
as shown on the drawings and additional features as listed below.

a. The breaker case shall be constructed from high dielectric strength, glass-reinforced insulating material.
b. The breaker shall be manually operated and provided with a handle for opening a quick-make quick-break mechanism.
c. The breaker shall be stationary-mounted within the switchboard.
d. The breaker shall be equipped with a solid-state programmer, flux shift trip device, and current sensors to control the breaker operation under overload and fault conditions. The solid-state electronic programmer shall have the following features and tripping functions.
   1) Adjustable current setting
   2) Adjustable long-time delay
   3) Adjustable short-time pickup and delay
   4) Adjustable ground fault pick-up where indicated on the drawings to provide two levels of ground fault.
   5) Adjustable ground fault delay, overloads and short circuits where indicated on the drawings to provide two levels of ground fault.
   6) Fault trip indicators for ground fault where indicated on the drawings to provide two levels of ground fault.

4. Molded Case Circuit Breakers less than 800 amps: The circuit breakers shall be 80% rated (unless otherwise noted on drawings), 3 pole device with ampere rating as shown on the drawings and additional features as listed below.
   a. The breaker case shall be constructed from high dielectric strength, glass-reinforced insulating material.
b. The breaker shall be manually operated and thermal magnetic.
c. The breaker shall be stationary-mounted within the switchboard.
d. Where spaces are shown, all mounting hardware and bus connectors shall be included. The only item to be included with the activation of the space is the circuit breaker.

H. Arc Energy Reduction Switch:

1. Provide arc energy reduction switch for each breaker rated 1200 amps or larger to comply with 240.87 of the NEC. Switch shall be equipped with a pad lockable cover with a blue LED pilot light that illuminates when system is activated. Locate switch and cover recessed mounted adjacent to the breaker it is serving. Provide Label. Provide all hardware required. Provide remote mount when indicated on the drawings.

I. Instruments

1. Provide a Square "D" model PM5563 or equal by General Electrical or Eaton digital power logic meter. Provide current and potential transformers as required.

2. Provide optional Ethernet communication card for Ethernet connections. Communication protocol shall include BACnet or Modbus TCP over Ethernet.

J. Infrared Viewing Ports:

Provide infrared viewing ports for incoming main connection, main breakers, feeder
connections for devices rated at 1200 amps and more, busway connections.

K. Space Heaters (Unconditioned Spaces and Exterior Unit):

Provide factory-installed space heaters in each vertical section. Provide with field adjustable humidistat control to set humidity range for anticipated environmental conditions. Provide unit with factory mounted transformer for 120V control power with appropriate overcurrent fusing.

PART 3 - EXECUTION

3.1 INSTALLATIONS

A. General: Install switchboards, including electrical connections, in accordance with manufacturer’s written instructions, NEC and recognized industry practices.

B. Housekeeping Pads: Mount switchboards on 4-inch high reinforced concrete housekeeping pads for indoor locations. Refer to Section 26 02 00, Paragraph 2.04.

C. Prior to energizing the switchboard, the manufacturer shall test all ground fault interrupters to verify proper operation. Contractor shall contact manufacturer for this test at least two weeks in advance.

D. All connections within switchboard whether field connected or factory assembled shall be tested and verified for proper torque valves per the manufacturer’s instructions.

E. Contractor shall make electronic adjustments to circuit breaker trips units as per the coordination/selective study. A manufacturer’s field service representative or qualified third part service company approved by owner and engineer may also set the breakers. This shall be performed prior to close out of job site. A report shall be submitted to certify the breaker setting have been set according.

F. Digital meters shall be configured as directed by the owner for monitoring. The logs shall be cleared at substantial completion. Date and time shall be set.

G. Switchboards shall be cleaned inside and out to remove dust and debris prior to energizing.

H. Infrared Scanning: After Substantial Completion by not more than 2 months after Final Acceptance, perform an infrared scan of switchboard. Remove fronts if not equipped with viewing ports to make joints and connections accessible to a portable scanner.

3.2 IDENTIFICATION OF CONDUCTORS AND SWITCHGEAR ELEMENTS

A. Identify main, feeder and branch circuit conductors at each outlet point where such conductor terminates. Identify feeder bundles passing through a junction or support box within enclosures.

B. Identify by use of permanent type bands, Brady or T & B. Employ a definite number or letter code uniform throughout each conductor.
C. Nameplates:

The switchboard will be supplied with a 3"x 6" master nameplate and individual nameplates for each main and branch overcurrent device. The nameplates shall be white and black 1/2" high lettering.

END OF SECTION 26 24 13
SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE

A. Provide panelboards as shown, scheduled and as specified herein.

B. The types of panelboards include:
   1. Panelboards.
   2. Power distribution panelboards.

1.2 STANDARDS

A. Products shall be designed, manufactured, tested and installed in compliance with applicable standards.

B. Products shall conform to all applicable UL standards and shall be UL-labeled.

1.3 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:
   1. General Electric Company/ABB
   2. Square D Company

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
   1. Cutsheets of all enclosures, circuit breakers, fusible switches, bussing, rating, schedules and all accessories clearly labeled.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:
   2. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General
Provide power distribution and panelboards as indicated in the panelboard schedule and as shown on the plans. Power distribution panelboards shall be equipped with fusible switches or circuit breakers as shown on the schedule. Panelboards shall be equipped with thermal-magnetic, molded case circuit breakers of frame and trip ratings as shown on the schedule.

B. Busing Assembly and Temperature Rise

Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 50°C rise above 40°C ambient. Heat rise test shall be conducted in accordance with Underwriters Laboratories Standard UL 67. The use of conductor dimensions will not be accepted in lieu of actual heat tests. All current carrying parts of the bus shall be tin or silver plated copper.

1. Bus structure shall be isolated. Bus bar connections to the branch circuit breakers shall be distributed phase or phase sequence type and shall accept bolt-on circuit breakers for lighting and appliance panelboards.

2. The lugs for terminating conductors shall be rated at 75°C on all panel boards and circuit breakers.

Provide an extruded bare copper ground bus. Provide an isolated ground copper bus in each panel serving isolated ground circuits. Provide a full-size copper neutral bus in each panelboard enclosure. Provide a double size neutral buss when served by a harmonic mitigating transformer.

C. Distribution Panelboards

Circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Large, permanent, individual circuit numbers shall be affixed to each breaker in a uniform position. Tripped indication shall be clearly shown by the breaker handle taking a position between “ON” and “OFF”. Provisions for additional breakers shall be such that no additional connectors will be required to add breakers. Circuit breakers shall be of the frame size, trip setting and interrupting capacity as indicated on the drawings. Circuit breakers shall be rated 65,000 AIC at 277 volts unless otherwise noted on plans.

1. Provide arc energy reduction switch for each breaker rated 1200 amps or larger to comply with 240.87 of the NEC. Switch shall be equipped with a pad lockable cover with a blue LED pilot light that illuminates when system is activated. Locate switch and cover recessed mounted adjacent to the breaker it serves or remote as indicated on the plans. Provide label and all required hardware. Remote switch(es) shall be flush mounted in wall near entry to the room.

D. 480/277 Volt Panelboards

Main breakers shall be vertically mounted. Horizontally mounted main breakers are not acceptable.

Circuit breakers shall be bolt-on thermal-magnetic, molded case circuit breakers. Breakers
shall be 1, 2 or 3 pole with an integral crossbar to assure simultaneous opening of all poles in multiple circuit breakers. Breaker shall have an over-center, trip-free, toggle-type operating mechanism with quick-make, quick-break action and positive handle indication. Handles shall have “ON”, “OFF” and “TRIPPED” positions. Circuit breakers shall be UL listed in accordance with UL Standard 489 and shall be rated 277-volt ac (single pole, 15-30 amperes) or 480Y/277 volts ac (2 and 3 pole) with continuous current ratings as noted on the plan. Interrupting ratings shall be a minimum of 18,000 rms symmetrical amperes at 277 volts ac (single pole) or 480Y/277 volts ac (2 and 3 pole). Single pole, 15 and 20 ampere circuit breakers intended to switch fluorescent lighting loads on a regular basis shall carry the SWD marking. Circuit breakers shall be rated 18,000 AIC at 277 volts unless otherwise noted on plans.

E. 240 Volt Panelboards

Main breakers shall be vertically mounted. Horizontally mounted main breakers are not acceptable.

Circuit breakers shall be bolt-on thermal-magnetic, molded case circuit breakers. Breakers shall be 1, 2, or 3 pole with an integral crossbar to assure simultaneous opening of all poles in multiple circuit breakers. Breakers shall have an overcenter, trip-free, toggle-type operating mechanism with quick-make, quick-break action and positive handle indication. Handles shall have "ON", "OFF" and "TRIPPED" positions.

Circuit breakers shall be UL listed in accordance with UL standard 489 and shall be rated 240 volts ac maximum with continuous current rating as noted on the plans.

Branch circuit breakers feeding convenience outlets shall have sensitive instantaneous trip settings of not more than 10 times the trip settings of the breaker to prevent repeated arcing short resulting from frayed appliance cords. Single pole 15 and 20 ampere circuit breakers shall be UL listed as "Switching Breakers" at 120V ac and carry the SWD marking.

UL Class A 5mA ground fault circuit protection shall be provided on all receptacle circuits serving wet areas and on all 120V ac branch circuits as specified on the plans or panelboard schedule. This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. A single pole circuit breaker with integral ground fault circuit interruption shall require no more panelboard branch circuit space than a conventional circuit breaker.

Circuit breakers shall be rated 10,000 AIC at 240V unless otherwise noted on plans.

Provide double sized neutral bus with panels served from a non-linear transformer or when indicated on drawings. This shall be a UL approved assembly.

F. Cabinets and Fronts

The panelboard bus assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. Wiring gutter space shall be in accordance with UL Standard 67 for panelboards. The box shall be fabricated from galvanized steel or equivalent rust resistant steel. All NEMA-1 panels shall have hinged
PANELBOARDS

front covers. The front cover shall have a door with hinges, latch and a lock. The piano hinged front covers door-in-door shall allow full access to the circuit breaker gutter area without having to remove the entire front cover. All panelboard lock shall be keyed alike. Circuit breaker and fusible distribution panels shall have four-piece trims. A welded circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door. Provide NEMA 1 enclosure where installed indoors unless otherwise noted. Provide NEMA 3R enclosure where installed outside or in a sprinkled area.

G. Safety Barrier

The distribution panelboard interior assembly shall be dead front with panelboard cover removed. Main lugs or main breakers shall have barriers on five sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers.

H. Integrated Equipment Short Circuit Rating

Each panelboard, as a complete unit, shall have a short circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or on the plans. This rating shall be established by testing with the over-current devices mounted in the panelboard. The short circuit tests on the over-current devices and on the panelboard structure shall be made simultaneously by connecting the fault to each over-current device with the panelboard connected to its rated voltage source. Method of testing shall be per Underwriters Laboratories Standard UL 67. The source shall be capable of supplying the specified panelboard short circuit current or greater. Testing of panelboard over-current devices for short circuit rating only while individually mounted is not acceptable. Also, testing of the bus structure alone is not acceptable. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage and shall be UL listed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install panelboards, including electrical connections, in accordance with manufacturers written instructions, NEC and recognized industry practices.

B. Housekeeping Pads: Mount floor mounted panelboards on 4-inch-high concrete housekeeping pads.

C. Fuses: Install fuses of the rating and class as shown in each fusible distribution panel scheduled on drawings.

D. Conduits: Stub up three one-inch conduits to an accessible location above the ceiling for each recessed panelboard.

Infrared Scanning: After Substantial Completion by not more than 2 months after Final Acceptance, perform an infrared scan of each switchboard. Remove fronts if not equipped with viewing ports to make joints and connections accessible to a portable scanner. Submit a copy the owner and engineer for review. If O&M manuals are submitted prior to performance of infrared scan, contractor shall submit a signed letter to verify the scan has been arranged. Letter shall indicate the scan provider and the date It will be performed.
3.2 IDENTIFICATION

A. Nameplate: Each panelboard shall have an engraved bakelite nameplate. Nameplates shall be white with black letters and show panel designation. Nameplates shall be attached with stainless steel screws. Refer to Section 26 02 00, paragraph 2.08(C).

B. Directory Card: Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include location and name of each item of equipment served. Spares and spaces shall be written in erasable pencil for future use. Circuit directory shall show the room served by each circuit. The final graphs/signage room numbers shall be used. Do not use Architectural numbering on plans.

C. Replacement Components: Where circuit breakers or fuses are applied in compliance with the series combination ratings marked on the equipment by the manufacturers, the equipment enclosure(s) shall be legibly marked in the field to indicate the equipment has been applied with a series combination rating. The marking shall be readily visible and state "caution - Series Rated System." (NEC 110-22). Nameplate shall also identify replacement components.

END OF SECTION 26 24 16
SECTION 26 27 26 – WIRING DEVICES

PART 1 – GENERAL

1.1 SCOPE

A. Provide wiring devices as shown; scheduled, required and as specified.

B. The types of wiring devices required include:
   1. Receptacles
   2. Switches
   3. Coverplates

1.2 STANDARDS

A. NEMAWD-1
B. NEMA WD-5
C. UL
D. Federal Spec WC-596-F and WS-896

1.3 ACCEPTABLE MANUFACTURERS

A. Hubbell
B. Leviton
C. Pass & Seymour

1.4 SUBMITTALS

A. Shop drawings shall include but not be limited to:
   1. Cut sheets of all devices indicating NEMA configuration, rating, materials, color, and all accessories.
   2. Cut sheets of all coverplates indicating materials, color and any engraving specified on drawing or in the specifications.

1.5 REQUIREMENTS OF REGULATORY AGENCIES WORK IN ACCORDANCE WITH:

A. National Electric Code.
B. Local, municipal, or state codes that have jurisdiction.

PART 2 – PRODUCTS

2.1 MATERIALS AND COMPONENTS
A. GENERAL
1. Provide factory assemble wiring devices with the rating type and color as required and specified for the service indicated.
2. Provide matching one-piece multiple gang plates where switches are ganged.
3. Provide wall plates for each receptacle furnished.
4. Architect reserves the right to select wiring device styles and colors to match wall finish.
5. Wall plates shall be of same manufacturer as devices.

2.2 SWITCHES

A. Provide specification grade White decora style rocker switches where indicated on the Drawings. Provide "Red" switches for switching emergency lighting circuits where switching is indicated. Coordinate exact locations with architect.

B. Wall switches shall be 20 amp, 120-277 volt and shall be Hubbell Decorator Series, Leviton, Decora or Pass & Seymour Decorator, as follows:

1. SINGLE POLE SWITCHES: Leviton 5621-2, P&S 2621, Hubbell DS120
2. DOUBLE POLE SWITCHES: Leviton 5622-2, P&S 2622, Hubbell DS220
3. THREE WAY SWITCHES: Leviton 5623-2, P&S 2623, Hubbell DS320
4. FOUR WAY SWITCHES: Leviton 5624-2, P&S 2624, Hubbell DS420
5. MOMENTARY CONTACT SWITCHES: Hubbell HBL1557, Leviton 1257, P&S 1251
6. THREE POSITION, TWO CIRCUIT MAINTAINED CONTACT SWITCHES: Leviton 1285, Hubbell HBL1385, P&S 1225

C. Light Handle Switches: Provide Leviton 5649-2 or P&S 2625 lighted handles to switch emergency lights where noted on the drawings.

2.3 RECEPTACLES

A. Provide specification grade, Decora type White receptacles where indicated on the drawings. Provide “Red” receptacles for receptacles on emergency power. Coordinate exact location with architect.

B. Receptacles shall be Hubbell StyleLine Decorators Series, Leviton, Decora or Pass & Seymour Decorator as follows:

1. Duplex 20A-125V-self grounding: (NEMA configuration 5-20R): Hubbell DR20, Leviton 16362, or P&S 26342.
2. Simplex 20A-125V-Self Grounding: (NEMA configuration 5-20R): Leviton 1635 or P&S 26361.

3. Isolated ground duplex, 20A-125V: (Orange, NEMA configuration 5-20R) Hubbell IG20DRX, Leviton 16362-IG or P&S IG26362 (where X denotes color).

4. Clock hanger receptacle 20A-125V: (Brown with stain finish stainless steel plate with hanger, NEMA configuration 5-20R): Hubbell 5235, Leviton 5361-CH P&S S3733-SS

5. Ground fault circuit interrupter (GFCI) receptacle 20A-125V; GF-5352. (NEMA Configuration 5-20R, shall incorporate self-test, auto monitoring technology and features which will lock-out or render the device incapable of being reset if ground fault protection is compromised, with "Feed through" connectors capable of protecting connected downstream receptacles on a single circuit, and of being installed in a 2-3/4” deep outlet box without adapter, Hubbell GFRST20, Leviton GFNT2 or P&S 2097

[Install Hubbell GFTRST20, Leviton GFTR2 or P&S 2095TR Tamper Resistant type for locations requiring Tamper Resistant installations]  
[Install Hubbell GFTWRST20, Leviton GFWR2 or P&S 2097TRWR Weather Resistant type for installations in damp and wet locations].


7. Surge Protection Duplex Receptacles 20A-125V, (NEMA 5-20R) Hospital grade to include LED light and audible alarm.  
Hubbell HBL8362SA, Leviton 8380, or P&S 8300SP

8. Special equipment receptacles shall be coordinated with owner/manufacturer requirements and the correct and appropriate receptacle and coverplate shall be installed.

9. USB Charger types receptacles to be Hubbell, 20A, 125V AC Hospital Grade, Tamper Resistant, with two USB Type 2.0 Ports 5.0 Amp, 5V DC, Decorator Type duplex receptacle. Hubbell USB8300A5, P&S TR20HUSBAC6 or equal by other approved wiring device manufacturers.

10. Plug load controlled receptacles to be Hubbell DR20C2WHI or P&S 26352CD white, two controlled faces or equal by Leviton.

11. ARC Fault circuit interrupter receptacles shall be Hubbell AFR20TR

12. Ground fault circuit interrupter/ARC Fault dual function receptacles shall be Hubbell AFGF20TR or P&S AFGF202TR.

2.4 OCCUPANCY SENSORS

A. Provide white dual technology wall mounted sensors, provide one of the following:

1. Single Pole:
   - Wattstopper #DSW301

2. Double Pole:
   - Wattstopper # DSW302

3. Dimmer:
   - Wattstopper #DW311

B. Provide dual technology ceiling sensor with low voltage controlling switch and power pack.
A. Single Button:
   - Wattstopper # DT300 Sensor, BZ150 Power Pack and LVSW101 Digital Switch

C. Provide Ultra Sonic Ceiling sensor for restrooms.
   a. Wattstopper #UT3000, BZ150 Power Pack

2.5 DIGITAL TIMER SWITCHES

A. Provide wattstopper TS-400-G digital timer. Locate in mechanical, electrical, MDF, and IDF Rooms.

B. The time switch shall provide audible notification and visual notification (blink the room lights) prior to turning lights off.

C. The time switch shall have a 12 hour manual over ride setting.

2.6 PLATES

[SELECT PLATE TYPE]

A. Furnish and install plates on all outlet boxes. Oversize (Jumbo) plates are not acceptable.

   Plates shall be smooth nylon.

B. Provide Hubbell WP Series, Bell, Carlon or Leviton NEMA 3R weatherproof coverplates on all exterior wiring devices. Enclosure shall be suitable for wet locations when in use.

C. Plates shall be Hubbell SS Series, Leviton, Pass & Seymour 302/304 smooth stainless steel on all receptacles 30 amps and larger.

D. Stainless steel device plates shall be provided at locations with tile or stone walls.

2.7 Floor boxes with surface activation shall be cast iron as manufactured by Hubbell or equal by Wiremold 880CS/CM series and as indicated below:

A. Slab at grade (dual level, fully adjustable type 1).
   1. Single gang: #B-2436 w/#SB-3083 carpet flange.
   2. Two gang: #B-4233 w/#SB-3084 carpet flange.
   3. Three gang: #B-4333 w/#SB-3085 carpet flange.

B. Slab above grade (shallow, fully-adjustable, type II)
   2. Two gang: #B-2422 w/#SB-3084 carpet flange.
   3. Three gang: #B-2423 w/#SB-3085 carpet flange.

C. Cover plates shall have brass finish as follows:
1. #S-3825 for duplex flap for duplex receptacles.
2. #S-3826 for data/communications.

2.8 PVC floor boxes manufactured by Hubbell or equal shall be as follows:

A. Provide CFBS1R4CFB dual service cast iron body floor box with PVC riser. Provide CFBS1R4CUP adjustable mounting cup, S1R4SP2X2DUPLEX sub-plate for (1) Duplex and (2) RJ-45 Keystone jacks OR S1R4SP2X2STYLE for (1) GFCI duplex, USB or Surge Device & (2) Keystone jacks, OR S1R4SPQUAD sub-plate with (4) 20A simplex receptacles, single and dual circuit wiring capability. Provide with CFBS1R4CVR cover, Color to be chosen by Architect.

NOTE TO SPECIFIER: Minimum depth of pour 5-inches, Maximum is 6-inches Maximum finished floor thickness (above top of box collar) with maximum adjustability is 1-1/2-inches at 5-inch, At 6-inches maximum adjustability is 1/2”.

2.9 Floor boxes, recessed activation type, meet UL 514A scrub water requirements, shall be stamped steel with corrosion resistant finish, UL Listed for slab-on-grade installations, or stamped steel for above-grade installations as manufactured by Hubbell or equal by Wiremold RFB2-11 series and as indicated below:

A. Recessed Activation Slab at grade:

1. Two gang: #CFB2G30CR or CFB2G30RCR (provisions for round cover), capable of up to 2” entry per gang. Flush flange, Surface flange and Furniture Feed cover availability. Surface Type Covers shall not exceed 0.15” rise. Covers with provisions for cable egress, when in use, shall not exceed/extend past 0.15” rise.

2. Four Gang: #CFB4G30CR or CFB4G30RCR (provisions for round cover), capable of up to 2” entry per gang. Flush flange, Surface flange availability. Cover shall not exceed 0.15” rise. Surface Type Covers shall not exceed 0.15” rise. Covers with provisions for cable egress, when in use, shall not exceed/extend past the 0.15” rise.

3. Six Gang: #CFB6G30CR or CFB6G30RCR (provisions for round cover), capable of up to 2” entry per gang. Flush flange, Surface flange availability. Surface Type Covers shall not exceed 0.15” rise. Covers with provisions for cable egress, when in use, shall maintain the 0.15” rise. Covers with provisions for cable egress, when in use, shall not exceed/extend past the 0.15” rise.

4. Ten Gang AV: #CFB10G55CR or CFB10G55RCR (provisions for round cover), with minimum (2) 2” KO’s, multiple front and back ¾” to 1-1/2” concentric KO’s. Flush flange, Surface flange availability. Cover shall not exceed 0.15” rise. Covers with provisions for cable egress, when in use, shall not exceed/extend past the 0.15” rise.

B. Recessed Activation Slab above grade:

1. Two Gang: #CFB2G30 or CFB2G30R (provisions for round cover), capable of up to 2” entry per gang. Flush flange, Surface flange and Furniture Feed cover availability. Surface Type Covers shall not exceed 0.15” rise. Covers with provisions for cable egress, when in use, shall not exceed/extend past the 0.15” rise.

2. Four Gang: #CFB4G30 or CFB4G30R (provisions for round cover), capable of up to 2” entry per gang. Flush flange, Surface flange availability. Cover shall not
exceed 0.15” rise. Surface Type Covers shall not exceed 0.15” rise. Covers with provisions for cable egress, when in use, shall not exceed/extend past 0.15” rise.

3. Six Gang: #CFB6G30 or CFB6G30R (provisions for round cover), capable of up to 2” entry per gang. Flush flange, Surface flange availability. Surface Type Covers shall not exceed 0.15” rise. Covers with provisions for cable egress, when in use, shall maintain the 0.15” rise. Covers with provisions for cable egress, when in use, shall not exceed/extend past the 0.15” rise.

4. Ten Gang AV: #CFB10G55 or CFB10G55R (provisions for round cover), with minimum (2) 2” KO’s, multiple front and back ¾” to 1-1/2” concentric KO’s. Flush flange, Surface flange availability. Cover shall not exceed 0.15” rise. Covers with provisions for cable egress, when in use, shall not exceed/extend past the 0.15” rise.

C. Service Fittings

1. Surface Style Rectangular for use with carpet, tile, VCT and other engineered floors, available with or without carpet insert and offer system’s furniture feed type cover providing (1) 1-inch and (1) 2-inch threaded openings

2. Flush Style Rectangular for use with tile, finished concrete or Terrazzo floors, available with or without carpet insert and offer system’s furniture feed type cover providing (1) 1-inch and (1) 2-inch threaded openings

3. Rectangular covers shall be powder coated in variety of common finishes, Aluminum, Black, Brass, Bronze and Satin Nickel

4. Round Covers for use with all floor types. Shall provide cable egress doors and systems furniture feed type cover providing (1) ½-inch and (1) 2-inch threaded openings. Round covers shall be plated metal in variety of finishes except Black (powder coated). Brushed Aluminum, Brass Plated, Bronze Plated, Satin Nickel Plated.

2.10 Fire rated poke through devices shall be as follows:

A. Installations requiring 4-inch cored openings, poke thru devices shall be manufactured by Hubbell or approved equal, Hubbell S1R4PTFIT Recessed Activation poke thru with either S1R4SPX2STYLE or S1R4SP2X2DUPLEx sub-plate for (1) 20A Duplex, GFCI OR USB 2 Port Duplex with (2) openings for (2) RJ-45 Jacks with S1R4CVR – color to be chosen by Architect.

B. Installations requiring 6-inch cored openings, with duplex power, shall be manufactured by Hubbell or Wiremold 6AT, Hubbell S1R6PTWZ-XXX Recessed Activation poke thru which includes S1R6SPW and S1RSSPZ sub plates and S1R6CVR cover, where XXX is finish. Color to be chosen by Architect. This includes (1) pre-wired 20A, 125 V duplex receptacle and (2) NEMA configured rectangular Decorator openings for telephone, signal or up to (12) Category 5e/Cat 6 RJ-45 Jacks.

C. Installations requiring 6-inch cored openings, with quad power, shall be manufactured by Hubbell or Wiremold 6AT, Hubbell S1R6PTDEH-XXX Recessed Activation poke thru which includes S1R6SPH and S1R6SPE sub-plates and S1R6CVR cover where XXX is finish. Color to be chosen by Architect. This includes (2) pre-wired 20A, 125 V duplex receptacles (quad) single, dual circuit capable and (1) NEMA configured rectangular Decorator opening for telephone, signal or up to (6) Category 5e/Cat 6 RJ-45 Jacks plus (2) additional Keystone openings for a total of (8) Category 5e/Cat 6 RJ-45 Jacks for this sub-plate.
D. Installations requiring 8-inch cored openings, shall be manufactured by Hubbell or Wiremold 8AT, Hubbell S1R8PTFIT3 Recessed Activation poke thru offering (2) perimeter (outer) sub-plate locations and (3) standard NEMA configured openings in center sub-plate location allowing multiple combinations for power, data and A/V connectivity devices including acceptance for third party AV devices such as Crestron, FSR, Extron.

E. Poke thru devices with above floor service fittings shall be Hubbell PT7XC Series or Wiremold RC9 approved equal for 3-inch cored openings with FR280BKA Pedestal Service Fitting for (1) 20A, 125V duplex receptacle and (1) NEMA configured Decorator opening for telephone, signal or Cat 5e/Cat 6 data cables with RJ-45 jacks.

F. Poke Thru devices for furniture feed applications shall be Hubbell S1R6PTFF-XXX or Wiremold 6AFTT where XXX is finish, to be chosen by Architect. Provides (1) ¾” threaded entry for Power feed and (1) 2-0” threaded opening for Data/AV Cables. Installed in 6-inch cored openings.

G. Poke Thru devices for furniture feed applications shall be Hubbell S1PTFF-XX or Wiremold 4FF or approved equal where XX is finish, to be chosen by Architect. Provides (1) ¾” threaded entry for Power feed and (1) 1-1/2” threaded opening for Data/AV Cables. Installed in 4-inch cored openings.

PART 3 – EXECUTION

3.1 WIRING DEVICE MOUNTING HEIGHTS

A. Unless noted to the contrary on plans, or directed otherwise during the progress of the Work, wiring devices shall be set as follows:

1. Switches 42” above finished floor.

2. Wall mounted receptacles shall be installed vertically at 15 inches to the bottom outlet above finished floor unless otherwise noted or as required by local codes.

3. Wall telephone outlets shall be mounted 15 inches to the bottom above finished floor unless otherwise noted. Mount even with wall mounted receptacles.

4. At locations above counters, set devices at 6 inches above to the centerline counter tops, verify exact mounting height with the architect.

3.2 INSTALLATION (Refer to 26 05 33 for outlet box specifications).

A. Wall switches shall be set in a suitable steel box and shall be installed on the strike side of the door as finally hung, whether so indicated on the Drawings or not.

B. Receptacles shall be installed in a suitable steel box.

C. The Architect reserves the right to relocate wiring device up to a distance of 5 feet from the location shown, before rough-in, without additional cost.

D. Provide multi-gang device covers at locations where devices gang together.

E. Device locations are indicated schematically on the drawings along with the type and mounting height. Final locations and mounting heights shall be coordinated with the Architect on the jobsite, and with shop drawings of equipment; including equipment to be furnished and installed by the Owner. Devices installed in walls covered with vinyl, fabric wallpaper or other special finishes shall be coordinated and verified with the Architect on
F. Stranded wire termination to switches, receptacles, devices and miscellaneous control devices shall be with an approved solderless terminal if clamp type securing is not possible (i.e. Sta-Con crimp on fork tongue connectors; Burndy Type TP-F).

G. Provide keyed switches in all common areas not monitored by the faculty (i.e. gym, corridors, cafeteria, commons natatoriums).

H. Tamper-resistant type receptacles shall be installed in all classrooms, cafeterias, corridors, special education, ALE, computer labs, special use classroom and all spaces where children 7 years and younger may occupy. In Child-Care facilities, tamper resistant receptacles shall be provided for all spaces with exception to back-of-house spaces, such as kitchens, custodial closets, electrical and mechanical rooms.

I. All 20A, 120V receptacles in food service areas shall be GFCI.

J. All circuit breaker serving electric drinking fountains shall be GFCI.

K. Provide ARC Fault circuit interrupters (AFCI) as required to comply with 210.12 of the N.E.C. This shall include but not limited to dwelling units and dormitory’s. AFCI breakers may be used.

L. Provide ground fault circuit interrupter (GFCI)/ARC Fault circuit interrupter (AFCI) dual function receptacles to comply with 210.8, 210.12 and 406.4 of the N.E.C.

END OF SECTION 26 27 26
SECTION 26 28 16 - SAFETY AND DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SCOPE

A. Provide safety and disconnect switches as shown, scheduled and as specified herein.

1.2 STANDARDS

A. Products shall be designed, manufactured, tested and installed in compliance with applicable standards.

1. NEMA KS1 - Enclosed switches

2. Federal specification W-S-865C-Heavy duty switches

B. Products shall conform all applicable UL standards, including UL98 (standard for safety, enclosed and dead front switches) and shall be UL-labeled.

1.3 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:

1. General Electric Company

2. Square D Company

3. Siemens

4. Eaton

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:

1. Cutsheets of switches with ratings, physical dimensions and all accessories clearly labeled.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:


2. Local, municipal, or state codes that have jurisdiction.
PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install heavy duty type safety switches with the number of switched poles as indicated on the plans and specifications. All safety switches shall be NEMA Heavy Duty Type HD, and Underwriters Laboratories listed.

2.2 MATERIALS AND COMPONENTS

A. Switch Interior

All switches shall have switch blades that are fully visible in the "OFF" position when the door is open. Switches shall have removable arc suppressor where necessary, to permit easy access to line side lugs. Lugs shall be front removable and UL listed for 60ºC and 75ºC copper or aluminum cables. All switches blades and contacts shall be plated copper. Adjust fuse block to accept Class J fuses.

B. Switch Mechanism

Switches shall have a quick-make and quick-break operating handle and mechanism, which shall be an integral part of the box, not the cover. Padlocking provisions shall be provided for locking in the "OFF" position with at least three padlocks. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch door when the handle is in the "ON" position, and to prevent closing of the switch mechanism with the door open. A means shall be provided to permit authorized personnel to release the interlock for inspection purposes. Handle position shall indicate if switch is "ON" or "OFF".

C. Neutral

Provide a solid neutral with the safety switch where a neutral is present in the circuit.

D. Ratings

Switches shall be horsepower rated for ac and/or dc as indicated by the plans. The fused switches shall have Class R rejection fuse clips or adjusted for Class J fuses. UL listed short circuit ratings of the switches, when equipped with Class R fuses, shall be 200,000 symmetrical amperes.

E. Enclosures

1. Indoor switches shall be furnished in NEMA 1 enclosures.
2. Outdoor switches, switches located in wet areas or sprinkled areas shall be furnished in NEMA 3R enclosures.
3. Switches installed in wet areas such as cooling tower areas shall be NEMA 4X stainless steel or fiberglass reinforced polyester.
4. Switches installed in kitchens shall be stainless steel.
5. Switches installed in areas of a corrosive nature and subjected to salt air shall be NEMA 4X stainless steel or fiberglass reinforced polyester.
F. Electrical Interlock Contacts

Provide electrical interlock contacts on all disconnect switches serving motors in which remote VFDs are serving the motor. Provide conductors from contacts to the safe circuit inside the VFD. De-energizing the disconnect switch shall signal VFD to stop.

G. Service Entrance

Switch shall be suitable for use as service entrance equipment when installed in accordance with the National Electrical Code.

PART 3 - EXECUTION

3.1 GENERAL

A. Install safety and disconnect switches, including electrical connections, and fuses in accordance with manufacturer’s written instructions, NEC and recognized industry practices.

B. Location: Install switches within sight of controllers.

C. Hubs: Provide bolt-on hubs for rainproof or wet area applications.

3.2 IDENTIFICATION

A. Nameplate: Each disconnect switch shall have an engraved bakelite nameplate. Nameplates shall be white with black letters and show equipment served. Nameplates shall be attached with stainless steel screws.

END OF SECTION 26 28 16
SECTION 26 29 01 - MOTORS AND STARTERS

PART 1 - GENERAL

1.1 SCOPE

A. Provide manual motor starters as shown, scheduled and as specified herein.

B. All integral motor starters furnished under Division 23 requirements shall be installed under Division 26 requirements unless noted otherwise on the plans.

1.2 STANDARDS

A. Products shall be designed, manufactured, tested and installed in compliance with applicable standards.

B. Products shall conform to all applicable UL standards and shall be UL-labeled.

1.3 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:

1. General Electric Company
2. Square D Company
3. Siemens
4. Eaton

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:

1. Cutsheets of all enclosures, switches, overloads, ratings, and all accessories clearly labeled.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:

2. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. GENERAL: Refer to the Drawings for starter requirements for each motor.

2.2 MANUAL MOTOR STARTERS
A. GENERAL: Manual starters shall consist of a manually operated toggle switch equipped with melting alloy type thermal overload relay. Thermal unit shall be of one-piece construction and interchangeable. Starter shall be inoperative if thermal unit is removed. Contacts shall be double break, silver alloy, visible from both sides of starter. Manual starters shall be square "D" class 2510 or 2512 or approved equal. Provide the size and number of poles shall be as shown and required by equipment served. Furnish red pilot light as indicated.

B. ENCLOSURES: All manual motor starter enclosures shall be NEMA 1, general purpose enclosures, unless shown otherwise. Provide NEMA 3R enclosure where installed outside or in a sprinkled area.

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTORS

A. GENERAL: Mount electric motors which are not factory installed.

B. MOTOR CONNECTIONS: Provide electrical and grounding connections to motors as indicated. Connections as follows:

1. Not less than 18-inch length of Sealtite, extending from motor connection box to motor branch circuit conduit on outdoor and wet locations. Provide Greenfield for inside dry locations.
2. Install connections mechanically secure, assuring electrical continuity, proper and effective grounding.

C. INSTALLATION OF MOTOR STARTER

1. Install motor starters in accordance with the manufacturer's written instructions, the applicable requirements of the NEC and the NECA's "Standard of Installation", and recognized industry practices to ensure that products serve the intended function.
2. Combination starter disconnects, and starters mounted in ceiling plenums shall be installed 18" above ceiling grid.

END OF SECTION
SECTION 26 29 26 - MISCELLANEOUS ELECTRICAL CONTROLS AND WIRING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 SCOPE

A. Provide the various miscellaneous control devices, wiring and additional branch circuits as required, shown and specified.

B. The types of miscellaneous control devices and wiring include but not limited to the following.

1. Contactors
2. Relays
3. Photocells
4. Time switches
5. Additional control wiring and safety devices as shown and specified.
6. Connect power from fire alarm relays to starters to shut down air handling units.

C. WORK SPECIFIED ELSEWHERE:

1. Various control devices, of an electrical nature, for the safe operation and temperature control of the heating, ventilating, air conditioning and plumbing systems provided under Division 23.
2. All control wiring and conduit shall be furnished under Division 23. All power wiring 120 volt or larger shall be provided by Division 26.
3. Refer to building controls specification, Division 23 for scope of work required to be performed by Division 26 (electrical contractor).

1.3 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:

2. Local municipal or state codes that have jurisdiction.

1.4 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:

1. LIGHTING CONTACTORS AND RELAYS
   a. General Electric
   b. Square D Company
   c. Automatic Switch Company

2. PHOTOCELLS AND TIME SWITCHES
   a. Tork, Inc.
   b. Intermatic time controls
c. AMF paragon

PART 2 - PRODUCTS

2.1 MATERIAL

A. GENERAL: This Section shall outline the basic installation of electric devices, conduit, boxes, fittings, and wiring required for complete interconnection of several systems, this may not reflect every required appurtenance. It does not cover integral parts of mechanical equipment.

B. CONTACTORS AND RELAYS: Provide control wiring, contactors, and relays with the ampere-rating and number of poles as shown, specified, and required for a complete and functioning system:

1. Rated at 600 volts, 60 hertz.
2. Continuously rated contacts for all types of ballast and tungsten lighting, resistance and motor loads. Contacts shall be sized as scheduled or noted.
3. Shall have totally enclosed, double-break silver-cadmium-oxide power contacts. Auxiliary arcing contacts are not acceptable. Contact inspection and replacement shall be possible without disturbing line or load wiring.
4. The contactor shall have straight-through wiring with all terminals clearly marked.
5. The contactor shall be approved per UL508 and/or CSA and be designed in accordance with NEMA ICS2-21 1B.
6. They shall be industrial-duty rated for applications to 600 volts maximum.
7. The contactor shall have provisions for factory or field addition of:
   a. Four (4) N.O. or N.C. auxiliary contacts rated 6 amperes continuous at 600 volts.
   b. Single or double circuit, N.O. or N.C., 30 or 60 ampere 600 volt power-pole adder.
8. The contactor shall have a NEMA type 1 enclosure unless otherwise noted.
9. Control power to the contactor 120V control circuit shall be provided from the nearest panelboard 120V circuit. If the 120V control power circuit is not shown, provide a control power transformer for 120-volt control power and a 120 volt coil when required for control. Provide primary and secondary fuses on the control power transformer.
10. Electrically Held Lighting - Contactor coils shall be continuously rated and encapsulated. Electrically held contactors are not to be used unless specifically shown on the plans.
11. Mechanically Held Lighting Contactors - Coil-clearing contacts shall be supplied so that the contactor coils shall be energized only during the instance of operation. Both latch and unlatch coils shall be encapsulated. All contactors shall be mechanically held unless noted otherwise on the plans.
12. Provide 2-wire or 3-wire control modules as required to operate lighting contactors.
13. Provide hand-off-automatic controls (H-O-A) for each lighting contactor.
14. Provide relays and contactors to shut down air handling units.

C. Photocells: Provide a specification grade self-contained, weatherproof, photoelectric control that shall be mounted on an FS type weatherproof junction box. The photocell shall:

1. Switch "ON" at dusk and "OFF" at dawn.
2. Adjustable from 2 to 50-foot candles.
4. Use 1" diameter cadmium sulphide cell.
5. Have a 2-minute delay to prevent false switching.

D. TIME SWITCHES: Provide a 7-day digital time clock with battery back-up feature installed in a NEMA 3R enclosure.
E. Control wiring shall be not less than #14 AWG type TW and shall be color coded and labeled with Brady markers throughout. Bundle multiple conductors with Ty-Raps.

PART 3 - EXECUTION

3.1 Install miscellaneous electrical controls and wiring to provide a functioning system.

3.2 DIVISION 22, 23, 27 AND 28 MISCELLANEOUS POWER AND CONTROLS

A. Install electrical devices not an integral part of system equipment providing conduit, boxes, fittings, wiring, circuit breakers, disconnecting means and other devices.

B. Contractor is responsible for providing all line voltage power to devices that require electrical power to operate. Contractor shall terminate line voltage power to termination points. Contractor shall coordinate between all trades to determine sizing and quantities of line voltage circuits to adequately power and control devices. Provide circuits from nearest low voltage panel using spare circuits provided, if device requires power not already available or indicated.

C. Provide GFCI receptacle with weather proof cover within 25 feet of all heating, air conditioning and refrigeration equipment.

3.3 Install contactor and relays in electrical/mechanical rooms unless otherwise noted.

3.4 Install photocells on the roof unless otherwise directed by the architect. Coordinate any roof penetrations with all other trades and shield from other light sources.

3.5 Provide miscellaneous connections for signs and other furnished equipment as shown on the Drawings.

END OF SECTION
SECTION 26 32 13.16 – 450 kW / 562 kVA NATURAL GAS ENGINE-DRIVEN STANDBY GENERATING SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. SCOPE

1. Provide a standby electric generating system manufactured by Cummins C450N6 series electric set rated for continuous standby service at 450 kW, 562 kVA at 0.8 power factor, 3-phase, 277Y/480, 60 cycle. The system shall be a package of new and current equipment consisting of:
   a. A natural gas engine driven electric plant in a (weather-protective housing) to provide emergency electric power.
   b. Automatic transfer switch(es) to provide automatic starting and stopping of the plant and switching of the emergency load.
   c. Mounted accessories as specified.
   d. Control wiring.
   e. Provide oversized alternator as specified.

1.2 PERMITS, TEST INSPECTIONS

A. This system shall be completely built, tested and shipped by a manufacturer who has been regularly engaged in the production of such equipment for the past ten years and who has parts and service facilities locally available so that there is one source of supply and responsibility. The performance of the electric plant shall be certified by an independent testing laboratory as to the plant's full power rating and voltage and frequency regulation. The complete system shall bear a seal showing that it is prototype test supported.

1.3 REQUIREMENTS

A. Level 1 applications are legally required emergency systems.

B. The electric generating system must meet all requirements of NFPA 110 (latest edition) including design specifications, prototype tests, one-step full-load pickup, and installation acceptance. Engine-generator system to provide source of power for Level 1 applications.

1.4 STANDARDS

A. Equipment shall meet the latest versions of the following codes:
   1. N.E.C.
   2. NFPA 101, 110, 37, 99, 30
   3. IEEE - 446, 587

(450 kW) NATURAL GAS ENGINE-DRIVEN STANDBY GENERATING SYSTEM
4. NEMA - MG1, ICS
5. ANSI
6. UL – 1008
8. UL 2200

1.5 SUBMITTALS

A. Shop drawings shall include but not be limited to:
   1. Catalog cut sheets with all equipment, accessories and devices including all ratings.
   2. Interconnection wiring diagrams.
   4. Certified performance tests.
   5. Specification compliance indicating any deviations.

B. Operation and Maintenance Data
   1. Submit under provisions of Division One.
   2. Furnish three copies of the manuals and books listed below in substantial three-ring binders for each unit:
      a. Operating Instructions: Describe and illustrate all switchgear controls and indicators and engine and general controls. Include instructions for operating transfer switch equipment under normal and emergency conditions when engine generator is running.
      b. Parts Books: Illustrate and list all assemblies, subassemblies and components, except standard fastening hardware (nuts, bolts, washers, etc.).
      c. Preventative Maintenance Instructions: Describe the daily, weekly, monthly, biannual and annual maintenance requirements and include a complete lubrication chart.
      d. Routine Test Procedures: Describe procedures for engine, radiator, all electronic and electrical circuits, and the generator.
      e. Troubleshooting Chart: Describe and list all troubles, probable causes, and suggested remedies.
      f. Recommended Spare Parts List: List all consumables anticipated to be required during routine maintenance and testing. List special tools, maintenance materials and replacement parts.
      g. Wiring Diagrams and Schematics: Show function of all electrical components.

(450 kW) NATURAL GAS ENGINE-DRIVEN STANDBY GENERATING SYSTEM

City of New Braunfels
POLICE HEADQUARTERS

August 21, 2020
Construction Documents
1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division One.

B. Accept units on site on skids. Inspect for damage.

C. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

1.7 ACCEPTABLE MANUFACTURERS

A. Provide products complying with these specifications and produced by the following:

1. Generator Manufacturer
   a. Cummins

2. Automatic Transfer Switches
   a. ASCO
   b. Cummins Power Generation

1.8 ACCEPTABLE SUPPLIERS

A. All equipment provided shall be supplied by an authorized distributor of the manufacturer who has been continuously engaged in the distribution of industrial grade power system products for a minimum of 15 years. The supplier shall provide initial start-up services, conduct field acceptance testing, and warranty service. The supplier shall be authorized to perform warranty service on all products provided.

B. The supplier shall maintain a minimum of 6 factory trained and qualified field technicians within 50 mile of the job site, a proper supply of spare parts for the supplied equipment, a shop with overhaul capabilities; and be able to provide 24 hour, 7 days per week, 365 days per year field service capability.

PART 2 - PRODUCTS

2.1 ENGINE

A. The engine shall be radiator cooled, natural gas fueled, 4 cycle, 8 cylinder. It shall have a total piston displacement of not less than 1709 cubic inches and develop not less than 679 brake horsepower at its operating speed. A radiator air discharge duct flange shall be provided for a connecting duct to allow all heated air and gases to be discharged out of the building, or enclosure, through one opening. The radiator cooling system shall be rated at 104 degrees F. ambient against an external restriction of 0.5 inch water column. Engine cooling air requirements shall not exceed 60000 CFM.

B. The engine shall be of 1-piece cast alloy iron construction with cast alloy iron heads. Valves shall be overhead and free to rotate. Valves shall be hard chrome-cobalt alloy faced with replaceable valve seat inserts of solid chrome-cobalt alloy. The crankshaft shall be forged steel. Main bearings provided between all cylinders. The connecting rods shall be forged steel with connecting rod bearings. Provide fuel system with automatic fuel shut-off, automatic positive head maintained on injectors, and a reusable air element air cleaner;

(450 kW) NATURAL GAS ENGINE-DRIVEN STANDBY GENERATING SYSTEM
mechanical fuel transfer pump with filters. Provide full-flow, replaceable oil filter with bypass. Oil pressure gauge shall be included.

C. The engine shall be equipped with adjustable isochronous electronic governor (speed regulation 5.0 percent, no load to full load) main output circuit breaker, fuel system with automatic fuel shut-off and a reusable air element air cleaner and natural gas fuel train.

D. Provide a 24 volt electrical system and electric starter.

E. 240/480 VAC thermostatically controlled water jacket heater system (4000 watts) shall be provided. Contractor shall install normal power to the heater.

F. Provide the following safety shutdown fault devices:

1. Low oil pressure
2. Over-speed
3. Over-crank
4. High temperature (with low water level)

G. Provide the following alarms:

1. Low engine temperature (indicating jacket heater malfunction)
2. Marginally high engine temperature
3. Marginally low oil pressure
4. Flashing light for control switch in "Stop" position.

H. Generator main output circuit breaker(s) shall be UL listed, set-mounted, factory connected, 100% rated, molded case type with electronic trip unit. Submittals shall demonstrate that the circuit breaker provides proper protection for the alternator by a comparison of the trip characteristic of the breaker with the thermal damage characteristic of the alternator. Field circuit breakers shall not be acceptable for generator overcurrent protection. (Lugs on breaker shall match “ATS” lugs). Provide ground fault alarm for breakers rated 100 amps an larger to comp with Article 700.6(D) of the National Electrical Code.

2.2 ALTERNATOR

A. Rating 475 kW, 594 kVA, at 0.8 power factor, 125 degrees Celsius, 480Y/277 volts, 60 Hz at 1800 rpm.

B. The alternator shall be a single bearing revolving field type, 2/3 pitch, 4-pole and shall be completely brushless. No commutator or commutator brushes shall be allowed. The main alternator and exciter shall be vacuum impregnated. The alternator shall be directly connected to the engine through a rigid coupling to insure permanent alignment. Voltage
regulation shall be within plus or minus 1% of rated voltage, from no load to full load. Voltage recovery to rated voltage after acceptance of 100% of rated load in one step shall occur within 10 seconds. Provide a permanent magnet generator (PMG) excitation system. Motor starting capability shall be a minimum of 1749 kVA. Rating for non-linear loads shall not be less than 225 kW at 0.8 power factor. The generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set. The instantaneous voltage dip shall be less than 10% of rated voltage when full load and rated power factor are applied to the alternator. Stable or study-state operation is defined as operation with terminal voltage remaining constant within plus or minus 1% of rated voltage. Temperature rise shall be within rating as defined by NEMA MG1-22.40. Radio interference reduction shall exceed requirements for general civilian or commercial applications with TIF less than 50 and wave form deviation less than 0.06 line to line.

C. Provide a 120 volt anti-condensation heater (minimum of 100 watts) to prevent condensation during non-operating periods. Heater shall be thermostatically controlled and rated for continuous use for the frame. Provide normal power to the heater.

D. Overload Rating: Capable of withstanding a three phase load of 300% rated current for 10 seconds, 150% of rated current for 2 minutes and 110% rated current for 60 minutes with field set for normal rated load excitation, and capable of withstanding an overspeed of 125%.

E. Performance Criteria:
   1. Wave form Deviation: Less than 5%.
   2. Crest Factor: 1.41 +/- 0.07.
   3. Form Factor: 1.11 +/- 0.05.
   4. Total Harmonic Distortion: 5%.
   5. Single Harmonic Distortion: 3%.
   6. Telephone Interference Factor: 50% maximum.
   7. Dynamic Balance: Less than 1 mil displacement peak to peak.

F. Enclosure: NEMA MG1, open dripproof.

G. Neutral Ground: As shown on drawings.

2.3 CONTROLS AND INSTRUMENTS

A. Provide comprehensive monitoring and control system integral to the Generator Set control to guard the electrical integrity of the alternator and power system. Provide single and 3-phase fault current regulation, so that downstream protective devices have the maximum current available to quickly clear fault conditions, without subjecting the alternator to potentially catastrophic failure conditions. Include provisions to either prevent over voltage due to single phase faults, or to shut down the generator set if line to neutral voltage on any
phase exceeds 115% for more than 0.5 second. Acceptable methods are a 100% rated, 600 volt circuit breaker mounted in the generator enclosure. Provide Square D size as indicated on drawings with handheld programmer or inherent protection provided by microprocessor-based AmpSentry protection. Submittals shall demonstrate that the protective device provides proper protection for the alternator by a comparison of the trip characteristic of the breaker with the thermal damage characteristic of the alternator. Field circuit breakers shall not be acceptable for generator overcurrent protection.

B. An instrument panel mounted on top of the alternator shall contain the following:

1. Run-stop-remote switch
2. Lighted charge rate ammeter
3. Lighted oil pressure gauge
4. Lighted coolant temperature gauge
5. Remote start-stop terminals
6. Running time meter
7. Full A.C. instrument panel (A.C. ammeter, A.C. voltage, phase selector switch, frequency meter, and voltage adjusting rheostat.) All parameters shall have a readout of not less than 2.5% accuracy.
8. Red alarm lights shall be provided for each fault and alarm condition.
9. Two sets of spare terminals shall be provided for customer selected faults.
10. An Emergency Shutdown contact shall be provided through which customer's push button or other momentary-closing switch contacts shall shutdown the generator set engine.
11. A fault reset switch contacts shall shutdown the generator set engine.
12. A fault reset switch shall be provided to clear fault indications and allow restarting of the engine after shutdown faults.
13. The control design shall be such that the fault indication shall remain until reset. The fault indicator memory shall not be dependent on the presence of either AC or DC voltage and shall retain the fault status memory even through complete removal and replacement of the starting batteries.
14. A battery warning that includes load testing the battery on each crank shall be provided.
15. The fault reset function shall operate only when the RUN-STOP-REMOTE switch is in the STOP position.
16. All devices for interconnection and compatibility with digital accuracy and response shall be provided. Digital panels shall comply with electromagnetic interference requirements of Minimum Standard 461C – Part 9, and IEC Standard 801.2, 801.3 and 801.4. indication of voltage level

17. Include a full wave rectified automatic digital voltage regulation system matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate; and be capable of being curve-matched to the engine torque curve with adjustments in the field.

18. The automatic voltage regulator shall be temperature compensated, solid-state design and include overvoltage and overexcitation protection functions. The voltage regulator shall be equipped with three phase RMS sensing. The regulator shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. Overvoltage protection shall sense the AC generator output voltage and (in the event of regulator failure or loss of reference), shut down regulator output on a sustained overvoltage of one (1) second duration. Overexcitation protection shall sense regulator output and shutdown regulator output if overloads exceed ten (10) seconds in duration. Both overvoltage and overexcitation protection shutdowns shall be latched, requiring the AC generator to be stopped for reset.

19. The regulator shall include an under frequency rolloff torque-matching characteristics, which shall reduce output voltage in proportion to frequency below a threshold of 58-59 Hz. The torque-matching characteristics shall include differential rate of frequency change compensation to use maximum available engine torque and provide optimal transient load response. Regulators which use a fixed volts per hertz characteristic are not acceptable.

20. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions.

21. All analog and digital metering shall be true-RMS indicating, and shall not be disrupted by non-linear load generated waveform distortion.

22. Digital metering set shall indicate generator RMS voltage and current, frequency, output current, output kW, kW-hours, and power factor. Generator output voltage shall be available in line-to-line neutral voltages and shall display all three phase voltages (line to neutral or line-to-line) simultaneously.

23. An under frequency sensing and protection system shall be provided which causes a shutdown of the generator set if true RMS frequency falls below 90% of rated frequency for more than 20 seconds.
24. The control system provided shall withstand the surge voltage produced by a 70A DC battery charging alternator operating at full load when the battery bank is disconnected. The test shall be successfully completed without tripping protective circuit breakers or blowing fuse protective devices.

25. All switches, lamps and meters shall be oil-tight and dust-tight and the enclosure door shall be gasketed.

26. All switches shall be provided with fully illuminated back-lit labels and all metering shall be individually lighted to allow for easy reading of functions in a completely dark room.

27. The field connections shall be made on permanently labeled terminal blocks, which are designed and tested by the manufacturer of the generator set to be suitable for use without wire termination lugs. Provisions shall be made for future addition of DIN-rail mounted components.

28. Control panel and interconnection enclosures shall be UL508 listed as a unit assembly.

29. Communications:
   a. Alarm Relay Mode: Provide Form C alarm contacts that can be individually linked to alarm or status outputs from the generator set to external devices.

30. Interface to Site Monitoring System: Provide necessary electronic components and wiring to interface with and communicate the analog and digital status information to an owner provided site monitoring system. Include in this contract all work required for translation of proprietary protocol required to achieve this interface, and all licensing or other fees associated with this interface. Mention Modbus Ethernet.

2.4 ELECTRIC PLANT MOUNTING

A. The plant shall be provided with shock or anti-vibration mounts with the plant. Provide Korfund LKD spring-type isolators or type EU pads. Vibration isolation may be integrally a part of the generator set to the skid package. The plant’s integral base shall have forklift sockets. Battery rack shall be integral part of plant base.

2.5 ACCESSORIES

A. All accessories needed for the proper operation of each plant shall be furnished. These shall include, but not limited to, the following:

1. Critical rated side inlet silencers with installation attachments for mounting within the set housing, flexible exhaust connection. Mount silencer on top of set housing for sets over 150 kW.

2. Belt driven battery charging alternator.
3. Lead acid starting batteries

4. Battery cables.

5. Fully automatic 325 watt, 120 volt, 10amp battery charger. Cummins model number 0300-5878.

6. Natural Gas Fuel Train consisting of:
   a. Dry fuel strainer
   b. 12 VDC fuel solenoid valve
   c. Pounds-to-ounces primary gas pressure reducing regulator
   d. UL Listed braided metallic flexible fuel line

7. An oil drain valve with hose extension shall be provided for draining oil at the side of the plant.

8. Detailed operation and maintenance manuals with parts list.

2.6 REMOTE ALARM ANNUNCIATOR

A. Cummins No.0300-5929 shall be provided for flush mounting at inside location remote from the generator set located by the fire alarm control remote annunciator panel in the front administration office area.

2.7 AUTOMATIC TRANSFER SWITCH

A. Scope

1. Provide open transition automatic transfer switches (ATS) with the number of poles, amperage, voltage and withstand current ratings as shown on the plans. Each automatic transfer switch shall consist of an inherently double throw power transfer switch unit and a control module interconnected to provide complete automatic operation.

B. Codes and Standards

1. UL 1008 - Standard for Automatic Transfer Switches
2. NFPA 70 - National Electrical Code
3. NFPA 99 - Essential Electrical Systems for Health Care Facilities
4. NFPA 110 - Emergency and Standby Power Systems

C. Acceptable Manufacturers

1. Cummins Power Generation
2. ASCO

D. Mechanically Held Transfer Switch
1. The transfer switch unit shall be electrically operated and mechanically held. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.

2. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction and be protected by separate arcing contacts.

3. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes.

4. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof are not acceptable.

E. Microprocessor Control Panel

1. The control panel shall direct the operation of the transfer switch. The panel's sensing and logic shall be controlled by a built-in microprocessor.

2. Operator Panel. Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be a sealed membrane panel rated NEMA 3R/IP53 or better (regardless of enclosure rating) that is permanently labeled for switch and control functions. The operator panel shall communicate with the engine generator, including display of all engine and alternator data, and other transfer switch data in the power system. The operator panel shall allow starting and stopping of the generator set via the transfer switch operator panel in both test and emergency modes.

F. Enclosure

1. The ATS shall be furnished in a NEMA type 1 enclosure for indoor use and NEMA Type 4 for exterior use.

G. Voltage and Frequency Sensing

1. The voltage of each phase of the normal source shall be monitored, with pickup adjustable from 85% to 100% of nominal, and dropout adjustable from 75% to 98% of pickup setting.

2. Single-phase voltage sensing of the emergency source shall be provided, with pickup voltage adjustable from 85% to 100% of nominal and independent frequency sensing with pickup adjustable from 90% to 100% of nominal.

H. Time Delays

1. A time delay shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Adjustable from 0 to 6 seconds.
2. A time delay shall be provided on transfer to emergency, adjustable from 0 to 5 minutes for controlled timing of transfer of loads to emergency.

3. A time delay shall be provided on retransfer to normal, adjustable from 0 to 30 minutes. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable.

4. A time delay shall be provided on shutdown of engine generator for cool down, adjustable from 0 to 60 minutes. Set at 15 minutes unless other directed by owner or engineer.

I. Additional Features

1. A set of DPDT gold-flashed contacts rated 10 amps, 32 VDC shall be provided for a low-voltage engine start signal.

2. A momentary-type test switch shall be provided to simulate a normal source failure.

3. One set of auxiliary contacts rated 10 amps, 250 VAC shall be provided.

4. Position indicating lights shall be provided.

5. An in-phase monitor or delayed transition shall be provided for motor load applications.

J. Withstand and Closing Ratings

1. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 3 cycle, long-time ratings. ATS’s that are tested and labeled with specific breaker ratings only are acceptable. If current limiting fuses are utilized, provide current limiting fuses and disconnect switch mounted next to or on Automatic Transfer Switch.

K. The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

2.8 LOAD BANK

A. Electrical Connection: Power source to load bank connection is 3-phase, 3-wire plus ground. Additional control wire connections for remote control as required.

B. Load Bank Rating:

1. Capacity: 150 kW, 1.0 p.f

2. Load Steps: 20 KW load step resolution
3. Voltage: 480 VAC, 3-ph., 3-W

4. Frequency: 60 Hertz

5. Air intake temperature: 155ºF maximum (radiator air outflow)

6. Airflow requirements: Radiator air outflow

7. Duty Cycle: Continuous

8. Air temp. rise: 100ºF, nominal

9. Air back pressure: .25-50" water column

C. Load Bank Design:

1. General: The load bank shall be a completely self-contained unit which includes all resistive load elements, load control devices, load element branch circuit fuse protection, main load bus and terminals, control terminals, system protection devices and enclosure of required type.

2. The load bank shall be the manufacturer's standard product that has been investigated, tested and listed by Underwriters Laboratories as a system for the purpose intended.

3. Enclosure: NEMA Type 3R, welded sheet steel, UL approved finish painted consisting of an epoxy primer and a polyurethane top coat, consisting of a power section, for installation and wiring of the load elements and a control section for installation and wiring of control components. The control section is to be physically and thermally isolated from both the hot load elements and the heated airflow. Mounting adapters suitable for the installation method selected shall be supplied with the load bank. The exhaust of the load bank shall be screened and, if installed outdoors, louvers shall be provided.

4. Load elements: Load elements shall be UL listed, labeled or recognized, Simplex Power Web Open wire, helically wound, chromium alloy, thermally derated to 60%. 5% tolerance, 2% balance. .995 p.f. element wire mechanically supported over entire length such that if a wire should break, the broken wire segments will not short to adjacent conductors or to ground. Load elements are individually serviceable and replaceable in the field without major disassembly of the load bank.

5. Load element short circuit protection: Branch circuit fuses, per each 50KW load branch circuit. Fuses shall be 200,000 A.I.C current limiting type.

6. Load control: One magnetic contactor per each fused branch circuit.

7. Load bank power wiring shall be 150ºC insulated.

8. Main terminals: Plated bus bar with a hole pattern to accept customer supplied cable
9. Control wiring shall be 105ºC insulated.

10. Control power shall be derived internally from the main load bus. Control and protective circuits shall operate at 120V via control power transformer or line-neutral circuit and shall be fused.

11. System protection: The load bank shall include a comprehensive protection system to protect against overheating. The system shall function to disconnect the load elements from the power source and activate an alarm upon sensing a loss of cooling airflow, or an exhaust air temperature greater than 300 degrees Fahrenheit.

12. Locate on top of the generator.

13. Load bank shall automatically connect to the generator when the running load is less than 30% of rated load and automatically disconnect when the load exceeds 50% of rated load.

2.9 OUTDOOR SOUND ATTENUATED WEATHER-PROTECTIVE HOUSING

A. The generator set shall be provided with a factory-installed housing to allow the generator set to operate at full rated load in the ambient conditions previously specified. The enclosure shall reduce the sound level of the generator set while operating at full rated load to an maximum of 77.4 dBA, which shall be an eight-position average of any location 7 meters from the geometric center point of the generator set in a free field environment. Housing configuration and materials used may be of a suitable design which meets application needs, except that acoustical materials used shall be oil and water resistant. No foam materials shall be used unless they can be demonstrated to have the same durability and life as fiberglass. The acoustical housing shall match the standard footprint of the standard housing-ready generator set base. The enclosure shall include hinged doors for access to both sides of the engine and alternator, and the control equipment. Key-locking and pad lockable door latches shall be provided for all doors. Door hinges shall be stainless steel. The enclosure shall be provided with an exhaust silencer which is mounted inside of the enclosure, and allows the generator set package to meet specified sound level requirements. Silencer and exhaust shall include a rain cap and rain shield. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer’s standard color using a two step electro coating paint process, or equal, meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating which meets the following requirements:

1. Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.

2. Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.

3. Crosshatch adhesion, per ASTM D3359-93, 4B-5B.

5. Salt spray, per ASTM B117-90, 1000+ hours.
6. Humidity, per ASTM D2247-92, 1000+ hours.
7. Water soak, per ASTM D2247-92, 1000+ hours.

B. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

C. A 120 VAC heater with thermostat shall be provided within the generator set control panel to eliminate condensation. Contractor shall provide 120 volt, 20 amp circuit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install generator on a 6 inch high reinforced concrete housekeeping pad. Provide blockouts as required. Bolt the generator to the concrete pad.

B. Provide all power wiring, control wiring, additional contacts and relays required for a complete installation. All conduit shall be in a two hour enclosure. Underground conduits shall be concrete encased. The wall mounted dual rate battery shall be taken off line during the starting of the generator. The generator belt driven alternator shall charge the batteries when the generator is running.

C. Install generator set and transfer switches in accordance with manufacturer’s instructions.


E. Provide engraved plastic nameplates under the provisions of Section 26 02 00.

3.2 WARRANTY

A. The complete standby electric power system, including engine-generator set equipped with set exerciser, and running time meter, shall be warranted for a period of five years from the date of initial start-up. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. This warranty shall be as detailed in available written documents. In the judgement of the specifying authority, the manufacturer supplying the warranty for the complete system must have necessary financial strength and technical expertise with all components supplied to provide adequate warranty support. All items of the engine, generator, and controls that are warranted in the first year shall be covered for the full five year term of the warranty. Warranty coverage shall include parts, labor, and travel for the full term of the warranty.

B. Extensions of warranty term up to 10 years from start-up and inclusion of comprehensive terms shall be available for one year after start-up.

3.3 TESTS

(450 kW) NATURAL GAS ENGINE-DRIVEN STANDBY GENERATING SYSTEM
A. Factory production model tests: Before shipment of the equipment, the generator set shall be tested under rated load and power factor for performance and proper functioning of control and interfacing circuits. Testing at unity power factory only (resistance banks only) is not acceptable, since kW output is affected by the higher generator efficiency at unity power factor, and the kVAR for motor starting and regulation loads is not correlatable between unity and rated power factor. Other tests shall include:

2. Transient response and steady state governing.
4. Prototype tests in accordance with NFPA 110 level 1 have been done on a complete and functional set. Component level type tests will not substitute for this requirement.

The engineer shall be notified in advance of these tests and shall have the option of witnessing these tests. Certified copies of test results shall be forwarded to the engineer for review.

B. Field Test After Installation:

1. The complete installation shall be initially started and checked out for operational compliance by factory-trained representative(s) of the engine-generator set and transfer switch manufacturer. The engine lubrication oil and antifreeze, as recommended by the manufacturer for operation under environmental conditions specified, shall be provided by the engine-generator set supplier.

2. Upon completion of initial start-up and system checkout, the supplier of the generator set shall perform a field test, with the engineer notified in advance, to demonstrate load carrying capability, stability, voltage, and frequency. The engineer shall be present during the field test.

3. The generator shall be run for four hours continuously with all available facilities emergency load connected to its output; in addition, the generator set supplier must provide a portable load bank to supplement any existing load to enable full load testing. Load shall not exceed 50% of generator-set rating for first 1/2 hour during first initial run for proper engine break-in. Records shall be maintained throughout this period to record water temperature, oil pressure, ambient air temperature, voltage, current, frequency, kilowatts, and power factor. The above data shall be recorded at 15 minute intervals throughout the test. There shall be a 10 minute unloaded run at the conclusion of the test to allow engine to cool before shutdown. Three copies of the field test data shall be furnished to the engineer. The contractor shall make all necessary hook-ups to accomplish field tests and shall furnish all fuel necessary for field test and start-up.

C. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:
1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

END OF SECTION 26 32 13.16
SECTION 26 33 53 - UNINTERRUPTIBLE POWER SYSTEM (UPS)

PART 1 – GENERAL

1.1 GENERAL

A. These specifications describe requirements for an Uninterruptible Power System (UPS) optimized for maximum efficiency. The UPS shall automatically maintain AC power to the critical load within specified tolerances and without interruption during failure or deterioration of the normal power source.

B. The manufacturer shall design and furnish all materials and equipment to be fully compatible with electrical, environmental and space conditions at the site. The UPS shall include all equipment to properly interface the AC power source to the intended load and shall be designed for unattended operation.

1.2 STANDARDS

The UPS and all associated equipment and components shall be manufactured in accordance with the following applicable standards:

A. The UPS shall be UL listed per UL Standard 1778, Fourth edition, Uninterruptible Power Supplies, and shall be CSA Certified.

B. The UPS shall be provided with a Short Circuit Withstand Rating (SCWR) label denoting the maximum source fault short circuit current that is applicable to the unit. The withstand rating shall be independently verified by a nationally recognized, third-party lab.

C. The UPS shall withstand input surges to both the rectifier and bypass when configured as either a single-input or dual-input unit without damage as per the criteria in EN62040-2 (4kV). The manufacturer shall provide evidence of compliance upon request.

D. The UPS shall comply with FCC Rules and Regulations, Part 15, Subclass B, Class A. This compliance is legally required to prevent interference with adjacent equipment. The UPS shall have a label stating FCC compliance. The manufacturer shall provide evidence and test data of compliance upon request.

E. The UPS shall be compatible with the wiring practices, materials and coding in accordance with the requirements of the National Electrical Code, OSHA and applicable local codes and standards. Provisions shall be made in the cabinets to permit installation of input, output and external control cabling using raceway or conduit for top and bottom access to input, output, bypass and DC connections. Connection cabinets shall provide for wiring gutter and wire bend radius as defined by the NEC and UL.

1.3 SYSTEM DESCRIPTION

Design Requirements
The UPS shall be sized to provide a minimum of ___kW output (unity load power factor rating)
The UPS output capacity shall have the option to enable scalability at the time of ordering. Models will be available in three frame sizes:

- 40kVA frame – Scalable from 10kVA to 40kVA (firmware and hardware upgrade)
- 100kVA frame – Scalable from 20kVA to 100kVA (20kVA hardware increments)
- 200kVA frame – Scalable from 20kVA to 200kVA (20kVA hardware increments).

The UPS shall be able to supply all required power to full rated output kVA loads with power factor from 0.5 lagging to 0.9 leading. The UPS shall also work from unity power factor to 0.5 leading power factors subject to derating.

Load voltage and bypass line voltage shall be 208VAC, three-phase, four-wire plus ground. Input voltage shall be 208VAC, three-phase, four-wire plus ground. The AC input source and bypass input source shall each be a solidly grounded wye service.

The rectifier AC input and bypass AC input may be fed from separate AC sources with the use of an optional Dual Transformer Cabinet.

The battery shall support the UPS at 100% rated kW load for at least _____ minutes at 77°F (25°C) at startup.

The UPS shall have an active power factor-corrected IGBT converter/rectifier, capable of maintaining input power factor and input current total harmonic distortion (THDi) within specifications without an additional input filter.

The UPS shall be of transformer-free design, requiring no internal transformer in the main power path for the basic operation of the module. Optional transformers in cabinets or otherwise external to the basic UPS module shall be permissible to provide isolation and/or voltage transformation.

1.4 MODES OF OPERATION

The UPS shall operate as an on-line reverse transfer system in the following modes:

A. Normal: The critical AC load shall be continuously powered by the UPS inverter. The rectifier/charger shall derive power from the utility AC source and supply DC power to the DC-DC converter, which in turn shall supply the inverter while simultaneously float charging the battery.

B. ECO Mode: The critical AC load shall be continuously powered by the bypass with the inverter available to power the load if the bypass source voltage or frequency exceeds adjustable parameters of power quality.

C. Battery: Upon failure of utility AC power, the critical load shall be powered by the inverter, which, without any switching, shall obtain its power from the battery plant via the DC-DC converter. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.

D. Recharge: Upon restoration of the utility AC source, the rectifier shall supply power to the output inverter and to the DC-DC converter, which shall simultaneously recharge the batteries. This shall be an automatic function and shall cause no interruption to the critical load.

E. Bypass: If the UPS must be taken out of service, the static transfer switch shall transfer the load to the bypass source. The transfer process shall cause no interruption in power to the critical load. An optional external wrap-around maintenance bypass shall be used to ensure full isolation of the unit for the service of internal components while providing safety from arc flash and in compliance with OSHA requirements.

F. Off-Battery: If the battery only is taken out of service, it shall be disconnected from the DC-DC converter by means of an external disconnect circuit breaker (in the case of external batteries). The
UPS shall continue to function and meet all the specified steady-state performance criteria, except for the power outage backup time capability. If multiple battery strings are used, each string shall be capable of being electrically isolated for safety during maintenance.

1.5 PERFORMANCE REQUIREMENTS

The solid-state power components, magnetics, electronic devices and overcurrent protection devices shall operate within the manufacturer’s recommended temperature when the UPS is operating at 100% critical load and maintain battery charging under either of the following conditions:

- Any altitude within the specified operating range up to 3300 ft. (1000m) elevation
- Any ambient temperature within the specified operating range of 32°F to 104°F (0°C to 40°C)

1.6 INPUT

A. Voltage: Input/output voltage specifications of the UPS shall be
   - Rectifier AC Input: 208V, three-phase, four-wire-plus-ground
   - Bypass AC Input: 208V, three-phase, four-wire-plus-ground
   - AC Output: 208V, three-phase, four-wire-plus-ground

B. Voltage Range: ±20%, -15% at full load; -40% at half load

C. Frequency Range: 40 - 70Hz

D. Maximum Inrush Current: UPS inrush current not to exceed 1.5 times rated input current

E. Input Current Walk-In: The UPS shall contain a controlled module walk-in to minimize inrush current upon auto-restart. The module walk-in is programmable for a 1 to 5 second delay.

F. Power Factor: Minimum 0.99 at full load with nominal input voltage

G. Current Distortion: Less than 5% THD at full load input current in double-conversion mode

H. Surge Protection: Withstands input surges of 4kV (Line to ground) without damage as per criteria listed in EN 61000-4-5: 1995

I. Short Circuit Current Rating: Units shall carry as standard 65kA Short Circuit Withstand Rating. All ratings shall be certified and a label shall be applied to the unit clearly identifying this rating as required by the National Electrical Code.

1.7 AC OUTPUT

A. Load Rating: 100% of load rating at 104°F (40°C) for any load from 0.5 lagging to 0.9 leading

B. Voltage Regulation:
   - ±1% RMS average for a balanced, three-phase load
   - ±2% for 100% unbalanced load for line-to-line imbalances

C. Voltage Adjustment Range: ±5% for line drop compensation adjustable by factory service personnel

D. Frequency Regulation:
   - Synchronized to bypass: ±2.0Hz default setting, (adjustable by factory service personnel)

E. System Efficiency (defined as output kW/input kW at rated lagging load power factor; and not less than the values listed below [select kVA rating for this specification]):

<table>
<thead>
<tr>
<th>Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 33 53 - 3</td>
</tr>
<tr>
<td>kVA Rating</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>120</td>
</tr>
<tr>
<td>140</td>
</tr>
<tr>
<td>160</td>
</tr>
<tr>
<td>180</td>
</tr>
<tr>
<td>200</td>
</tr>
</tbody>
</table>

F. **Phase Imbalance:**
- Balanced loads 120° ±1°
- 100% unbalanced loads 120° ±2°

G. **Voltage Transients** (average of all three phases):
- 0-100% or 100-0%
  - Response: Meets IEC 62040-3: 2010 Figure 2 Curve 1, Class 1
  - Meets ITIC and CBEMA Curve Requirements
- Transient Voltage Deviation, RMS 5%
- Recovers within 60 ms

H. **Overload at Full Output Voltage with ±1% voltage regulation:**
- 100% continuously
- 105% - 110% of full load for 60 minutes at 104°F (40°C) ambient
- 110% - 125% of full load for 10 minutes at 104°F (40°C) ambient
- 125% - 150% of full load for 60 seconds at 104°F (40°C) ambient
- >150% of full load for a minimum of 200 milliseconds at 104°F (40°C) ambient

1.7.1 **Grounding**
The UPS chassis shall have an equipment ground terminal.

1.8 **ENVIRONMENTAL CONDITIONS**
The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:

A. **Operating Ambient Temperature**
- UPS: 32°F to 104°F (0°C to 40°C) without derating
- Battery: 77°F (25°C), ±5°F (±3°C)

B. **Storage/Transport Ambient Temperature**
- -4°F to 158°F (-20°C to 70°C)

C. **Relative Humidity**
- 0 to 95%, non-condensing
D. Altitude
- Operating: To 3300 ft. (1000m) above Mean Sea Level without derating (compliant with IEC/EN 62040-3 at altitudes exceeding 1000m)
  Consult factory for derating above 3300 ft. (1000m) elevation.
- Storage/Transport: To 50,000 ft. (15,000m) above Mean Sea Level

E. Audible Noise Level
- 59 dBA measured 4.6 ft. (1.4m) from the surface of the unit

1.9 SUBMITTALS

Proposal Submittals
Submittals with the proposal shall include:
- Descriptions of equipment to be furnished, including deviations from these specifications.
- Document stating compliance with FCC requirements.
- Document stating listing to UL, including edition used for listing.
- Document showing compliance with required SCCR and labeling.
- System configuration with single-line diagrams.
- Detailed layouts of customer power and control connections.
- Functional relationship of equipment, including weights, dimensions and heat dissipation.
- Information to allow distribution system coordination.
- Size and weight of shipping units to be handled by contractor.

Order Submittals
Submittals supplied at time of order shall include:
- All the documentation presented with the proposal, per Section 1.5.1 above.
- Detailed installation drawings including all terminal locations.
- Interconnect wiring diagrams showing conduit wiring with terminal numbers for each wire.

UPS Delivery Submittals
Submittals upon UPS delivery shall include:
- A complete set of submittal drawings.
- Two (2) sets of instruction manuals. Manuals shall include a functional description of the equipment, safety precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

1.10 WARRANTY

UPS Warranty
The UPS manufacturer shall warrant the unit against defects in workmanship and materials for 12 months after initial startup or 18 months after the shipping date, whichever comes first.

Warranty – End User
Warranties associated with items not manufactured by the UPS supplier but included as part of the system shall be passed through to the end user.
1.11 QUALITY ASSURANCE

Manufacturer’s Qualifications
A minimum of 20 years’ experience in the design, manufacture and testing of solid-state UPS systems shall be required.
The quality system for the engineering and manufacturing facility shall be certified to conform to Quality System Standard ISO 9001 for the design and manufacture of power protection systems for computers and other sensitive electronics

Factory Testing
Before shipment, the manufacturer shall fully and completely test the UPS unit to ensure compliance with the specification.
The UPS unit shall be tested at the system-specified capacity. Testing shall be done using load banks at part-load and the full kW rating of the unit.
Operational discharge and recharge tests to ensure guaranteed rated performance.
System operations such as startup, shutdown and transfers shall be demonstrated.
A certified copy of the test results shall be available for each system as indicated on the order.

PART 2 – PRODUCT

2.1 FABRICATION

Materials
All materials of the UPS shall be new, of current manufacture, high grade and shall not have been in prior service except as required during factory testing. All active electronic devices shall be solid-state. All power semiconductors shall be sealed. Control logic and fuses shall be physically isolated from power train components to ensure operator safety and protection from heat.

UPS Internal Wiring
Wiring practices, materials and coding shall be in accordance with the requirements of the National Electrical Code, OSHA and applicable local codes and standards. All bolted connections of busbars, lugs and cables shall be in accordance with requirements of the National Electrical Code and other applicable standards. All electrical power connections shall be torqued to the required value and marked with a visual indicator.

Field Wiring
All field wiring power connections shall be to tin-plated copper busbars for connection integrity. Busbars shall have adequate space to allow two-hole, long-barrel, compression type lugs forming a permanent connection between field wiring and field-installed lugs.
Provisions shall be made in the cabinets to permit installation of input, output and external control cabling using raceway or conduit. Provision shall be made for top and bottom access to input, output, bypass and DC connections. In conformance with the NEC, connection cabinets shall provide for adequate wire bend radius.

Construction and Mounting
The UPS shall be in NEMA Type 1 enclosures, designed for floor mounting. The UPS shall be structurally adequate and have provisions for hoisting, jacking and forklift handling. Maximum cabinet height shall be 78.7 in. (2000mm).
The UPS shall be NEMA Type 1-compliant, with front doors open to enable safe change of air filters without the need for shutdown.

Cooling

Adequate ventilation shall be provided to ensure that all components are operated within temperature ratings.

Temperature sensors shall be provided to monitor the UPS’s internal temperature. Upon detection of temperatures in excess of the manufacturer’s recommendations, the sensors shall cause audible alarms to be sounded and visual alarms to be displayed on the UPS control panel. Air filters shall be located at the point of air inlet and shall be changeable. No service clearance or ventilation shall be required in the rear of the system.

2.2 EQUIPMENT

UPS System

The UPS system shall consist of an IGBT power factor-corrected rectifier, DC-DC converter and three-phase, transformer-free inverter, bypass static transfer switch, bypass synchronizing circuitry, protective devices and accessories as specified. The specified system shall also include a battery disconnect breaker and battery system.

Surge Protection

The UPS shall have built-in protection against surges, sags and overcurrent from the AC source. The protection shall meet the requirements of ANSI C62.41 A3 and B3 including:

- 6kV, 100kHz ring wave, line-to-line, line-to-neutral, line-to-ground and neutral-to-ground
- 6kV, combined wave, line-to-line, line-to-neutral, line-to-ground and neutral-to-ground

Output Protection

The UPS shall be protected against sudden changes in output load and short circuits at the output terminals. The UPS shall have built-in protection against permanent damage to itself and the connected load for all predictable types of malfunctions. Fast-acting, current-limiting devices shall be used to protect against cascading failure of solid-state devices. Internal UPS malfunctions shall cause the module to trip off-line with minimum damage to the module and provide maximum information to maintenance personnel regarding the reason for tripping off-line. The load shall be automatically transferred to the bypass line uninterrupted for an internal UPS malfunction. The status of protective devices shall be indicated on a graphic display screen on the front of the unit.

2.3 COMPONENTS

Rectifier

The term rectifier shall denote the solid-state equipment and controls necessary to convert alternating current to regulated direct current to supply the inverter and charge the battery. The DC output of the rectifier shall meet the input requirements of the inverter without the battery being connected.

A. Input Current Harmonic Distortion

The rectifier shall actively control and reduce input current distortion over the full operating range of the UPS without the need for an additional passive input filter. Input current THD shall be less than 5% at rated load and nominal voltage in double-conversion mode.

B. Dynamic Current Input Limit Reduction
The rectifier, in conjunction with the other UPS controls and circuitry, shall adjust the current demanded for battery charging as a function of UPS wattage load and input voltage level.

DC-DC Converter
The term *DC-DC converter* shall denote the equipment and controls to regulate the output of the rectifier to the levels appropriate for charging the battery and to boost the battery voltage to the level required to operate the inverter. The DC-DC converter shall be solid-state, capable of providing rated output power and, for increased performance, shall be a pulse width-modulated design and shall utilize insulated gate bipolar transistors (IGBTs). The DC-DC converter shall control charging of the battery. The AC ripple voltage of the charger DC shall not exceed 1% RMS of the float voltage.

A. Battery Equalize Charge
A manually initiated equalize charge feature shall be provided to apply an equalize voltage to the battery. The duration of equalize charge time shall be adjustable from 8 to 30 hours. A method shall be available to deactivate this feature for valve regulated battery systems.

B. Stop Battery Charging Function
Battery charging may be stopped by a shunt trip of the battery cabinet breaker when overtemperature is sensed in the battery cabinet, on generator or when environmental contact is closed.

C. Overvoltage Protection
There shall be DC overvoltage protection so that if the DC voltage rises to the pre-set limit, the UPS shall shut down automatically and initiate an uninterrupted load transfer to bypass or shall disconnect the battery via the DC breaker(s) in the battery string.

D. Temperature-Compensated Charging
The UPS shall adjust the battery charging voltage based on the battery temperature reported from external battery temperature sensors. When multiple sensors are used, the voltage shall be based on the average temperature measured. Excessive difference in the temperature measurements shall be reported and the charging voltage adjusted to protect the batteries from excessive current.

E. Battery Load Testing
The UPS shall be capable of performing battery load testing under operator supervision. To accomplish this, the rectifier shall reduce charging voltage to force the batteries to carry the load for a short time. If the curve of battery voltage drop indicates diminished battery capacity, the UPS shall display an alarm message. If the voltage drop indicates battery failure, the UPS shall terminate the test immediately and annunciate the appropriate alarms.

Inverter
The term *inverter* shall denote the equipment and controls to convert direct current from the rectifier or battery via the DC-DC converter to precise alternating current to power the load. The inverter shall be solid-state, capable of providing rated output power and, for increased performance, the inverter shall be a pulse-width-modulated design and shall utilize insulated gate bipolar transistors (IGBTs). To further enhance reliable performance and efficiency, the inverter shall not require an inverter output series static switch/isolator for the purposes of overload or fault isolation or transfers to bypass.

A. Overload Capability
The inverter shall be able to withstand an overload across its output terminals while supplying full rated voltage of up to 150% for 60 seconds. The inverter shall be capable of at least 200% current for short-circuit conditions including phase-to-phase, phase-to-ground and three-phase faults. After the fault is removed, the UPS shall return to normal operation without damage. If the short circuit is sustained, the
load shall be transferred to the bypass source and the inverter shall disconnect automatically from the critical load bus.

B. Output Frequency
The inverter shall track the bypass continuously, providing the bypass source maintains a frequency of 60Hz ±1% (0.6 Hz).

C. Phase-to-Phase Balance
The inverter shall provide a phase-to-phase voltage displacement of no worse than ±3% with a 100% unbalanced load.

D. Inverter Fault Sensing and Isolation
The UPS shall be provided with a means to detect a malfunctioning inverter and isolate it from the critical load bus to prevent disturbance of the critical load voltage beyond the specified limits.

E. Battery Protection
The inverter shall be provided with monitoring and control circuits to protect the battery system from damage due to excessive discharge. Inverter shutdown shall be initiated when the battery voltage has reached the end of discharge voltage. The battery end-of-discharge voltage shall be calculated and automatically adjusted for partial load conditions to allow extended operation without damaging the battery. Automatic shutdown based on discharge time shall not be acceptable.

Inverter Bypass Operation
When maintenance is required or when the inverter cannot maintain voltage to the load due to sustained overload or malfunction, a bypass circuit shall be provided to isolate the inverter output from the load and provide a path for power directly from an alternate AC (bypass) source. The UPS control system shall constantly monitor the availability of the inverter bypass circuit to perform a transfer. The inverter bypass circuit shall consist of a continuous duty bypass static switch and an overcurrent protection device to isolate the static bypass switch from the bypass utility source. The bypass static switch shall denote the solid-state device incorporating SCRs (silicon controlled rectifiers) that can automatically and instantaneously connect the alternate AC source to the load.

A. Static Bypass Switch Rating
The static bypass switch shall be rated for continuous duty operation at full rated load for highest reliability without the use of mechanical devices, such as those used with a momentary rated device.

B. Manual Load Transfers
A manual load transfer between the inverter output and the alternate AC source shall be initiated from the control panel. Manually initiated transfers shall be make-before-break, utilizing the inverter and the bypass static switch.

C. Automatic Load Transfers
An automatic load transfer between the inverter output and the alternate AC source shall be initiated if an overload condition is sustained for a period in excess of the inverter output capability or due to a malfunction that would affect the output voltage. Transfers caused by overloads shall initiate an automatic retransfer of the load to the inverter only after the load has returned to a level within the rating of the inverter source and the alarm has been acknowledged.

D. Momentary Overloads
In the event of a load current inrush or branch load circuit fault in excess of the inverter rating, the bypass static switch shall connect the alternate AC source to the load for at least 600 milliseconds, allowing up to 1000% of the normal rated output current to flow. Output voltage shall be sustained to the extent the alternate AC source capacity permits. If the overload condition is removed before the end of
the 600-millisecond period, the bypass static switch shall turn Off and the load shall remain on inverter power. If the overload remains, then a transfer to the alternate AC source is to be completed.

E. Back-Feed Protection

As required by UL1778 and CSA, the static transfer switch shall not back-feed UPS power to the bypass distribution system while the UPS is operating on battery during a bypass power outage. The purpose of this requirement is to prevent the risk of electrical shock on the distribution system when the normal source of power is disconnected or has failed. If a shorted SCR is detected, the static transfer switch shall be isolated by an internal automatic circuit breaker and an alarm message shall be annunciated at the UPS control panel. The load shall remain on conditioned and protected power after detection of a shorted SCR and isolation of the bypass static switch.

F. Active ECO-Mode

When selected, this mode of operation shall transfer the load to the bypass source and maintain it there as long as the bypass source frequency, slew rate and voltage are within the adjusted operating parameters. While in this mode, the inverter shall remain operating to be able to instantaneously assume the load without interrupting the output voltage. Should the bypass source go outside the adjusted limits, the bypass static switch shall turn Off, isolating the load from the bypass while the inverter assumes the full critical load. The load shall be transferred from the bypass source to the inverter while maintaining the output voltage within the ITIC and CBEMA curves.

Display and Controls

A. UPS Control Panel

The UPS shall be provided with a microprocessor-based control panel for operator interface (may also be referred to as User Interface, or UI) to configure and monitor the UPS. The control panel shall be located on the front of the unit where it can be operated without opening the hinged front door. A backlit, menu-driven, full-graphics, color touchscreen liquid crystal display shall be used to enter setpoints for the battery test (duration and end voltage), display system information, metering information, a one-line diagram of the UPS and battery, active events, event history, startup instructions and transfer and shutdown screens.

No mechanical push buttons shall be used.

B. Logic

UPS system logic and control programming shall reside in a microprocessor-based control system with nonvolatile flash memory. Rectifier, inverter and system control logic shall utilize high-speed digital signal processors (DSPs). CANbus shall be used to communicate between the logic and the User Interface as well as the options. Switches, contacts and relays shall be used only to signal the logic system as to the status of mechanical devices or to signal user control inputs. Customer external signals shall be isolated from the UPS logic by relays or optical isolation.

C. Metered Values

A microprocessor shall control the display and memory functions of the monitoring system. All three phases of three-phase parameters shall be displayed simultaneously. All voltage and current parameters shall be monitored using true RMS measurements for accuracy to ±3% of voltage, ±5% AC current. The following parameters shall be displayed:

- Input voltage, line-to-line
- Input current per phase
- Input frequency
- Input apparent power (kVA)
- Battery voltage
- Battery charging/discharging current
• Output voltage, line-to-line
• Output frequency
• Bypass input voltage, line-to-line
• Bypass input frequency
• Load current
• Load real power (kW), total and percentage
• Load apparent power (kVA), total and percentage
• Load percentage of capacity
• Battery temperature, each battery string
• Battery state of charge

D. Power Flow Indications
A power flow diagram shall graphically depict whether the load is being supplied from the inverter, bypass or battery and shall provide, on the same screen, the status of the following components:
• AC Input Circuit Breaker (optional)
• Battery Circuit Breaker, each breaker connection of complete battery complement, complete disconnection and partial connection (one or more, but not all breakers open.)
• Maintenance Bypass Status

E. Main Display Screen
The following UPS status messages shall be displayed:
• Rectifier (Off / Soft Start / Main Input On / Battery Input On)
• Input Supply (Normal Mode / Battery Mode / All Off)
• Battery Self Test (True / False)
• Input Disconnect (Open / Closed)
• EPO (True / False)
• Charger (On / Off)
• Output Disconnect (Open / Closed)
• Maint. Disconnect (Open / Closed)
• Bypass Disconnect (Open / Closed)
• Inverter (Off / Soft Start / On)
• Bypass (Normal / Unable To Trace / Abnormal)
• Output Supply (All Off / Bypass Mode / Inverter Mode / Output Disable)
• Inverter On (Enable / Disable)

F. HMI Control Buttons
Buttons shall be provided to start and stop the inverter. A pop-up message requesting confirmation shall be displayed whenever a command is initiated that would change the status of the UPS.
Other buttons shall be provided to reset faults and silence the alarm buzzer.

G. Event Log
This menu item shall display the list of events that have occurred recently while the UPS was in operation. The Event Log shall store up to 2048 events, with the oldest events being overwritten first if the log’s capacity is reached.

H. Battery Status Indicator
A battery status indicator shall display DC alarm conditions, temperature, battery state of charge, the present battery voltage, total discharge time, status of last battery test and battery time remaining during discharge.
The UPS shall provide the operator with controls to perform the following functions:

- Configure and manage manual battery test
- Modify test duration and minimum voltage
- Start battery test
- Monitor test status and progression
- Stop battery test
- Battery test status

I. Alarms

The following alarm messages shall be displayed:

- Mains Voltage Abnormal
- Mains Undervoltage
- Mains Freq. Abnormal
- Charger Fault
- Battery Reversed
- No Battery
- Parallel Comm. Fail
- Bypass Unable To Track
- Bypass Abnormal
- Inverter Asynchronous
- Fan Fault
- Control Power Fail
- Unit Over Load
- System Over Load
- Bypass Phase Reversed
- Transfer Time-Out
- Load Sharing Fault
- Bypass Over Current.

J. Controls

System-level control functions shall be:

- Start Inverter (and transfer to inverter)
- Stop Inverter (after transferring to bypass)
- Startup Screen
- Battery Test Setpoint Adjustment
- Configure Manual Battery Test
- Initiate Manual Battery Test
- System Settings (Time, Date, Language, LCD Brightness, Password, Audio Level)
- Alarm Silence Command
- Fault Reset Command
- ECO mode

K. Manual Procedures

- Load Transfers: HMI buttons (START INVERTER, STOP INVERTER) shall provide the means for the user to transfer the load to bypass and back on UPS.
Self-Diagnostics
- Event Log File - The control system shall maintain a log of the event conditions that have occurred during system operation. Each log shall contain the event name, event time/date stamp and a set/clear indicator.

Remote Monitoring and Integration Capabilities
A. The UPS manufacturer shall be capable of 24x7 continuous monitoring of events and parametric data, event and data analysis reports and dispatch of factory-trained field service personnel. The UPS shall be able to initiate periodic and critical event-driven communication with a remote service center to transfer event and parametric data for analysis and action. The remote service center shall be staffed with factory-trained service personnel who are capable of receiving, analyzing and interpreting the communicated events and data. The remote service center personnel shall also be capable of dispatching factory-trained field service personnel to the location of the UPS.

B. Communication Cards: The UPS can be equipped with up to three optional communication card(s) including:
- Optional IntelliSlot™ Unity™ card providing Web-based UPS monitoring and management capabilities, and two of the following third-party open protocols:
  - SNMP protocols (v1, v2, v3)
  - Modbus RTU or Modbus TCP
  - BACnet MSTP or BACnet IP
  
  Note: Modbus RTU and BACnet MSTP cannot both be enabled simultaneously.
- Optional SiteScan® Interface card to interface with SiteScan Web software.

C. Output Alarm Contacts: Dry contact outputs shall be provided for Summary Alarm, Bypass Active, Low Battery and AC Input Failure.

D. Customer Input Contacts: The UPS shall have four discrete input contacts available for the input and display of customer-provided alarm points or to initiate a pre-assigned UPS operation. Each input can be signaled by an isolated, external, normally open contact.

When an assembly is selected as a pre-assigned UPS operation, the following actions shall be initiated:
- On Generator—Provides selectable choices to enable or disable battery charging, and enable or disable ECO Mode operation while on generator.
- Transfer to Bypass—Manual command to transfer from inverter operation to static bypass operation.
- Fast Power Off—Emergency Module Off (EPO) command to stop UPS operation.
- Acknowledge Fault—Acknowledge a UPS alarm condition and present faults will be reset.
- Bypass/Inverter Off—Emergency Power Off (EPO) command to stop UPS operation.
- External Maintenance Bypass Breaker (MBB) status (open or closed)

1.10.8 Stored Energy Systems
The UPS system shall be provided with a stored energy system that shall comply with the specifications of:

The battery power pack shall consist of sealed, valve-regulated batteries, a circuit breaker for isolating the battery pack from the UPS and a control interface to the UPS module.

The circuit breaker shall be sized to allow discharge at the maximum published rating of the battery. The interface to the UPS module shall provide status and thermal data to allow the UPS to regulate the charging voltage and inhibit the conditions associated with battery thermal runaway. If the temperature measurement in a battery cabinet indicates that thermal runaway is occurring, then the UPS controls shall
isolate the cabinet from the charger by tripping the battery breaker in that cabinet while leaving the other battery cabinets connected to allow UPS operation during a loss of power to the rectifier.

The battery cabinet shall be rated NEMA 1, matching the UPS style and design.

- Battery Cabinets Connected Directly to the UPS: The manufacturer shall provide all power and control parts necessary to connect the UPS to the battery cabinets.
- Battery Cabinets Separated from the UPS: The manufacturer shall provide all power and control parts necessary to interconnect the battery cabinets. The installer shall provide all cabling necessary to interconnect the UPS and the battery cabinets.

Both overhead and under-floor site installed cabling shall be accommodated. Cable installation shall not require removal of batteries or any other battery cabinet assemblies.

The battery system shall be sized to support a _____kW load for _____ minutes. The battery system shall provide 100% initial capacity upon delivery.

The battery shall be lead-calcium, sealed, valve-regulated type with a three (3) -year full warranty and a seven (7) -year pro rata warranty under full float operation. The battery design shall utilize absorbent glass mat (AGM) technology to immobilize the electrolyte.

2.3.1 Battery Disconnect Breaker

The battery cabinet shall have a properly rated circuit breaker (600VDC) to isolate it from the UPS. This breaker shall be in a separate NEMA-1 enclosure or in a matching battery cabinet. When this breaker is open, there shall be no battery voltage in the UPS enclosure. The UPS shall be automatically disconnected from the battery by a shunt trip of the battery cabinet breaker when signaled by other control functions.

PART 3 – EXECUTION

3.1 FIELD QUALITY CONTROL

The following inspections and test procedures shall be performed by factory-trained field service personnel during the UPS startup.

A. Visual Inspection

- Inspect equipment for signs of damage.
- Verify installation per drawings supplied with installation manuals or submittal package.
- Inspect cabinets for foreign objects.
- Verify that neutral and ground conductors are properly sized and configured per UPS manufacturers’ requirements as noted in submittal drawings supplied with installation manuals or submittal package.
- Inspect each battery jar for proper polarity.
- Verify that all printed circuit boards are configured properly.

B. Mechanical Inspection

- Check all control wiring connections for tightness.
- Check all power wiring connections for tightness.
- Check all terminal screws, nuts and/or spade lugs for tightness.

C. Electrical Inspection

- Check all fuses for continuity.
- Confirm input and bypass voltage and phase rotation are correct.
- Verify control transformer connections are correct for voltages being used.
• Ensure connection and voltage of the battery string(s).

3.2 UNIT STARTUP

1. Energize control power.
2. Perform control/logic checks and adjust to meet required specification.
3. Verify DC float and equalize voltage levels.
4. Verify DC voltage clamp and overvoltage shutdown levels.
5. Verify battery discharge, low battery warning and low battery shutdown levels.
6. Verify fuse monitor alarms and system shutdown.
7. Verify inverter voltages and regulation circuits.
8. Verify inverter/bypass sync circuits and set overlap time.
10. Simulate utility outage at no load.
11. Verify proper recharge.

3.3 MANUFACTURER’S FIELD SERVICE

A. Service Personnel
The UPS manufacturer shall directly employ a nationwide service organization, consisting of factory-trained field service personnel dedicated to the startup and maintenance of UPS and power equipment.

The manufacturer shall provide a national dispatch center to coordinate field service personnel schedules. One toll-free number shall reach a qualified support person 24 hours a day, 7 days a week and 365 days a year. If emergency service is required, on-site response time shall be 4 hours or less within 150 miles of an authorized services center.

Two local customer engineers shall be assigned to the site with a regional office as a backup. Escalation procedures shall be in place to notify Power Technical Support if a site is not functioning within 24 hours.

B. Automated Site Monitoring
The UPS manufacturer shall provide as an option an automated site monitoring service. This service shall be staffed by a qualified support person 24 hours a day, 7 days a week and 365 days a year. At the detection of an alarm within the UPS, the controls shall initiate communication with the monitoring service. The monitoring service shall be capable of interpreting the communicated alarms to allow dispatch of a service engineer.

C. Replacement Parts Stocking
Parts shall be available through an extensive network to ensure round-the-clock parts availability throughout the country.

Spare parts shall be stocked by local field service personnel with backup available from national parts centers and the manufacturing location. A Customer Support Parts Coordinator shall be on call 24 hours a day, 7 days a week, 365 days a year for immediate parts availability.
D. Maintenance Contracts

A complete offering of preventive and full-service maintenance contracts for both the UPS system and battery system shall be available.

END OF SECTION
SECTION 26 41 13 13 - LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.1 GENERAL

A. The General Conditions, Supplementary General Conditions, Division 1 and the Section entitled "Electrical Work - General Requirements" apply to all work herein.

B. Objective: To provide safety for the building and occupants by preventing damage to building structure caused by lightning.

C. Provide a lightning protection system for the building.

1.2 STANDARDS: The following specifications and standards of the latest issue form a part of this specification:

A. Lightning Protection Institute
   Installation Standard, LPI 175

B. Underwriters Laboratories, Inc.
   Installation Requirements, UL96A

C. National Electrical Code (NEC)

D. National Fire Protection Association
   Lightning Protection Code, NFPA 78

E. U.S. Bureau of Standards

1.3 SCOPE: The work covered in this section of the specifications consists of furnishing all labor, materials, and items of service required for the completion of a functional and unobtrusive lightning protection system as approved by the engineer, and in strict accordance with this section of the specifications and the applicable Contract Drawings.

If any departure from the Contract Drawings or submittal drawings covered below are deemed necessary by the Contractor, details of such departures and reasons therefore shall be submitted as soon as practical to the engineer for approval.

1.4 QUALITY ASSURANCE: The lightning protection system shall conform to the requirements and standards for lightning protection systems of the LPI, UL, NFPA and NEC. Upon completion, application shall be made to the Underwriters Laboratories, Inc. for inspection and certification. In addition, the Lightning Protection Institute certified system certificate shall be issued and delivered to the owner ensuring that the concealed components have also been monitored during job progress.

The system to be furnished under this specification shall be the standard product of manufacturers regularly engaged in the production of lightning protection equipment and shall be the manufacturer's latest approved design. The equipment shall be UL listed and properly UL labeled.

1.5 QUALIFIED MANUFACTURERS:
A. Bonded Lightning Protection Systems, Inc. - Dallas
B. Advanced Lightning Technology - Dallas
C. Thompson Lightning Protection - Minnesota
D. Harger Lightning Protection - Illinois
E. East Coast Lightning Equipment – Connecticut

1.6 SUBMITTALS: Complete shop drawings showing the type, size and locations of all grounding, down conductors, through-wall assemblies, roof conductors and air terminals shall be submitted to the engineer for approval.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. All materials on the roof shall be copper as manufactured by Thompson Lightning Protection, Inc., Minneapolis, Minn., or approved equal, and shall be approved by the Underwriters' Laboratories, Inc. All down conductors shall be copper. All anchors on down conductors shall be Thompson #169 Loop Masonry Anchors which includes 1/4"-20 Pak-tite masonry anchors and 1/4" x 3/4" brass machine screws (no exceptions).

B. STANDARD: All equipment used in this installation shall be UL listed and properly UL labeled. All equipment shall be new, and of a design and construction to suit the application where it is used in accordance with accepted industry standards and LPI, UL, NFPA and NEC code requirements.

2.2 LIGHTNING PROTECTION EQUIPMENT: All materials shall be copper and bronze and of the size, weight and construction to suit the application and used in accordance with LPI, UL, NEC and NFPA. Class II sized components are required for roof levels over 75 feet in height. Bolt-type connectors and splicers shall be utilized on Class II structures. Pressure squeeze clamps are not acceptable. All mounting hardware on the roof shall be stainless steel and on the facade shall be brass and/or copper.

PART 3 – EXECUTION

3.1 INSTALLATION:

A. The installation shall be accomplished by an experienced installation company that is UL listed, a member of the Lightning Protection Institute, United Lightning Protection Association qualified, and an employer of Certified Master Installers of lightning protection systems. A Certified Master Installer shall directly supervise the work.

B. All equipment shall be installed in a neat, workmanlike manner. The system shall consist of a complete conductor network at the roof and include air terminals, connectors, splicers, bonds, copper downleads and proper ground terminals.

C. Copper downlead cables shall be utilized. No penetration shall be made in the roof membrane.
D. Provide 20% spare air terminals to owner for replacement stock.

E. Where conductors are run in conduit for protection, the conductor shall be bonded to the entrance and exit point of the conduit by bonding wedges or approved methods to maintain electrical continuity.

F. All roof-mounted and downlead conductors shall be Thompson No. 28R "Sampson ropelay copper with a minimum of 28 strand, 14-gauge heavy duty copper (99.97% pure), and shall be stranded cable weighing not less than 375 lbs. per 1000 feet, with 1/2" diameter. Down conductors shall be attached to ground devices in accordance with the specific provisions of the Underwriters' Laboratories, Inc., Code. Air terminals shall be nickel-tipped copper, having a copper base and shall be spaced not more than twenty feet apart. All metals of conductance within six feet of the lightning protection system shall be securely bonded and made a part thereof. Where stack or chimney is present, lead covered non-corrosive air terminals and conductors shall be used. Metal water pipes extending into the ground may be rated as best in ground virtue and should be made an integral part of the grounding system.

3.2 COORDINATION: The lightning protection installer will work with any other trades present to insure a correct, neat and unobtrusive installation.

It shall be the responsibility of the lightning protection installer to assure a sound bond to the main water service and to assure interconnection with other ground systems.

3.3 COMPLETION: Upon completion of the installation, the lightning protection installer shall secure and deliver to the owner the Underwriters Laboratories, Inc. Master Label certification. The system will not be accepted without the UL Master Label plate.

END OF SECTION 26 41 13. 13
SECTION 26 43 13.13 - SURGE PROTECTIVE DEVICES (SPD) – STANDARD INTERRUPTING

PART 1 - GENERAL

1.1 SCOPE

A. Specify the electrical and mechanical requirements for a modular high-energy surge protective device system (SPD). The specified system shall provide effective high energy surge current diversion and be suitable for application in ANSI/IEEE C62.41 Category A, B and C3 environments, as tested by ANSI/IEEE C62.11, C62.45.

B. The system shall be constructed using multiple surge current diversion modules utilizing metal oxide varistors (MOV) computer matched to +/- 1-volt variance and tested for manufacturer’s defects. The modules shall be designed and constructed in a manner that ensures surge current sharing. Use of gas tubes, silicon avalanche diodes or selenium cells are unacceptable. Devices shall utilize a minimum of three (3) MOV’s per fuse links per phase. This will allow greater than 50% redundant protection if a MOV fails.

C. Third Party Test Report verifying surge current rating, longevity, testing, and filtering capabilities shall be provided with submittal.

1.2 STANDARDS

A. The specified system shall be designed, manufactured, tested and installed in compliance with the following codes and standards:

- Canadian Standards Association (CSA)
- American National Standards Institute and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.11, C62.41, C62.45)
- Institute of Electrical and Electronic Engineers 1100 Emerald Book
- Federal Information Processing Standards Publication 94 (FIBS PUB 94)
- National Electrical Manufacturer Association (NEMA LS-1 1992)
- National Fire Protection Association (NFPA 20, 70, 75 and 780)
- National Electric Code
- Underwriters Laboratories (UL 1449 and UL 1283) (Fourth Edition 2006 Revisions (June 1, 2009)
- International Electrotechnical Commission (IEC 801)
- International Standards Organization (ISO) Company certified ISO 9001 for manufacturing, design and service
- EMC Directive 89/336/EEC - CE compliant

B. The systems individual units shall be UL Listed and labeled under UL 1449 (Fourth Edition) Standard for Surge Protection Devices Type 1 20kA with a nominal discharge current of 20kA and the surge ratings shall be permanently affixed to the SPD. The units shall also be listed and labeled to UL1283 for type 2 locations Standard for Electromagnetic Interference Filters, and CSA Listed.

1.3 ACCEPTABLE MANUFACTURERS

A. Southern Tier Technologies
1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:

1. Cutsheets of surge protection devices with ratings, physical dimensions and all accessories clearly labeled.

2. Device labels shall be clearly indicated in cutsheets.

3. All standards and listings, as specified in section 1.2A-B, shall be clearly labeled in cutsheets provided.

4. Cutsheets shall clearly outline that design requirements of this specification have been met.

1.5 QUALITY ASSURANCE

A. The manufacturer shall be ISO 9001 certified. The specified system shall be tested at the component and fully assembled level, under surge conditions with AC power applied for a minimum of 1 hour. Testing shall include but not be limited to quality control checks, dielectric voltage withstand test per UL and CSA requirements, UL ground continuity tests and operational and calibration tests.

B. The unit shall be designed and manufactured in the USA by a qualified manufacturer of line conditioning equipment and Active Tracking Filters. The manufacturer shall have been engaged in the design and manufacture of such products for a minimum of 10 years.

PART 2 - PRODUCTS

2.1 ENCLOSURE

A. The specified system shall be provided in a heavy duty NEMA 4 or better dust-tight, drip-tight enclosure with no ventilation openings.

2.2 OVERCURRENT PROTECTION (FUSING)

A. All components, including suppression, filtering, and monitoring components, shall be individually fused and rated to allow maximum specified surge current capacity. For every 100 K amps of Surge Current Capacity, 120 amps RMS of internal, integral fusing shall be required.

B. Individual surge components shall be sand packed and fused at a maximum of 7 1/2 amps to prevent violent failure. The fusing shall be UL listed to be capable of interrupting up to 300 kA symmetrical fault current with 600VAC applied. Replaceable fusing is unacceptable. Overcurrent protection that limits specified surge currents is not acceptable.

2.3 DESIGN REQUIREMENTS

A. Protection Modes:
The SPD shall provide protection as follows: All modes, L-N or L-L, L-G and N-G (where applicable) Note: L = Line, G = Ground, N = Neutral

B. UL 1449 Ratings:
The maximum UL 149 listed surge ratings for each and/or all the specified protection modes shall not exceed the following in any mode of protection:

<table>
<thead>
<tr>
<th>System voltage</th>
<th>Voltage Protection Rating L-L</th>
</tr>
</thead>
<tbody>
<tr>
<td>120/208 or 120/240 volt</td>
<td>900 volts</td>
</tr>
<tr>
<td>277/480 volt</td>
<td>1800 volts</td>
</tr>
</tbody>
</table>

C. Noise Attenuation:
The unit shall be UL 1283 Listed as an electromagnetic interference filter in type 2 locations. The filter shall provide insertion loss with a maximum of 60 dB from 100 KHz to 100 MHz per 50 Ohm Insertion Loss Methodology from MIL 220A. The system shall provide up to 120 dB insertion loss from 100 KHz to 100 MHz when used in a coordinated facility system.

D. Life Cycle Testing:
The SPD system shall be duty life cycle tested to survive 16,000 20kV, 10kA Surges, per IEEE C62.41 Category C3 surge current with less than 5% degradation of clamping voltage.

2.4 CONNECTIONS
A. Provide 60” wire leads #10 AWG or UL 1449 tested size.

2.5 ACCESSORIES
A. Unit Status Indicators:
Red and green solid state indicators with printed labels shall be provided on the front cover to redundantly indicate on-line unit status including N-G monitoring. The absence of the green light and the presence of the red light shall reliably indicate that surge protection is reduced and service is needed to restore full operation.

B. Dry Contacts for remote monitoring:
Electrically isolated Form C dry contacts, one normally open and one normally closed set standard on all units for remote monitoring.

C. Undervoltage detection:
Unit shall be equipped with 70% undervoltage detection capability.

D. Phase Loss Monitoring:
Unit shall be equipped with phase loss monitoring.

E. Power Loss Monitoring:
Unit shall be equipped with power loss monitoring.

2.6 TESTING
A. Component Testing and Monitoring:
Unit shall include an on-line circuit which tests and redundantly monitors individual components in all protection modes including neutral to ground (where applicable). Units that require external test sets or equipment are not acceptable.

2.7 ENVIRONMENTAL REQUIREMENTS

A. Storage Temperature: -55 to +85 C (-67 to +187 F)
B. Operating Temperature: -40 to +60 C (-40 to 140 F)
C. Relative Humidity: 0% to 95%
D. Audible Noise: less than 45 dBA at 5 feet (1.5 m).
E. Operating Altitude: 0 to 18,000 feet above sea level.

2.8 WARRANTY

A. The manufacturer shall provide a full 10 year parts and a 5 year labor warranty from date of shipment against any part failure when installed in compliance with manufacturer’s written instructions, UL Listing requirements and any applicable national, state or local electrical codes. Direct, factory trained, ISO 9001 certified employees must be available for 48 hour assessment. A 24 hour 800 number must be available to support warranty.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the parallel SPD with short and straight conductors as practically possible. Locate adjacent to the switchboard or panel it is serving. The contractor shall twist the SPD input conductors together to reduce input conductor inductance. The contractor shall follow the SPD manufacturer’s recommended installation practices as found in the installation, operation and maintenance manual and comply with all applicable codes. Provide STT Tierguide cable if the cable length exceeds 5 feet from the circuit breaker servicing the SPD.

END OF SECTION
PART 1 - GENERAL

1.1 SCOPE

A. Provide electrical and mechanical requirements for a modular high-energy surge protective device system (SPD). The system shall provide effective high energy surge current diversion and be suitable for application in ANSI/IEEE C62.41 Category A, B and C3 environments, as tested by ANSI/IEEE C62.11, C62.45.

B. The system shall be constructed using multiple surge current diversion modules utilizing metal oxide varistors (MOV) computer matched to +/- 1-volt variance and tested for manufacturer’s defects. The modules shall be designed and constructed in a manner that ensures surge current sharing. Use of gas tubes, silicon avalanche diodes or selenium cells are unacceptable. Devices using less than 14 MOV’s/fuse links per phase will not be accepted.

C. Third Party Test Report verifying surge current rating, longevity, testing, and filtering capabilities

1.2 STANDARDS

A. The specified system shall be designed, manufactured, tested and installed in compliance with the following codes and standards:

- Canadian Standards Association (CSA)
- American National Standards Institute and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.11, C62.41, C62.45)
- Institute of Electrical and Electronic Engineers 1100 Emerald Book
- Federal Information Processing Standards Publication 94 (FIBS PUB 94)
- National Electrical Manufacturer Association (NEMA LS-1 1992)
- National Fire Protection Association (NFPA 20, 75 and 780)
- National Electric Code NFPA 70
- Underwriters Laboratories (UL 1449 and UL 1283) (Third Edition 2006)
- Revisions (June 1, 2009)
- International Electrotechnical Commission (IEC 801)
- International Standards Organization (ISO) Company certified ISO 9001 for manufacturing, design and service
- EMC Directive 89/336/EEC - CE compliant

B. The systems individual units shall be UL Listed and labeled under UL 1449 (Fourth Edition) Standard for Surge Protection Device type 1 nominal discharge current of 20kA and the surge ratings shall be permanently affixed to the SPD. The units shall also be listed and labeled to UL1283 for type 2 locations Standard for Electromagnetic Interference Filters, and CSA Listed.

1.3 ACCEPTABLE MANUFACTURERS

A. ASCO Power Technologies (formerly Liebert)
1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:

1. Cutsheets of surge protection devices with ratings, physical dimensions and all accessories clearly labeled.
2. Device labels shall be clearly indicated in cutsheets.
3. All standards and listings, as specified in section 1.2A-B, shall be clearly labeled in cutsheets provided.
4. Cutsheets shall clearly outline that design requirements of this specification have been met.

1.1 QUALITY ASSURANCE

A. The manufacturer shall be ISO 9001 certified. The specified system shall be tested at the component and fully assembled level, under surge conditions with AC power applied for a minimum of 1 hour. Testing shall include but not be limited to quality control checks, dielectric voltage withstand test per UL and CSA requirements, UL ground continuity tests and operational and calibration tests.

B. The unit shall be designed and manufactured in the USA by a qualified manufacturer of line conditioning equipment and Active Tracking Filters. The manufacturer shall have been engaged in the design and manufacture of such products for a minimum of 10 years.

PART 2 - PRODUCTS

2.1 ENCLOSURE

A. The specified system shall be provided in a heavy duty NEMA 4 or better dust-tight, drip-tight enclosure with no ventilation openings. The cover of the enclosure shall be hinged on the left side and require a tool for access to internal components. A drawing pocket shall be provided inside the door for storage of unit drawings and installation/operation manual. All monitoring indication must be visible without opening the door. The enclosure maximum dimensions shall be (20) inches/(508) millimeters high, (16) inches/(406) millimeters wide and (8) inches/(203) millimeters deep.

2.2 OVERCURRENT PROTECTION (FUSING)

A. All suppression components shall be individually fused and rated to allow maximum specified surge current capacity. For every 100 k Amps of Surge Current Capacity, 120 amps RMS of internal, integral fusing shall be required. Devices that utilize a single fuse to protect two or more suppression paths are not accepted.

B. Individual surge components shall be sand packed and fused at a maximum of 17.2 amps to prevent violent failure. The fusing shall be UL listed to be capable of interrupting up to 200kA symmetrical fault current with 480VAC applied. Replaceable fusing is unacceptable. Overcurrent protection that limits specified surge currents is not acceptable.

2.2 DESIGN REQUIREMENTS

A. Protection Modes
The SPD shall provide protection as follows: All modes, L-N or L-L, L-G and N-G (where applicable) Note: L = Line, G = Ground, N = Neutral

B. UL 1449 Ratings
The maximum UL 1449 listed surge ratings for each and/or all of the specified protection modes shall not exceed the following:

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>Voltage Protection Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L-N</td>
</tr>
<tr>
<td>120/240</td>
<td>700- volts</td>
</tr>
<tr>
<td>120/208</td>
<td>700- volts</td>
</tr>
<tr>
<td>240</td>
<td>1200- volts</td>
</tr>
<tr>
<td>277/480</td>
<td>1000- volts</td>
</tr>
<tr>
<td>480</td>
<td>1800- volts</td>
</tr>
</tbody>
</table>

C. Noise Attenuation
The unit shall be UL 1283 Listed as an electromagnetic interference filter for type 2 locations. The filter shall provide 41dB at 100kHz, 31dB at 1MHz, 35dB at 10MHz, 53dB at 100MHz, per 50 Ohm Insertion Loss Methodology from MIL 220A. The system shall provide up to 120-dB insertion loss from 100 kHz to 100 MHz when used in a coordinated facility system.

D. Life Cycle Testing
The SPD system shall be duty life cycle tested to survive, 10kA (8x20µs), 20kV (1.2x50µs), IEEE C62.41 Category C surge current with less than 5% degradation of clamping voltage. The minimum numbers of surges the unit shall be able to protect against are:

<table>
<thead>
<tr>
<th>Model Surge Rating</th>
<th>Number of Life Cycle Surges Per Mode</th>
<th>Per Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L-N</td>
<td>L-G</td>
</tr>
<tr>
<td>160kA per phase</td>
<td>12000</td>
<td>12000</td>
</tr>
<tr>
<td>320kA per phase</td>
<td>24000</td>
<td>24000</td>
</tr>
</tbody>
</table>

2.3 CONNECTIONS
A. The terminals shall be provided to accommodate wire sizes up to #1/0 AWG.

2.4 INTERNAL CONNECTIONS AND SERVICEABILITY
A. All surge current diversion module intra-unit connections shall be by way of low impedance copper plates. Surge current diversion modules shall use bolted connections to the plates for reliable, low impedance connections. The system shall be designed for simple change out of any or all SPD component modules by a qualified electrician. Designs that require factory service are not acceptable. All connections, conductors and terminals must be appropriately sized for specified surge current capacity.

2.5 STANDARD FEATURES
A. Component Testing and Monitoring
The monitoring circuitry must continually verify the protection status during operation and display this information on the front cover status panel. The SPD must also contain a built-in-test circuit that will verify the integrity of all fuse links and each associated MOV. The built-in-test circuit must cycle through all phase banks and the neutral-ground bank sending test signals to all modules including N-G. The integrity of all fuses in test must be indicated on the status panel. All testing must be able to be performed without disconnecting power to the SPD. Units that require external test sets or equipment are unacceptable.

B. Unit Status Indicators:
Red and green solid-state indicators with printed labels shall be provided on the hinged front cover to redundantly indicate on-line unit status. The absence of the green light and the presence of the red light shall reliably indicate that surge protection is reduced and service is needed to restore full operation.

C. Surge Counter:

D. Provide 7 digit surge counter to total transient voltage surges.

E. Dry Contacts for remote monitoring:
Electrically isolated Form C dry contacts, one normally open and one normally closed set standard on all units for remote monitoring.

F. Undervoltage detection:
Unit shall be equipped with 70% undervoltage detection capability.

G. Phase Loss Monitoring:
Unit shall be equipped with phase loss monitoring.

H. Power Loss Monitoring:
Unit shall be equipped with power loss monitoring.

2.6 ENVIRONMENTAL REQUIREMENTS
Storage Temperature: -55 to +85 C (-67 to +187 F)
Operating Temperature: -40 to +60 C (-40 to 140 F)
Relative Humidity: 0% to 95%
Audible Noise: less than 45 dBA at 5 feet (1.5 m).
Operating Altitude: 0 to 18,000 feet above sea level.

2.7 WARRANTY

A. The manufacturer shall provide a full 10 year parts and 5 year on site labor warranty from date of shipment against any part failure when installed in compliance with manufacturer’s written instructions, UL Listing requirements and any applicable national, state or local electrical codes. Direct, factory trained, ISO 9001 certified employees must be available for 48-hour assessment. A 24 hour 800 number must be available to support warranty.
PART 3 - EXECUTION

3.1 INSTALLATION

A. The contractor shall install the parallel SPD with short and straight conductors as practically possible. Locate adjacent to the switchboard or panel it is serving. The contractor shall twist the SPD input conductors together to reduce input conductor inductance. The contractor shall follow the SPD manufacturer’s recommended installation practices as found in the installation, operation and maintenance manual and comply with all applicable codes. Provide ASCO Accuguide cable if the cable length exceeds 5 feet from the circuit breaker serving the SPD.

END OF SECTION 26 43 13
SECTION 26 51 00. 13 - LIGHTING FIXTURES - LIGHT EMITTING DIODE (LED)

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install general and emergency lighting fixtures as noted on the drawings. Fixtures shall be completely wired with lamps installed and shall be in perfect operating condition at the time of substantial completion.

B. The types of lighting fixtures required for this project include:
   1. LED

1.2 STANDARDS

A. All fixtures shall conform to all applicable UL standards and shall be UL label including damp and wet location ratings. “ETL listed” is an acceptable listing.

B. All fluorescent ballast shall comply with certified ballast manufacture (CBM) standard and CBM labeled.

C. NFPA 101

D. ANSI C82.1

E. NEMA-LE

F. IEEE Publication 587 Category "A" (Electronic Ballast)

G. All LED drivers shall be UL recognized Class 2 per UL1310 or non-Class 2 per UL 1012 as applicable.

H. All LED drivers shall comply with applicable requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 15, for Non-Consumer Equipment.

I. All LED drivers shall be RoHS compliant.

J. TM-21

K. LM-80

L. LM-79

M. L70

N. DLC

O. UL 1008
1.3 ACCEPTABLE MANUFACTURERS

A. Provide lighting fixtures produced by manufacturers as shown and scheduled.

1.4 SUBMITTALS

A. Shop drawings shall include a brochure with a separate cut sheet for each fixture type arranged in alphabetical order with fixture and all accessories/options clearly labeled. Provide performance data for each fixture. Provide an independent test lab report for each fixture if requested by the Architect/Engineer.

B. Provide driver and LED module data brochures for each fixture type.

C. Furnish air handling and heat removal data for light fixtures specified with these requirements.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:

2. Local, municipal, or state codes that have jurisdiction.
3. UL fire resistance directory.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General:

Provide the size, type and rating of each light fixture shown and scheduled. All light fixtures shall complete with reflectors, lens, trim rings, flanges, LED modules, lamp holders, drivers, fuses, wiring, earthquake clips, etc. to provide a complete functioning light fixture.

B. Lighting Fixture Types:

1. LED Fixtures
   a. Fixtures shall be pre-wired with frame-in kit and integral thermal management system for fixtures. Driver shall be encased in metal-can construction for optimal thermal performance.
   b. Total fixture lumen output is dependent on the chip, thermal management, driver current and optical system. LED fixtures shall be tested as a complete unit or system. Only DOE recognized CALiPER testing laboratory results shall be utilized.
   c. Interior LED fixtures shall have integral common mode and differential mode surge protection of 3kV(1.2/50µs, 2 ohm combination wave).
   d. Exterior LED fixtures shall have integral common mode and differential mode surge protection of 10kV/10kA(1.2/50µs, 2 ohm combination...
2. Exit signs
   a. Exit signs shall meet all federal, state and local codes.
   b. Provide fire alarm interface relay when required to flash exit signs.
   c. Provide battery packs for emergency operation when not connected to emergency generator power.

2.2 LED MODULES AND DRIVERS - COORDINATE WITH LIGHT FIXTURE SCHEDULE

A. LED

1. Driver manufacturer shall have a 10-year history producing electronic drivers for the North American market.
2. Driver shall carry a five year limited warranty from date of manufacture against defects in material or workmanship (including replacement) for operation at a maximum case temperature of 80 degrees Celsius.
3. Drivers shall not contain any Polychlorinated Biphenyl (PCB).
4. Provide driver with integral color-coded leads.
5. Driver shall operate from 50/60 Hz input source of 120 Volt through 277 Volt or 347 Volt through 480 Volt with sustained variations of +/- 10% (voltage) with no damage to the driver.
6. Driver output shall be regulated to +/- 5% across published load range. And shall have a power factor greater than .90 for primary application to 50% of full load rating with an input current Total Harmonic Distortion (THD) of less than 20% to 50% of full load rating.
7. Provide drivers with a Class A sound rating.
8. Provide LED drivers for outdoor fixtures with a minimum operating temperature of -40 degrees Celsius (-40 F). Provide LED drivers for indoor fixtures with a minimum operating temperature of -20 degrees Celsius (-2F).
9. Drivers shall tolerate sustained open circuit and short circuit output conditions without fail and auto-resetting without need for external fuses or trip devices.
10. Driver output ripple current shall be less than 15% measured peak-to-average, with ripple frequency being greater than 100Hz.
11. Driver performance requirements shall be met when operated to 50% of full load rating.
12. Driver shall have integral thermal foldback to reduce driver power above rated case temperature to protect the driver if temperatures reach unacceptable levels.
13. Drivers shall comply with NEMA 410 for in-rush current limits.
14. Dimmable drivers shall be controlled by a Class 2 low voltage 0-10VDC controller with dimming range controlled between 1 and 8VDC with source current 150µA.

2.3 LAMPS – COORDINATE WITH LIGHT FIXTURE SCHEDULE

2.4 SPARE FIXTURES

A. Provide 3 TYPE “A” fixtures.

B. Ship to the Owner in original

2.5 BRANCH CIRCUIT EMERGENCY TRANSFER SWITCH (BCELTS)
A. Provide 20A, 120-277 Volt UL 1008 Branch Circuit Emergency Transfer Switch to control emergency light fixtures served by a generator. Provide Bodine GTD 20A or ETC SC 1008, UL 924 Devices are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Install the type of light fixture where shown and indicated in accordance with manufacturer's written instructions.
2. Provide earthquake clips on all recessed lay-in light fixtures as required by building code.
3. Adjust all adjustable light fixtures, as directed by the Architect.
4. Provide safety chains and wire guards for light fixtures located in gymnasium, multi-purpose rooms, play areas, etc.

B. Coordination

1. The contractor shall verify the type of fixtures with the ceiling types as indicated on the drawings. Any discrepancies shall immediately be brought to the architect's attention before the contractor places his order and accepts delivery. Fixtures shall fit exact in the type of ceiling scheduled. Provide plaster frames, trim rings and other accessories required for a correct fit.
2. Provide supports attached to structural member to support fixtures when the ceiling system cannot maintain support. Provide separate supports for all recessed ceiling mounted HID fixtures.
3. Refer to architectural reflected ceiling plan for the exact location of all light fixtures. Notify the architect for any discrepancies or conflicts with structural, architectural, mechanical piping or ductwork before installation.

C. Mounting

1. Provide support channels to support outlet boxes used support surface mounted light fixtures such as exit signs or downlights.
2. Pendant or surface mounted fixture shall be provided with required mounting devices and accessories, including hickeys and stud-extensions, ball-aligners, canopies and stems. Locations of fixtures in mechanical areas shall be coordinated with mechanical contractor. Mounting stems of pendant fixtures shall be of the correct length to uniformly maintain the fixture heights shown on the drawings or established in the field. The allowable variation tolerance in mounting individual fixtures shall not exceed 1/4 inch and shall not vary more than 1/2 inch from the floor mounting height shown on the Drawings. Fixtures hung in continuous runs shall be installed absolutely level and in line with each other. Hanging devices shall comply with Code requirements. Fixtures shall employ single - not twin - stem hangers unless otherwise noted.
3. All structure mounted fixtures (i.e. bracket mounted, pipe mounted and surface mounted) shall be provided with cables of suitable size and weight to support the
weight of the fixture. Cables shall be fastened around or fastened to the housing of the fixture. On pendant fixtures, one safety cable of suitable size and weight to support the weight of the fixture assembly shall connect the top of the pendant to the supporting structure by means of welding or bolting, and one safety cable shall connect the housing of the fixture to the bottom of the pendant. Where more than one pendant per fixture occurs, only one pendant must be cabled. Track fixtures for pendant mounted track shall also be supplied with clip-on safety cables of suitable size and weight to support the weight of the fixture.

4. Provide secondary support wires from all four (4) corners of the lay-in fixtures to the structure above. Do not support fixtures from ceiling grid wire supports, piping, conduit, side walls, or mechanical equipment. Ceiling specifications do not supersede this requirement.

D. Electrical Connection

1. All light fixtures shall be connected from a branch circuit junction box using 1/2" flexible metal conduit or MC cable fixture pigtails not exceeding 8'- 0". Provide #12 AWG conductors. All fixtures must be grounded by using a grounding conductor. Fixture to fixture wiring of fixtures installed in an accessible ceiling is not permitted. Fixture whips shall not lay-on ceiling tile or grid. Provide caddy clips to provide additional support.

E. Fire Rated Ceiling

1. Provide fire rated canopy or enclosure for all fixtures recessed in a fire rated ceiling. The fire rated canopy or enclosure shall be as required by the UL design number listed in the UL fire resistance directory. Refer to architectural drawing for the UL design number. Coordinate with ceiling installer and manufacturer.

F. Air Handling Fixtures

1. Install all air handling light fixtures with return air slot in the open position, if it is to be as an air handling fixture. Coordinate with mechanical contractor.

3.2 FINAL INSPECTION

A. Remove all plastic and protective coating from all fixtures. Fixtures shall be thoroughly cleaned. Replace any damaged fixture or fixture parts including reflectors, louvers, lens and metal parts that show signs of corrosion.

B. Replace all other defective fixtures showing signs of excessive usage.

C. Demonstrate proper operation of all fixtures and controls.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. This section includes general design requirements, administration topics, and installation for communications systems.

1.2 SYSTEM DESCRIPTION
A. The objective of this project is to provide a complete communications cabling infrastructure system installation including, but not limited to: fiber backbone, riser system, horizontal data and voice cabling with attendant terminations, mounting equipment, cable pathway and management systems, testing and other items/materials, as specified in drawings, these specifications, and contract documents.

B. Related Sections
1. Section 270526 Grounding and Bonding for Communications Systems
2. Section 270528 Pathways for Communications
3. Section 271100 Communications Equipment Room Fittings
4. Section 271500 Communications Horizontal Cabling

1.3 SCOPE OF WORK
A. This section establishes an infrastructure to be used as signal pathways for communications systems, but is not limited to the following:
   1. Comply with all Project Contract documents and the following requirements for a complete project installation.
   2. Provide a structured cabling system as described hereafter that includes, but is not limited to, supplying, installing and testing of: backbone cabling, riser cabling; data and voice horizontal cabling, cable connectors, communications outlets and terminations, and equipment racks/cabinets for networking hardware and patch panels.
   3. Furnish all labor, materials, tools, equipment and services for the installation described herein.
   4. Follow industry standard installation procedures for communications cable to assure that the mechanical and electrical transmission characteristics of this cable plant and equipment are maintained.

B. Work of this section covers complete installation of permanent links for a data and voice communications networks utilizing copper and fiber transmission media that includes, but is not limited to the following:
   1. Provide, install, terminate, test, and document all fiber and copper backbone cables, riser cables, and horizontal cables.
   2. Provide and install all termination devices such as, but not limited to, modular patch panels, termination blocks, information outlets (jacks and plates), phone jacks, fiber distribution panels, bulkheads, connectors, and fiber fan out kits. Document all termination devices with proper labeling.
3. Provide in quantities specified, interconnect components such as, but not limited to, fiber patch cables, copper patch cords, and station cables.

4. Provide and install specified Telecommunication Room equipment such as, but not limited to, racks, cabinets, horizontal and vertical cable support devices, cable trays and cable runway, and required mounting brackets/hardware.

5. Provide and install UL-approved firestopping systems in all communication pass-through locations of rated ceiling, wall or floor penetrations involving, conduits, cable, and cable trays in coordination with General Contractor.

6. Provide and install grounding and bonding connection to the bus (TGMB/TGB) provided by Division 26.

7. Provide and install all appropriate consumable items required to complete the installation.

8. Coordination with other trades.

9. Provide complete documentation and demonstration of work.

10. Provide indexed and organized complete Test Results of all copper and fiber cable and their components.

11. Provide Submittals as outlined below.

12. Provide a Manufacturer’s Extended Product Warranty and System Assurance Warranty for this wiring system.

13. Conduct a final document handover meeting with client, consultant, and PM to review, discuss and educate the Owner on the final product, test results, and As-Built Drawings.

C. Changes to the Scope of Work

1. Owner changes to the scope of work shall be in writing.

2. Change orders shall be submitted to the Owner/Project Manager complete with price breakdown and description for approval before any work is done.

3. The Contractor shall respond to these changes with a complete material list, including pricing, labor, and taxes in writing to be presented to the Owner for approval.

4. The Contractor shall not proceed with additional scope of work without signed approval by the Owner. Owner will not pay for additional work performed by the Contractor without written/signed approval of these changes.

5. Contractor will attach a copy of the signed change order with billing information.

1.4 SUBSTITUTION PROCEDURES

A. Substitution may be considered when a product becomes unavailable through no fault of the Contractor. An alternate product must be equal to or exceed specified requirements. The material substituted shall not void, alter or change manufacturers’ structured cabling system warranty.
B. Document substitution requests with complete data substantiating compliance of proposed substitution with Contract Documents. Include in each request for substitution:

1. Product identification, manufacturer’s name and address
2. Product Data:
   a) Description, performance and test data, reference standards, finishes and colors.
   b) Samples: Finishes.
   c) Complete and accurate drawings indicating construction revisions required (if any) to accommodate substitutions.
   d) Data relating to changes required in construction schedule.
   e) Cost comparison between specified and proposed substitution.

C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

D. The Owner will be the final judge of acceptability, with review by DBR and the distribution of the acceptance by the Architect.

E. No substitute shall be ordered, installed or utilized without the Architect’s prior written verification of acceptance from the Owner.

1.5 REFERENCES AND RELATED DOCUMENTS

A. Drawings and General provisions of the contract, including Uniform General Conditions, Supplementary General Conditions, Architectural plans and specifications, requirements of Division 1, Electrical, Mechanical, Plumbing, Audio-Visual, Security and Communications specifications and plans, and the publications listed below apply to the Communications section, are incorporated into this specification by reference, and shall be considered a part of this section.

B. Reference to codes, rules, regulations, standards, manufacturer’s instructions, or requirements of regulatory agencies shall mean reference to the latest printed edition of each in effect at the date of contract.

C. The Contractor shall read all sections in their entirety and apply them as appropriate for work in this section.

D. Conflicts

1. Drawings and specifications are to be used in conjunction with one another and to supplement one another.

2. In general, the specifications determine the nature and quality of the materials and tests, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to during the installation of the communications system components.

3. If there is an apparent conflict between the drawings and specifications, or between specification sections, the items with the greater quantity and/or quality shall be estimated and installed.

4. Clarification with the Owner and/or DBR about these items shall be made in writing prior to procurement and installation.

E. Codes and Standards
1. American National Standards Institute/Telecommunications Industry Association (ANSI/TIA)
   a) ANSI/TIA-568-C.0 "Generic Telecommunications Cabling for Customer Premises"
   b) ANSI/TIA-568-C.1 "Commercial Building Telecommunications Cabling Standard"
   c) ANSI/TIA-568-C.2 "Balanced Twisted-Pair Telecommunication Cabling and Components Standard"
   d) ANSI/TIA-568-C.3 "Optical Fiber Cabling Components Standard"
   e) ANSI/TIA-568-C.4 "Broadband Coaxial Cabling and Components Standard"
   f) ANSI/TIA-569-C "Telecommunications Pathways and Spaces"
   g) ANSI/TIA-606-B "Administration Standard for Commercial Telecommunications Infrastructure"
   h) ANSI/TIA-607-B "Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications"
   i) ANSI/TIA-758-B "Customer-Owned Outside Plant Telecommunications Infrastructure Standard"
   k) ANSI/TIA-942-A: “Telecommunications Infrastructure Standard for Data Centers”
   l) ANSI/TIA-1152: “Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling”

2. American National Standards Institute (ANSI)
   a) ANSI C80.1 Electrical rigid steel conduit (erse)

3. American Society for Testing Materials (ASTM)
   a) ASTM A123/A123M-13 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   b) ASTM A510/A510M-13 Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel
   c) ASTM A653/A653M-13 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
   d) ASTM B3-13 Standard Specification for Soft or Annealed Copper Wire
   e) ASTM B8-11 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
   f) ASTM B33-10 Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
   g) ASTM B633-13 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

4. BICSI
   a) BICSI Outside Plant Design Reference Manual
   b) BICSI Telecommunications Distribution Methods Manual (TDMM)
5. Federal Specifications (FS)
   a) FS W-C-58C Conduit Outlet Boxes, Bodies Aluminum and Malleable Iron
   b) FS W-C-1094 Conduit and Conduit Fittings Plastic, Rigid
   c) FS WW-C-566C Flexible Metal Conduit
   d) FS WW-C-581D Coatings on Steel Conduit

6. Institute of Electrical and Electronic Engineers (IEEE)
   a) IEEE 142-1991 Recommended Practice for Grounding of Industrial and Commercial Power Systems
   b) IEEE 1100-2005 IEEE Recommended Practice for Powering and Grounding Electronic Equipment

7. National Electrical Code (NEC)
   a) NEC Article 250 - Grounding and Bonding
   b) NEC Chapter 8 - Communications Systems

8. National Electrical Manufacturers Association (NEMA)
   a) NEMA RN1 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
   b) NEMA TC2 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
   c) NEMA TC3 Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
   d) NEMA VE 1 - Metal Cable Tray Systems
   e) NEMA VE 2 - Cable Tray Installation Guidelines

9. Underwriters' Laboratories (UL)
   a) UL Cable Certification and Follow-Up Program
   b) UL 6: Electrical Rigid Metal Conduit - Steel
   c) UL 83: Thermoplastic-Insulated Wires and Cables
   d) UL 467: Grounding and Bonding Equipment
   e) UL 514B: Conduit, Tubing, and Cable Fittings
   f) UL 651: Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
   g) UL 651A: Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit
   h) UL 1666: Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

10. Local, county, state and federal regulations and codes in effect as of date of installation.

11. Owner’s current standards on Communications (Structured Cabling) Systems shall be followed. If there is any conflict or discrepancy from this spec, contractor shall follow and price in the specification with more stringent requirements.

   a) It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.
1.6 QUALITY ASSURANCE
A. Communications Contractor shall have a complete working knowledge of low voltage communications cabling applications such as, but not limited to data, voice and video network systems.
B. Communications Contractor shall have installed similar-sized systems in at least ten (10) other projects in the last five (5) years prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document.
C. Communications Contractor and individual installation crew members shall be experienced and qualified to perform the work specified herein at time of bid submission. All onsite supervision personnel that will be assigned to this project shall be listed in the Pre-Installation Submittal.
   1. 80% shall have a minimum of three (3) years of experience in the installation of the types of systems, equipment, and cables specified in this document prior to this bid.
   2. All installation team members must demonstrate knowledge and compliance with all applicable methods, standards, and codes.
   3. All members of the installation team shall be certified by the Structured Cabling System Assurance Warranty provider as having completed the necessary training to complete their part of the installation and capable of an installation that falls under manufacturer’s guidelines necessary to obtain the Manufacturer’s System Assurance Warranty.
   4. Any personnel substitutions shall be noted in writing to the Owner.
D. A BICSI RCDD shall supervise and approve all on-site work as a recognized member of the Contractor's installation team.
E. Refer also to General Conditions.

1.7 CONTRACTOR REQUIREMENTS
A. In order to accomplish the conditions of this agreement, the Contractor shall perform the specific duties listed herein.
B. Contractor shall provide and pay for all labor, supervision, tools, equipment, test equipment, tests and services to provide and install a complete communications cabling infrastructure system. Pay all required sales, gross receipts, and other taxes.
C. Insurance
   1. The Contractor shall procure, submit for review, and maintain for the duration of this agreement, insurance against claims for injuries to persons or damages to property which may arise from, or in connection with, the performance of work hereunder by the Contractor, his agents, representatives, employees or subcontractor. The Contractor shall pay the cost of such insurance.
   2. The Owner, its directors, officers, representatives, agents and employees, respectively, shall have no responsibility to the Contractor with respect to any insurance in accordance with the provisions set forth herein.
D. Regulatory Requirements
1. Communications Contractor shall supply all city, county, and state telecommunication cabling permits required by Authority Having Jurisdiction (AHJ).

2. Communications Contractor shall be licensed and/or bonded as required for telecommunications/low voltage cabling systems.

E. Privacy and Confidentiality

1. The Contractor will respect and protect the privacy and confidentiality of Owner, its employees, processes, products, and intellectual property to extent necessary, consistent with the legal responsibilities of the Owner policies.

2. Contractors shall sign a non-disclosure agreement and abide by the requirements to keep confidential all information concerning bid documents and this project.

F. Use of Subcontractors

1. Successful bidder shall inform the Owner’s contact and General Contractor in writing about the intention to use Subcontractors and the scope of work for which they are being hired.

2. The Owner or Owner’s designated contact must approve the use of Subcontractors in writing prior to the Subcontractor’s hiring and start of any work.

G. The Contractor’s designated Project Manager will be recognized as the single point of contact. The Project manager shall oversee all work performed to ensure compliance with specifications as outlined in bid documents (which includes all specifications, references, and drawings) to ensure a quality installation and attend project meetings with the telecommunication consultant, the Owner and others.

H. Coordination

1. Coordinate installation work with other trades (examples include ceiling grid contractors, HVAC and sheet metal contractors, etc.) to resolve procedures and installation placement for cable trays and cable bundle pathways.

2. The goal of this coordination will be to establish priority pathways for critical data/voice network cable infrastructure, materials, associated hardware, as well as mitigate delays to the project and to allow service access for communications and HVAC components.

3. Exchange information and agree on details of equipment arrangements and installation interfaces.

4. Coordinate with electrical contractors and plan for the pathway routes used communications cabling to minimize cable lengths. Report any potential over distance cable runs for approval before pulling the cables.

5. Record agreements with other trades and distribute record to other participants, Owner and telecommunication consultant.

1.8 PRE-INSTALLATION MEETINGS

A. Communications Contractor shall attend and/or arrange a scheduled pre-installation conference prior to beginning any work of this section. This venue is to ask and
clarify questions in writing with consultant and/or project manager/Owner representative.

B. Agenda
1. Safety
2. Work to be performed
3. Scheduling
4. Coordination
5. Other topics as necessary

C. Attendance
1. Communications project manager/supervisor shall attend meetings arranged by General Contractor, Owner’s representatives, and other parties affected by work of this document.
2. All individuals who will serve in an on-site supervisory capacity, including project managers, site supervisors, and lead installers, shall be required to attend the pre-installation conference. Individuals who do not attend the conference will not be permitted to supervise the installation and testing of communications cables on the project.

1.9 CONTRACT ADMINISTRATION
A. DBR Inc may perform site visits and provide job field reports upon inspection of Contractor’s installation, materials, supporting hardware, coordination with other trades and progress to schedule to the client.
B. Job Field Report outline:
   1. General: The general installation progress in relation to scheduled work made by the Contractor up to that date.
   2. Deficiencies and/or Items of Note: Documents observations of the cable installation that may require corrective action by the Contractor.

1.10 POST INSTALLATION MEETINGS
A. At the time of substantial completion the contractor shall call and arrange for a post installation meeting to present and review all submittal documents to include but not be limited to As-Built Drawings, Test reports, Warranty paperwork, etc.
B. Attendees shall include
   1. Communications Contractor
   2. Project Manager/Owner Representative
   3. General Contractor
   4. DBR Inc.
   5. Other trades that the GC deems appropriate.
C. At this meeting the Communications Contractor shall present and explain all documentation.
D. Any discrepancies or deviations noted by and agreed to by participants shall be remedied by the Communications Contractor and resubmitted within one (1) week of the meeting.
1.11 DELIVERY, STORAGE, AND HANDLING

A. Coordination with delivery companies, drivers, site address, and contact person(s) will be the responsibility of the Contractor.

B. Communications Contractor requirements:
   1. Be responsible for prompt material deliveries to meet contracted completion date.
   2. Coordinate deliveries and submittals with the General Contractor to ensure a timely installation.
   3. No equipment materials shall be delivered to the job site more than three weeks prior to the commencement of its installation.
   4. Equipment shall be delivered in original packages with labels intact and identification clearly marked.
   5. Equipment shall not be damaged in any way and shall comply with manufacturer’s operating specifications.
   6. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants.
   7. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner.
   8. Contractor shall be responsible for all handling and control of equipment. Contractor is liable for any material loss due to delivery and storage problems.

C. Owner/General Contractor shall provide the security requirements for Contractor to follow.

1.12 PROJECT/SITE CONDITIONS

A. For all environmental recommendations, refer to master Architectural section.

B. For all security recommendations, refer to related consultant sections.

C. Contractor shall provide daily a clean work environment that is free from trash/rubbish accumulated during and after cabling installation.

D. Contractor shall keep all liquids (drinks, sodas, etc.) away from finished spaces. If any liquid or other detriment (cuts, soils, stains, etc.) damages any finishes, Contractor shall provide professional services to clean or repair scratched/soiled finishes, at Contractor’s expense.

E. Damage by Communications Contractor to the work of others will be remedied at the Contractor’s expense in a timely manner.

1.13 WARRANTY

A. The Contractor shall be a certified Manufacturer’s Value Added Reseller (VAR) and/or Authorized Installer and provide an end-to-end product warranty, adhere to the industry standard engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this project.

B. Contractor shall coordinate with manufacturer for warranty paperwork and procedures prior to the start of the project.
C. Contractor shall provide a minimum one (1) year warranty on installation and workmanship PLUS an Extended Product Warranty and System Assurance Warranty for this wiring system and shall commit to make available local support for the product and system during the Warranty period.

1. The Extended Product Warranty shall apply to all passive structured cabling system components and shall cover the replacement or repair of defective products and labor for the replacement or repair of such defective products for a minimum of one (1) year.

2. The System Assurance Warranty provides a complete system and product warranty that will be extended to the end-user, ensuring the structured cabling system will be free of defects in materials and workmanship, will meet or exceed applicable performance requirements defined in the contract documents, and support all current and future network applications for a minimum of twenty (20) years.

D. System Certification: Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a numbered certificate, from the manufacturer, registering the installation.

1.14 PAYMENT

A. Refer to the General Contractor contract documents and/or master specifications issued by Architect for project and cost payment details.

1.15 SUBMITTALS

A. Refer to Requirements of Division 1

B. Refer to Sections 271300 and 271500

C. The Communications Contractor shall not perform any portion of the work requiring submittal and review of shop drawings, product data, or samples until Owner has approved the respective submittal in writing. Such work shall be in accordance with approved submittals.

D. Pre-Installation Submittal Requirements

1. Communications Contractor shall provide certificates for the appropriate insurance coverage as defined in contract documents.

2. City, county, and/or state telecommunication cabling permits as required by Authority Having Jurisdiction (AHJ).

3. Executed non-disclosure agreement.

4. Appoint a Project Manager and provide the name and contact information.

5. Shop Drawings

   a) Communications Contractor shall submit, for approval, floor plans that identify all device locations, cable routes and quantities, cable types, riser locations, and references to installation details and diagrams.

      1) Communication Contractor shall notify Owner of cable routes exceeding standardized lengths.
b) Communications Contractor shall submit, for approval, diagrams that show room layouts, rack layouts (including elevations), riser layouts, etc.

c) The Contractor shall make any corrections as required by the consultant team and submit revised shop drawings to the team for approval.

d) Approval by the Consultant of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from the drawings or specifications, nor shall it relieve the Contractor from responsibility for errors of any sort in shop drawings or schedules. Requests to deviate shall be submitted in writing to the Architect.

6. Product Data Cut-sheets

a) Communications Contractor shall submit catalogue cut-sheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be handwritten and/or highlighted to indicate exact selection.

b) Communications Contractor shall identify applicable specification section reference for each product performance for each component specified for approval prior to purchase and installation.

7. Warranty

a) The Communications Contractor shall submit appropriate documentation from the certifying manufacturer showing the project is registered and qualified for the System Assurance Warranty.

b) All subsequent work shall be in accordance with approved submittals. The Communications Contractor shall not perform any portion of the work requiring approval of the System Assurance Warranty manufacturer’s warranty registration qualification procedures that would disqualify any part or all of the wiring system from that warranty qualification.

8. Qualifications

a) Communications Contractor shall submit a list of the Contractor’s previous projects that demonstrate qualification for this project. This list shall include, but not be limited to:

1) At least ten (10) other projects in the last five (5) years
2) Name and location of project
3) Project contacts, email addresses, and phone numbers
4) Total square footage
5) Total number of cables/drops
6) Types of media

b) Communications Contractor shall submit an up-to-date and valid statement of qualifications for those assigned to perform the work specified herein at time of bid submission.

1) Communications Contractor Employees
2) Subcontractors

c) Manufacturer certifications for Contractor and installers.

9. Cable Testing Plan
The Contractor shall provide a complete and detailed test plan for approval of the cabling system specified herein, including a complete list of test equipment for copper and fiber components and accessories prior to beginning cable testing.

b) The following minimal items shall be submitted for review:
1) A testing plan that clearly describes procedures and methods.
2) Product data for test equipment.
3) Certifications and qualifications of all persons conducting the testing.
4) Calibration certificates indicating that equipment calibration meets National Institute of Standards and Technology (NIST) standards and has been calibrated at least once in the previous year of the testing date.
5) Examples of test reports, including all graphs, tables, and charts necessary for display of testing results.

10. Samples

a) For workstation outlet connectors, jack assemblies, housings and faceplates for color selection and evaluation of technical specifications and requirements. Confirm with Architect, interior designer, and Owner representative for color before purchasing materials.

11. Unit Pricing

a) Provide add/deduct unit pricing for a permanent link, including all components, with an average cable length of a linear 150'-0". All requirements and specifications will be enforced.

E. Closeout Submittal Requirements

1. As-Built Drawings

a) Communications Design drawings are to be supplied to the Architect to prepare the master “As-Built” drawings.

b) Submit one electronic copy and one hard copy with project deliverables within three (3) weeks subsequent to substantial completion. Provide a laminated floorplan with drop designations in the respective serving Telecom Room.

c) As-Built drawings shall be in AutoCAD format, same version as used by Architect and consultant. Dimensions and scale of the drawing sheets submitted shall match the size of the drawing sheets used for the contract documents.

d) Utilize normal recognized drafting procedures that match AutoCAD standards, Architect and Consultant guidelines, and methodology.

e) The As-Built drawings shall incorporate all changes made to the building identified in, but not limited to, addendum, change notices, site instructions or deviations resulting from site conditions.

1) Contractor shall clearly identify any resubmitted drawing sheets, documents or cut sheets either by using a color to highlight or cloud around resubmitted information.

2) Maintain drawing numbering or page/sheet scheme consistency as per previously issued drawings/documents.
f) Provide dimensioned plan and elevation views of networking components, showing:

1) All work area outlet locations complete with outlet/cable labeling.
2) Rack and/or cabinet locations complete with labeling.
3) One-line diagram of equipment/device interconnections with the cable plant.
4) Standard or typical details of installations unique to Owner’s requirements.
5) Graphic symbols and component identification on detail drawing shall conform to the latest conventions:
   i) ANSI/TIA-568-C.0 "Generic Telecommunications Cabling for Customer Premises"
   ii) ANSI/TIA-569-C "Telecommunications Pathways and Spaces"
   iii) ANSI/TIA-606-B "Administration Standard for Commercial Telecommunications Infrastructure"
   iv) ANSI/TIA-607-B "Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications"

2. The Communications Contractor shall deliver the Installer's Extended Product Warranty and Manufacturer's signed System Assurance Warranty of installed cabling system to include all components that comprise the complete cabling system.

   a) Delivery shall be completed within two (2) weeks of the time of final punch list review.
   b) Product Certificates shall be signed by manufacturers of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.

3. Cable Testing Report Requirements

   a) Submit certified test reports of Contractor-performed tests. Contractor shall submit the required Test Reports in the format and media specified, upon completion of testing the installed system.
   b) The tests shall clearly demonstrate that the media and its components fully comply with the requirements specified herein.
   c) Three (3) sets of electronic and hardcopy versions of test reports shall be submitted together and clearly identified with cable designations.
   d) Cable inventory data shall be submitted for all fiber, copper, and coaxial cabling and termination components. Include products furnished:
      1) Manufacturer's name
      2) Manufacturer's part numbers
      3) Cable designations
      4) Location and riser assignments
      5) Product Data

4. Supply Owner with training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.
F. The Contractor’s BICSI Registered Communications Distribution Designer (RCDD) supervisor shall review, approve and stamp all documents prior to submitting. The Contractor’s RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein upon completion of all work.

PART 2 - PRODUCTS

2.1 SUMMARY

A. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer’s latest standard design in satisfactory use for at least one year prior to bid opening.

B. All material and equipment, as provided, should be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufacturing of such products.
   1. All shall be typical commercial designs that comply with the requirements specified.
   2. All material and equipment shall be readily available through manufacturers and/or distributors.

C. All equipment shall be standard catalogued items of the manufacturer and shall be supplied complete with any optional items required for proper installation.

D. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance and backward compatibility.

E. All materials shall be UL- and/or ETL-approved and labeled in accordance with NEC for all products where labeling service normally applies.

F. Materials and equipment requiring UL 94, 149 or 1863 listing shall be so labeled. Modification of products that nullifies UL labels is not permitted.

G. Backward Compatibility: The provided products shall be backward compatible with lower category ratings such that if higher category components are used with lower category components, the basic link and channel measures shall meet or exceed the lower category’s specified parameters.

H. Component Compliance: The provided products shall each meet the minimum transmission specifications listed herein such that no individual component will be less than specifications for permanent link and channel, regardless of the fact that tests for link and channel ultimately meet required specifications.

2.2 ACCEPTABLE MANUFACTURERS

A. Identification (Labeling) System
   1. Brady
   2. Dymo
   3. Hellerman-Tyton
   4. Acceptable alternate

B. Fire-Stop Systems
   1. Hilti
2. SpecSeal
3. 3M
4. Acceptable alternate
C. Other Products as Referenced in other Division 27 Specifications.

PART 3 - EXECUTION

3.1 PREPARATION
A. Field Measurements
   1. Verify dimensions in areas of installation by field measurements before
      fabrication and indicate measurements on shop drawings. Coordinate
      fabrication schedule with construction progress to avoid delaying the work.
B. Established Dimensions
   1. Where field measurements cannot be made without delaying the work,
      coordinate with the General Contractor to establish dimensions.
   2. When approved in writing, proceed with fabricating units without field
      measurements.
   3. Coordinate supports, adjacent construction, and fixture locations to ensure
      actual dimensions correspond to established dimensions.
C. Pre-installation inspection
   1. The Contractor shall visually inspect all cables, cable reels, and shipping
      cartons to detect possible cable damage incurred during shipping and
      transport.
   2. Visibly damaged goods are not acceptable and shall be replaced by the
      contractor at no additional cost to the Owner.

3.2 INSTALLATION
A. General
   1. Contractor shall install work in accordance with specifications, drawings,
      manufacturer’s instructions and approved submittal data.
B. Allowable cable bend radius and pull tension:
   a) In general, communications cable cannot tolerate sharp bends or
      excessive pull tension during installation.
   b) Refer to cable manufacturer's bend radius recommendations for the
      maximum allowable limits.
   c) After installation, exposed cable and other surfaces must be cleaned
      free of lubricant residue. Use only lubricants specifically designed for
      cable installation.
C. Pull Strings
   1. Provide pull strings in all new conduits, including all conduits with cable
      installed (trailer strings) as part of this contract.
   2. Data and video cables can be pulled in tandem with pull strings.
3. The pull strings must move freely to prevent cable jacket/cable damage during pulls.

D. Labeling

1. Follow Owner’s current labelling standard and submit labelling scheme for review and approval before installation to start.

2. Cable labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

3. Flat-surface labels: Self-adhesive vinyl or vinyl-cloth labels, machine printed with alphanumeric cable designations.

4. Provide transparent plastic label holders, and 4-pair marked colored labels.

5. In accordance with ANSI/TIA-606-B "Administration Standard for Commercial Telecommunications Infrastructure":
   a) Install colored labels according to the type of field as per color code designations.
   b) Use “designation strip color-code guidelines for voice, data, cross-connect, riser, and backbone fields”.

6. Pathway Labels and Labeling System

   a) Labeling system shall consist of a hand-held portable printer
   b) Conduits: General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive. Label size shall be appropriate for the conduit size. Font size shall be legible from the finished floor.
   c) Inner duct: Polyethylene general-purpose tagging material attached using tie wraps.
   d) Junction boxes: General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive, trade name. Font size shall be easily visible from the finished floor.
   e) All labels shall be permanent, i.e. will not fade, peel, or deteriorate due to environment or time.
   f) Identification
      1) All conduits, junction boxes, gutters, and pull boxes shall have machine-generated labels easily visible from the finished floor.
      2) Conduits shall be labeled with the word “communications” and the conduit’s origination room number and destination room number.
      3) The Contractor shall label conduit at each wall and floor penetration and at each conduit termination, such as outlet boxes, pull boxes, and junction boxes, or as otherwise specified in other sections.
      4) Junction boxes, gutters and pull boxes shall be labeled with identification name or number as determined by contractor and submitted for approval.
      5) The Contractor shall label conduit sleeves at each wall and floor penetration.

E. Firestop
1. Provide approved fire-resistant materials to restore originally-designed fire-ratings to all wall, floor, and ceiling penetrations used in the distribution and installation for communications cabling system.

2. Install and seal penetrations (conduit, sleeves, slots, chases) in fire-rated barriers created for communications infrastructure to prevent the passage of smoke, fire, toxic gas, or water through the penetrations.

3. The firestopping material shall maintain/establish the fire-rated integrity of the wall/barrier that has been penetrated.

4. All through penetrations in a fire rated surface require a sleeve, regardless of penetration diameter or penetrating cable count.

5. Using a “ring and string” method of installing cabling for membrane penetrations in a wall cavity is acceptable, provided the solution was accepted by the Owner in writing. Code-compliant firestopping rules still apply.

6. Coordinate firestopping procedures and materials with General Contractor.

7. Sharing the pathway of other trades/utilities through compliant and non-compliant penetrations does not remove the requirement to maintain code-compliant firestopping.

8. Provide and install removable, intumescent mechanical systems in floor chases for all openings greater than 0’-4”.

9. Provide and install removable, intumescent, firestop bricks for all openings greater than 0’-4” where there are penetrations through walls.

10. Bricks shall be listed for insertion in fire-rated openings and require restraining materials or apparatus as needed per manufacturers’ specifications.

11. Provide manufacturer recommended material for rated protection for any given barrier.

12. Laminate and permanently affix adjacent to chases the following information:

   a) Manufacturer of firestop system.
   b) Date of installation/repair.
   c) Part and model numbers of system and all components.
   d) Name and phone numbers of local distributor and manufacturer’s corporate headquarters.

13. Solutions and shop drawings/submittals for firestop materials and systems shall be presented to the General Contractor for written approval of materials/systems prior to purchase and installation.

14. Materials shall be installed per manufacturer instructions, be UL-listed for intended use, and meet NEC and locals codes for fire stopping measures.

15. The material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and maintain the characteristics for which it is designed to allow for the removal and/or
addition of communication cables without the necessity of drilling holes in the material.

16. Develop training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.

F. Within the normal environment, the installed systems shall not generate nor be susceptible to any harmful electromagnetic emission, radiation, or induction that degrades, or obstructs any equipment.

G. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in patch panels, cross connects, and terminal strips, and space in cable pathways and backboard layouts to accommodate 20% future increase in structure cable system capacity.

H. In the event of a breach of the representations and warranties contained herein, the Contractor, at their own expense, shall take all measures necessary to make the cabling system work and comply with the applicable manufacturer written technical recommendations and standards.

I. System Tests

1. Upon completion of the installation of the communications infrastructure systems, including all pathways and grounding, the Contractor shall test the system.

   a) Cables and termination modules shall be affixed, mounted or installed to the designed/specified permanent location prior to testing.

   b) Any removal and reinstallion of any component in a circuit, including faceplates, shall require retesting of that circuit and any other disturbed or affected circuits.

   c) Approved instruments, apparatus, services, and qualified personnel shall be utilized.

   d) The Contractor must verify that the requirements of the specifications are fully met through testing with an approved tester (rated for testing parameters listed elsewhere), and documentation as specified below.

   e) This includes confirmation of requirements by demonstration, testing and inspection. Demonstration shall be provided at final walk-through in soft copy and printed test data.

2. Non-Compliant Cabling

   a) Testing that shows some or all pairs of a cable do not comply with specifications, without written approval by the Owner, shall be replaced at Contractor’s expense (including respective connectors).

   b) With the Owner’s written approval, the over-length cable(s) shall be excluded from requirements to pass standardized tests and shall be explicitly identified.

      1) Testing is still required for non-compliant cabling.
      2) The tests shall be for wire-mapping, opens, cable-pair shorts, and shorts-to-ground.
      3) The test results must be within acceptable tolerances and shall be submitted with the Owner’s acceptance document.

3. Failed Tests
a) If tests fail, Contractor shall correct as required to produce a legitimate passing test.
b) Manipulation of tester parameters on a failing test in order to achieve a passing test is unacceptable.
c) If the Contractor is found to have manipulated or falsified any failing test result to show a “PASS” for any reason (without written notice and prior approval of the Owner), the Contractor shall be required to employ a Third-Party Testing Agent selected by the Owner to retest the complete cable plant and shall be required to pay all costs associated with this retesting.

4. Owner reserves the right to be present during any or all testing.

3.3 CLEANING
A. The Contractor will clean all surfaces prior to final acceptance by Owner.

3.4 COMPLETION INSPECTION AND PUNCH LIST
A. When the Contractor determines that the Scope of Work has been completed in accordance with the plans and specifications, Contractor shall schedule a Completion Inspection with the Owner.
B. A Punch List will be generated during the Completion Inspection containing deficiencies in need of corrective action.
C. Complete all punch list deficiencies within 10 working days. The work is not complete until all punch list deficiencies have been addressed.

3.5 ACCEPTANCE
A. Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with contract documents, the Owner shall notify Contractor in writing of formal acceptance of the system.
B. Contractor must warrant in writing that 100% of the installation meets the requirements specified herein (Standards Compliance & Test Requirements).
C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation soft and hard copies as described herein.

END OF SECTION 27 00 00
PART 1 - GENERAL

1.1 SUMMARY

A. This section includes grounding and bonding products, design requirements and installation for communications systems.

B. Related Sections

1. Section 270000 Communications
2. Section 270528 Pathways for Communications Systems
3. Section 271100 Communications Equipment Room Fittings
4. Section 271500 Communications Horizontal Cabling

1.2 REFERENCES

A. The publications referenced in Section 270000 form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer’s instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts

1. Refer to Section 270000.

D. Codes and Standards

1. Refer to Section 270000.

1.3 SYSTEM REQUIREMENTS

A. General

1. All conductor wire, busbars and conduit shall be UL listed.
2. The communications ground system shall be independent from all power grounding except for the connection to the building’s electrical service main grounding electrode system.
3. Power grounding and/or bonding shall not be allowed to interfere or provide any back feed or be a conductor to the separate communications ground system source or to any communications bonded materials or equipment.

B. Telecommunications Main Grounding Busbar (TMGB) and Bonding Conductor for Telecommunications (BCT)

1. The main ground source feed for the Telecommunications Main Grounding Busbar (TMGB) in the MC (MDF) shall be an independent feed from the building’s electrical service main grounding electrode system, known as the Bonding Conductor for Telecommunications (BCT).
2. The BCT shall be a stranded copper ground wire from the building ground system to the TMGB in the MC (MDF) sized at a minimum #4/0 unless otherwise sized by the Electrical Engineer of Record.
3. The BCT connections shall be low emission exothermic welds at the connecting ends.

C. Telecommunication Bonding Backbone (TBB) and Telecommunications Grounding Busbar (TGB)
   1. The Telecommunication Bonding Backbone (TBB) originates at the TMGB and shall be extended from the TMGB within the MC (MDF) throughout the building along the same route as the telecommunications backbone pathways, to the Telecommunications Grounding Busbar(s) (TGBs) in each TR (IDF).
   2. The minimum TBB conductor size between busbars shall be a stranded copper ground wire one (1) AWG size smaller than the Bonding Conductor for Telecommunications (BCT).

D. Grounding Equalizer (GE)
   1. Whenever two or more TBBs are used in a multistory building, the TBBs shall be bonded together with a GE (by low emission exothermic welds) at the top floor and at a minimum of every third floor in between with a copper conductor equal to the gauge of the TBB.

E. TEBC and RBC
   1. All cabinets and racks shall be connected by the Telecommunications Equipment Bonding Conductor (TEBC). The TEBC is a stranded copper #4 conductor from the TMGB/TGB extending along each row of racks within the room. Bond each rack with a Rack Bonding Conductor (RBC). The RBC is a stranded copper #6 conductor connected to the vertical rack bonding terminal. All connections shall be irreversible crimp connections. Route conductor so as to minimize the quantity of sweeping bends.

1.4 SUBMITTALS
   A. Refer to Section 270000

1.5 QUALITY ASSURANCE
   A. Refer to Section 270000.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Refer to Section 270000.
   B. The Contractor shall ship on manufacturer's standard reel sizes of one continuous length. Where cut lengths are specified, mark reel quantity accordingly.

PART 2 - PRODUCTS
2.1 ACCEPTABLE MANUFACTURERS
   A. Subject to compliance with requirements, manufacturers that may be incorporated in the work, include:
B. Cable Manufacturers
   1. Houston Wire and Cable Company
   2. Okonite Company
   3. General Cable
   4. Pirelli Cable Corporation
   5. Triangle Wire and Cable
   6. Owner Approved Alternate

C. Electrical Service Entrance Bonding Conductor and Connector Manufacturers
   1. Copperweld
   2. Thomas & Betts
   3. Blackburn
   4. Owner Approved Alternate

D. Exothermic Connector Manufacturers
   1. Erico Products (Cadweld)
   2. Continental Industries (thermOweld)
   3. Harger
   4. Owner Approved Alternate

E. Crimp Connector Manufacturers
   1. Thomas & Betts
   2. FCI Burndy Electrical
   3. O-Z/Gedney
   4. Owner Approved Alternate

F. Telecommunication Grounding Busbars
   1. Chatsworth
   2. Panduit
   3. Leviton
   4. Owner Approved Alternate

G. Bonding Straps
   1. Chatsworth
   2. Harger
   3. Brundy
   4. Owner Approved Alternate

H. C-Type Compression Taps
   1. Brundy
   2. Harger
   3. Owner Approved Alternate

I. Antioxidant Joint Compound
   1. Chatsworth
2. Owner Approved Alternate

J. Labeling
   1. Refer to Section 270000.

K. Firestopping
   1. Refer to Section 270000.

2.2 MATERIALS

A. Communications Grounding Conductors: Copper American Wire Gauge (AWG) wire of the following sizes:
   1. Bonding Conductor for Telecommunications (BCT): #4/0 (unless otherwise sized by the Electrical Engineer of Record)
   2. Telecommunication Bonding Backbone (TBB): #3/0 (unless otherwise sized by the Electrical Engineer of Record)
   3. Grounding Equalizer (GE): equal AWG as the TBB (unless otherwise sized by the Electrical Engineer of Record)
   4. Telecommunications Equipment Bonding Conductor (TEBC): #4
   5. Rack Bonding Conductor (RBC): #6

B. Grounding Connectors
   1. Connectors shall be a copper alloy material and two-hole, double-crimp compression lug type at the connecting ends.

C. Telecommunications Main Ground Busbar (TMGB)
   1. Use pre-drilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors.
   2. Sized for the immediate requirements and allow for 25% growth.
   3. The minimum dimensions shall be 0'-¼" thick X 0'-4" wide X 1'-8" long.
   4. Contain (2) tiers of pre-drilled holes for use with standard sizes of two-hole copper compression lugs.
   5. ASTM-B187-C11000 Copper bar suitable for use with two-hole compression-type copper lugs.

D. Telecommunications Ground Busbar (TGB)
   1. Use pre-drilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors.
   2. Sized for the immediate requirements and allow for 25% growth.
   3. The minimum dimensions shall be 0'-¼" thick X 0'-4" wide X 0'-10" long.
   4. Contain (2) tiers of pre-drilled holes for use with standard sizes of two-hole copper compression lugs.
   5. ASTM-B187-C11000 Copper bar suitable for use with two-hole compression type copper lugs.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Refer to Section 270000

3.2 PREPARATION

A. Refer to Section 270000.

B. Copper and copper alloy connections should be cleaned prior to connection.

3.3 INSTALLATION

A. Refer to Section 270000.

B. The Contractor shall install the work in accordance with the specifications, drawings, manufacturer’s instructions and approved submittal data.

C. All work shall be supervised and reviewed by the Contractor’s on-site RCDD.

D. Installation plans and Requests For Information (RFIs) shall be reviewed by the Contractor’s RCDD.

E. General

1. Bonding and grounding procedures and components shall comply with ANSI/TIA-607-B "Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications".

2. Bonding should be accomplished such that the bonding system is integrated and compliant with NEC specifications.

3. Bonding conductors shall be routed with minimum bends or changes in direction and should be made directly to the points being bonded.

4. Bonding connections should be made by using compression copper lugs. However, for parts of the ground electrode system that are subject to corrosion, must carry high currents reliably, or for locations that require minimum maintenance, connections are made with low emission exothermic welding (see NEC Article 250).

5. Make connections to dry surfaces only.

6. Remove paint, rust, oxides, scales, grease and dirt from surfaces before making connection.

7. Burnish clean a 0’-1” X 0’-1” area, drill, tap, apply an adequate amount of antioxidant joint compound mixed for the metal surface types affected, and bolt conductor and connector to burnished and compounded area. Ensure proper conductivity.

8. Route bonding conductor(s) the shortest distance between bonding contact points.

9. The ground-wire connecting ends shall have a minimum amount of insulation removed at the ground lug.

10. Do not connect ground wire in power cable assemblies to the telecommunications ground system.

11. All grounding and bonding conductors shall be copper and may be insulated. If bare-bonding conductors are used, isolate bonding conductors and prevent contact.

12. Antioxidant material shall be installed to separate dissimilar metals and prevent corrosion.
13. If multiple systems are involved (lightning protection systems, communications, radio and TV, CATV, etc.), those systems shall be bonded together to minimize potential differences between the systems, per NEC 250.94.

F. Telecommunication Bonding Conductors

1. Each telecommunications grounding and bonding conductor shall be labeled at each end detailing the function and room number of its opposite end. Labels shall be located on conductors as close as practicable to their point of termination in a readable position. Labels shall be nonmetallic and include the following text, “TELECOMMUNICATIONS GROUND - DO NOT REMOVE. IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER”.

2. Furnish and install all required bonding material, hardware, and utilize tools manufactured for this purpose.

3. The connections of the BCT, TBB, GE, TEBC, and RBC shall be made using low emission exothermic welding or hydraulically crimped with a double crimp connector. Two-hole grounding lugs are preferred for connection to the grounding bus bars.

   a) All low emission exothermic welding shall be by Division 26.

   b) Coordinate with the building services personnel in occupied spaces to prevent the smoke from the exothermic weld process from potentially setting off smoke/fire alarms.

4. Grounding and bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place grounding and bonding conductors in a ferrous metallic conduit that exceeds 1m (3ft) in length, the conductors shall be bonded to each end of the conduit using a grounding bushing or a No. 6AWG conductor, minimum.

5. The bonding conductors should be installed without splices.

   a) Where splices are necessary, the number of splices should be minimized, be accessible, and be located within the telecommunications spaces.

   b) Joined segments of a bonding conductor shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent. All joints shall be adequately supported and protected from damage.

G. Equipment Cabinets and Racks

1. The busbar shall be installed at the base and back of each cabinet/rack for floor fed cabinets/racks.

2. The busbar shall be installed at the top and back of each cabinet/rack for top fed cabinets/racks.

3. Each cabinet and rack shall be provided with a minimum # 6 AWG ground wire.

4. Do not loop from cabinet/rack to cabinet/rack.

5. Each cabinet or rack bay against the wall shall be bottom/side ground fed from the wall.

   a) Wall ground feeds/raceways to racks shall not be exposed on the walls.

   b) Exception: Some cabinet or rack bays will require the ground to be fed from the ceiling raceway.
6. All ground raceways within each cabinet/rack or cabinet base and adjacent-ganged cabinet base shall be an insulated metallic flex type raceway and shall not interfere with equipment mounting frames or equipment mounting brackets.

H. Cable Runway, Cable Raceway and Support System Grounding

1. The Contractor shall provide communications cable tray and cable runway systems with a communications dedicated ground from the TGB.
2. All cable tray needs to be electrically continuous per NEC 250.96.
   a) Metal raceways, wire-mesh cable trays, cable armor, cable sheath, enclosures, frames, fittings, and other metal non-current-carrying parts that are to serve as an alternate grounding path, with or without the use of supplementary equipment grounding conductors, shall be effectively bonded where necessary to ensure electrical continuity and the capacity to conduct safely any fault current plausibly to be imposed on them.
   b) Any nonconductive paint, enamel, or similar coating shall be removed at the threads, contact points, and contact surfaces.
   c) Grounding or bonding conductors shall be connected by fittings designed for that purpose to ensure adequate bonding.
3. The Contractor shall provide and install a #6 AWG ground wire to bond one end of each cable tray/runway system to the TGB.
4. For electrically non-continuous conduits that contain only grounding conductor, the Contractor shall bond the conduit and conductor together at both ends to ground to the nearest TGB with grounding bushings or ground clamps.

I. Shielded Backbone Cabling

1. The Contractor shall terminate and bond the shield to the nearest TGB or TMGB at both ends, following manufacturer’s guidelines.

3.4 FIELD QUALITY CONTROL

A. Testing

1. Upon completion of the electrical system, including all grounding, the Electrical Contractor shall test the system for stray currents, ground shorts, etc.
2. Approved instruments, apparatus, services, and qualified personnel shall be utilized.
3. If stray currents, shorts, etc., are detected, eliminate or correct as required.

END OF SECTION 27 05 26
SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Hangers and Supports, including open-top supports (cable hooks) for communications systems.
2. Conduits and Pull Boxes for communications systems.
3. Cable Tray and Cable Runway with associated accessories and fittings for communications systems.

B. Related Sections

1. Section 270000 Communications Systems
2. Section 270526 Grounding and Bonding for Communications Systems
3. Section 271100 Communications Equipment Room Fittings
4. Section 271500 Communications Horizontal Cabling

1.2 REFERENCES

A. The publications referenced in Section 270000 form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer’s instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts

1. Refer to Section 270000.

D. Codes and Standards

1. Refer to Section 270000.

1.3 SUBMITTALS

A. Refer to Section 270000.

1.4 QUALITY ASSURANCE

A. Refer to Section 270000.

1.5 DELIVERY, STORAGE, and HANDLING

A. Refer to Section 270000.

B. Conduit Storage

1. Package conduits in bundles maximum 10’-0” long, with conduit and coupling thread protectors for indoor/outdoor storage.
2. Package fittings in manufacturer's standard quantities and packaging suitable for indoor storage.
3. Protect coating on plastic-coated rigid conduit, fittings, and bodies from damage during shipment and storage.
4. Store conduit above ground on horizontal racks to prevent corrosion and entrance of debris.
5. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants. Protect plastic conduit and inner duct from sunlight. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers that may be incorporated in the work, include:

B. Cable Hooks

1. Cooper B-Line, Inc.
2. Erico
3. Caddy
4. Arlington
5. Owner approved alternate

C. Basket Type Cable Tray (for use in work areas)

1. Eaton B-Line Flextray
2. Cablofil EZ Tray
3. Owner approved alternate

D. Wire Basket Cable Tray Cutting Tool

1. Eaton B-line
2. Cablofil EZ Tray
3. Owner approved alternate

E. Polyethylene Cable Support System

1. Erico
2. Owner approved alternate

F. Innerduct

1. Carlon Riser Guard Flexible Raceway (corrugated innerduct)
2. Maxcell Fabric Innerduct
3. Owner approved alternate

G. Measured pull tape (pull tape printed with sequential footage markings)
1. Fibertek
2. Condux International
3. Owner approved alternate

H. Labeling
1. Refer to Section 270000.

I. Firestopping
1. Refer to Section 270000.

2.2 CABLE HOOKS

A. Cable hooks shall be factory assembled for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions.

B. Features
1. Cable hooks shall have a flat bottom and provide a minimum of 0’-1.625” cable-bearing surface.
2. Cable hooks shall have 90° radius edges to prevent damage while installing cables.
3. Cable hooks shall be designed so that the mounting hardware is recessed to prevent cable damage.
4. Cable hooks for non-corrosive areas shall be pre-galvanized steel. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish.
5. Cable hooks for corrosive areas shall be stainless steel.
6. Cable hooks shall have a stainless steel cable latch retainer to provide containment of cables within the hook.
7. The retainer shall be removable and reusable.

C. Factory assembled multi-tiered cable hooks shall be used where required to provide separate cabling compartments, or where additional capacity is needed.

D. Load cable hooks in accordance with manufacturer requirements and recommendations.

E. Provide capacity for 25% growth, add additional hooks as needed.

2.3 PULL BOXES, JUNCTION BOXES, AND GUTTERS

A. All junction boxes, gutters and pull boxes shall be UL listed and comply with NEC requirements.

B. All junction boxes, gutters and pull boxes shall meet the following minimum material requirements:
1. 16-gauge steel or heavier
2. Seams shall be continuously welded and grounded smooth
3. External screws and clamps
4. External mounting feet (where applicable)
5. Oil-resistant gasket and adhesive
6. ANSI 61 gray polyester powder coating inside and out over phosphatized surface
C. All junction boxes, gutters and pull boxes shall be provided with bushings for conduits and/or cabling.

D. All junction boxes, gutters and pull boxes shall be securely installed.

2.4 CONDUITS

A. All conduits shall be UL listed and comply with NEC requirements.

B. Conduit Fittings

1. All fittings shall be compression or threaded.
2. Fittings shall provide a secure connection for pulling communications cables.
3. Setscrew fittings are not permitted.
4. Conduit “condulets” are not permitted.

C. Non-metallic conduits are not permitted in above ground installations. Conversion fittings are required for non-metallic (below ground) to metallic (above ground) transitions.

D. Innerduct:

1. All fiber shall be installed in innerduct unless fiber cabling is armored.
2. Shall be constructed of non-metallic material.

E. Only manufacturer’s fittings, transition adapters, terminators and fixed bends shall be used.

F. Measured Pull Tape

1. Pre-lubricated, woven polyester, low friction, and high abrasion resistant yarn with footage markers printed on the tape.
2. Minimum average tensile strength shall be 1130 lbs. for 0’-1.5” and smaller conduits and innerduct.
3. Minimum average tensile strength shall be 1800 lbs. for conduits larger than 0’-1.5”.

G. Fill and Bend Radius

1. Conduit fill shall comply with NEC requirements.
2. The minimum bend radius is 6 X the conduit inside diameter (ID) for 0’-2” conduit or less.
3. The minimum bend radius is 10 X the conduit ID for a conduit greater than 0’-2”.
4. There shall be no more than two 90° bends (180° total) between conduit pull boxes.
5. Changes in direction shall be accomplished with sweeping bends observing minimum bend radius requirements above.
6. Do not use pull boxes for direction changes unless specifically designated otherwise in the drawings.
7. Unless otherwise noted in the drawings, conduits entering pull boxes shall be aligned with exiting conduits.

H. Routing

1. Conduits shall be routed in the most direct route possible, with the fewest number of bends possible.
2. There shall be no continuous conduit sections longer than 100’-0” for premises conduits. For runs that total more than 100’-0”, insert junction or pull boxes so that no continuous run between pull boxes is greater than 100’-0”.

I. Penetrations

1. All conduit penetrations shall comply with all applicable fire codes.
2. All conduit penetrations in fire-rated walls or floors shall be sealed and fire-proofed to meet or exceed the designed rating of the penetration area.

2.5 CABLE TRAY

A. Cable tray systems are defined to include, but are not limited to, straight sections of cable trays, bends, tees, elbows, reducers, crosses, wyes, vertical bends, up/down tees, cable support fittings, drop-outs, supports and accessories.

B. Install all tray types utilizing manufacturer recommended installation instructions and applicable standards.

C. Load cable tray and cable runway in accordance with manufacturer requirements and applicable standards.

D. Cable Tray Materials

1. Aluminum
2. Pre-galvanized Steel
3. Hot-dip Galvanized Steel
4. Stainless Steel
5. Yellow Zinc Dichromate
6. Pre-Galvanized Zinc
7. Electro-Galvanized Zinc

E. Cable Tray Systems

1. Wire basket (mesh) of types and sizes indicated on the drawings; with connector assemblies, clamp assemblies, connector plates, splice plates, cable drop outs, bonding accessories, and splice bars. Construct units with rounded edges and smooth surfaces.

2. Continuous mesh polyethylene cable-support system: with connector assemblies and appropriate support components. All parts shall be UL-listed. Plastic (non-metallic) parts shall have a zero detectable halogen content as substantiated by an independent test laboratory.

3. Ladder type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs shall be spaced 0’-9” on center. Spacing in radius fittings shall be 0’-9” as measured at the center of the tray's width. Rungs shall have a minimum cable-bearing surface of 0’-.875” with radius edges. No portion of the rungs shall protrude below the bottom plane of the side rails.

4. Ventilated trough type trays shall consist of two longitudinal members (side rails) with a corrugated bottom welded to the side rails.

5. Solid bottom trough type trays shall consist of two longitudinal members welded to the side rails.
F. Cable trays shall have sufficient depth and width so as not to exceed a maximum 50% fill ratio, including 25% capacity for anticipated growth.

G. All straight sections shall be supplied in minimum 8'-0" lengths, except where shorter lengths are permitted to facilitate tray assembly lengths.

2.6 HANGERS AND SUPPORT

A. Steel support brackets shall be galvanized steel and capable of supporting a minimum of 200 lbs with a safety factor of 3.

B. Steel support brackets shall have a removable galvanized steel retaining strap.

C. Steel support brackets shall accept 0'-3/8" (10mm) threaded rod for attachment to building structure or sub structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Refer to Section 270000.

3.2 PREPARATION

A. Refer to Section 270000.

B. Verify system is properly sized for cables before installation.

C. Verify that the manufacturer recommended loads are not exceeded.

D. Verify general routing and coordinate locations with other trades before installation. Layout cable runs in advance to determine quantities of cable to be installed along pathways, and to ensure non-interference from other trade installations.

3.3 INSTALLATION

A. Refer to Section 270000.

B. Cable Hooks

1. Provide cable hook (j-hook) cable support system for horizontal and/or riser cabling in accessible ceiling space. Assemblies shall be complete with mounting hardware.

2. Provide threaded rod for supporting hangers when hanging from floor deck and deck members.

3. Follow manufacturers fill capacities.

4. Locate cable hooks on 4’ to 5’ centers to adequately support and distribute the cable’s weight.

5. Suspended cables shall be installed with at least 0’-3” of clear vertical space above the ceiling tiles and support channels.

6. For larger quantities of cables, provide special supports that are specifically designed to support the required cable weight and volume.

7. Do not support pathways or cables with the ceiling suspension system or use electrical, plumbing, or other pipes for support.
8. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment 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.
9. Secure and support exposed horizontal cable at intervals not exceeding 5’-0” and not less than 1’-4” (16”) from cabinets, pack pole, boxes, fittings, outlets, racks, frames, and terminals.
10. Cable sag between vertical supports for horizontal pathway shall not exceed 0’-6”. Provide at least 0’-3” cable sag between supports.
11. Painted J-hooks shall meet or exceed NEC requirements for the environment in which the product is installed.

C. Conduit and Pull Boxes

1. The Contractor shall route the conduit in approximate locations unless drawing is dimensioned for precise placement.
2. Conduit cuts shall be square. Ream ends of burrs, and remove metal shavings and cutting lubricants before conduit is connected to the conduit system.
3. For conduit embedded in concrete, coat threaded connections in conduits with colloidal rust and corrosion inhibitor and sealant. Conduit must be clean and dry and must pass standard sizing test after concrete is poured.
4. Cap unused conduits with watertight caps.
5. Make conduit connections with appropriate fittings and tighten securely.
6. Use appropriate tools to install PVC coated conduit; avoid damage to exterior coating.
7. Install liquid-tight flexible metal conduit where exposed to weather, water, or other liquids.
8. Use IMC, PVC conduit, or rigid galvanized steel conduit in underground installations.
9. The Contractor shall provide fabric innerduct in all underground conduits, as indicated on the drawings.
   a) The Contractor shall use pre-lubricated, woven polyester, low friction, and high abrasion resistant fabric.
   b) The Contractor shall be trained for proper installation technique by the innerduct manufacturer. The Contractor shall coordinate with the owner to demonstrate that pull ropes in each inner duct cell move freely from end to end.

D. Cable Tray and Cable Runway

1. Cut wire basket tray members square with approved cable tray cutting tool as to not leave sharp edges at cut point. Remove burrs and smooth the ends before the cut is connected to wire-mesh tray system.
2. Ensure that standard splices are designed to have less than 1 milliohm (0.0001 Ω) of resistance between connections and provide bonding between sections. Painted wire mesh tray requires the outer mask of the non-conductive surface be removed at each end of the tray prior to installing the splice to provide continuity between painted tray sections.
3. Threaded rod (minimum 0’-½” diameter) or equivalent and slotted channel shall be used for hanging cable tray between floor deck and deck members.

E. Fiber Support:
1. Support vertical fiber optic cable with basket weave wire/cable grips. Support fiber riser with single weave support grip with a single offset eye.

2. Mount/attach pulling eye to a wall or ceiling deck secured hook to support/provide strain relief to riser cable. Provide a minimum 3’-0” loop of fiber prior to entering fire stopped floor sleeve.

3. Where required coil up slack fiber cable into pull box and secure with single weave support grip.

F. Clearances

1. A minimum of 1’-0” access headroom shall be provided above a cable tray. Ensure that other building components do not restrict access to the cable trays from the sides.

2. Power outlets shall not be installed in or mounted to cable tray or cable runway.

3. Provide 3’-0” of unencumbered space for every 10’-0” segment of tray.

4. Cable tray clearances

   a) Motors or transformers: 4’-0”
   b) Power cables and conduit: 1’-0”
   c) Fluorescent lighting: 0’-5”
   d) Halide lights: 1’-0”
   e) Above the ceiling tiles: 0’-3”
   f) Access above and on one side of the cable tray: 1’-0”

3.4 FIELD QUALITY CONTROL

A. Test system to ensure electrical continuity of bonding and grounding connections.

B. Ensure compliance with specified maximum ground resistance.

C. Refer to NFPA 70B Chapter 18 for testing and test methods.

3.5 CLEANING

A. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.

B. Wipe clean all cable trays and apply appropriate manufacturer’s paint to areas that have been scratched.

END OF SECTION 27 05 48
SECTION 27 05 43 – UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes underground communications duct banks, hand-holes and maintenance holes

B. Related Sections

1. Section 260000 Electrical (including related sub-sections)
2. Section 270000 Communications Systems
3. Section 270526 Grounding and Bonding for Communications Systems
4. Section 270528 Pathways for Communications
5. Section 271100 Communications Equipment Room Fittings
6. Section 271300 Communications Backbone Cabling
7. Section 271500 Communications Horizontal Cabling
8. Section 274133 Master Antenna Television Systems
9. Section 280000 Electronic Security (including related sub-sections)

1.2 REFERENCES

A. Refer to section 270000

B. Conflicts

1. Refer to section 270000

C. Codes and Standards (Most recent editions or as required in contract)

1. National Electrical Manufacturers Association (NEMA)
   a) RN1 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Electrical metallic Tubing
   b) TC2 Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
   c) TC3 PVC Fittings for Use with Rigid PVC conduit and tubing

2. Underwriters Laboratories (UL)
   a) 651 Schedule 40 and 80 Rigid PVC conduit
   b) 651A Type EB and A Rigid PVC Conduit and HDPE Conduit

3. ANSI/TIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces


5. BICSI Telecommunications Distribution Methods Manual (TDMM)

6. Standard for Riser Application for Optical Fiber Raceway

7. BICSI Customer Owned Outside Plant (CO-OSP) Design Manual

8. Local, county, state and federal regulations and codes in effect as of date of installation

   a) It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

D. Related Documents

1. Refer to section 270000

1.3 SUBMITTALS

A. Refer to section 270000

1.4 QUALITY ASSURANCE

A. Refer to section 270000, and ANSI/IEEE C2-2007
B. Follow Annex B of National Electrical Code (NEC)
C. Items of the same classification shall be identical. This requirement includes equipment, assemblies, parts, and components.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped.

1. Store nonmetallic ducts with supports to prevent bending, warping, and deforming
B. The contractor shall endeavor to make the site ready for installation of manholes when delivered so that they can be placed off of the truck into final position.

1. When this is not possible, store precast concrete and other factory-fabricate underground utility structures as Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
C. Lift and support precast concrete units only at designated lifting or supporting points.
D. Clearly mark containers "For Communications Duct Banks Only".
E. Refer also to section 270000

1.6 WARRANTY

A. Refer to section IEEE C2
B. Refer also to section 270000

1.7 MAINTENANCE

A. Refer to section IEEE C2
B. Refer also to section 270000

PART 2 - PRODUCTS

2.1 ACCEPTIBLE MANUFACTURERS

A. Ducts

1. Use owner approved solution

B. Hand Holes

1. Christy Concrete Products
2. Cretex Concrete Products West, Inc.; Riverton Division
3. Oldcastle Precast Group
4. Oldcastle Precast Inc.; Utility Vault Division
5. Utility Concrete Products, LLC
6. Owner Approved equivalent
C. Maintenance (Man) Holes

1. Christy Concrete Products
2. Cretex Concrete Products West, Inc.; Riverton Division
3. Oldcastle Precast Group
4. Oldcastle Precast Inc/; Utility Vault Division
5. Utility Concrete Products, LLC
6. Owner Approved equivalent

2.2 MATERIALS

A. Continuous Tape for Underground Conduit
   1. The Contractor shall use orange warning ribbon, PVC tape (detectable, i.e., containing metallic tracings), three inches wide, permanently imprinted with "CAUTION--BURIED COMMUNICATIONS LINE BELOW" in black letters, minimum 0'-1” high.

B. Labeling
   1. Refer to section 270000

C. Firestopping
   1. Refer to section 270000

PART 3 - EXECUTION

3.1 EXAMINATION

A. Where necessary, Contractor shall provide all excavation, boring, trenching, backfill and restoration of grounds for all OSP pathways.
   1. In addition, Contractor shall include all labor, materials, and equipment.

B. The owner of the property has the option to obtain a testing laboratory to ensure proper soil compaction.

C. All work shall comply with all city, county and State Codes, NEC, EIA/TIA, OSHA, and BICSI TDMM requirements, codes and standards.

D. The above referenced codes and standards are to be considered as a minimum requirement.
   1. If the plans or specifications call for material and/or methods of construction higher than the standard, the plans or specification shall govern.

E. All holes, trenches and/or any other excavation shall be covered, fenced, and/or taped off to make the area safe at all times.
   1. Conform to general Contractor requirements.

F. The Contractor will visit the job site prior to submitting a proposal to determine existing conditions.
   1. Contractor shall evaluate the site for materials, and any other information that may affect the work to be performed.

G. The Contractor shall locate and protect all existing conduits.
   1. Should damage occur notify the appropriate utility.
2. Damage costs are the responsibility of the Contractor.

H. The Contractor shall CALL BEFORE YOU DIG, One Call Directory Telephone Numbers (Texas: 1-800-245-4545, 1-800-344-8377) to locate any existing conduits (Power, Gas, Telephone, and other utilities) prior to start of work.

I. Any proposed re-routing of all trenches/pole lines shall be reviewed and approved by the owner/consultant.

3.2 PREPARATION

A. Refer to Section 270000

B. The Contractor shall verify materials are on-site in proper condition and of sufficient quantity.

C. The Contractor shall verify proper excavation depth (minimum 4’-0” below finished grade), width, route and support of work.

1. Verify proper location of hand-holes and maintenance holes (minimum every 350’-0”).

2. Communications facilities must be placed in separate hand-holes and maintenance holes from electrical facilities.

D. Trenches greater than or equal to 5’-0” deep shall:

1. Be shored to prevent cave-in.

2. Have 2’-0” clearance from the dirt pile.

E. Directional boring is a suitable option when trenching is impractical or impossible.

1. Locating existing underground utilities is crucial when directional boring is planned because of the potential for the drilling unit to encounter high voltages.

2. Although directional boring machines are manufactured with electrical strike sensing capabilities, which can warn the operator of any contact with a high voltage source, accidents may still occur.

3. Operators of directional boring machines require special protection due to the potential for exposure to high voltage.

   a) Therefore, operators must always have a ground mat grid underfoot as insulation protection.

   b) In addition, operators must wear insulating boots and gloves, along with hard hats and safety glasses.

F. Minimum separation between electrical and communications underground cable (measured from conduit sidewall):

1. Concrete: 0’-3”

2. Masonry: 0’-4”

3. Well-tamped earth: 1’-0”

G. Before encasement, the Contractor shall:

1. Prove and verify all ducts are free of debris and properly installed in support and spacer system.

2. Verify the system is properly fitted together and hold-down hardware is properly installed.

3. Verify ducts are capped at both ends
3.3 INSTALLATION

A. Refer to section 270000

B. Hand Holes

1. Unless otherwise shown, Hand-holes shall be at least 4'-0" X 4'-0" and shall be constructed of 0'-2" thick cement covered with 0'-3/8" steel plate.
2. The hand-hole or maintenance hole shall rest on a 0'-4" blanket of sand, and 0'-4" around the sidewalls shall be filled with sand.
3. Each hand-hole or maintenance hole which contains a pedestal shall have four bollards installed 1'-6" (18") diagonally from each corner, with a cross member welded at 2'-6" (30") connecting the four corners.
   a) These barriers will be constructed of 0'-4" ridged conduit filled with concrete, driven 4'-0" in the ground and extending 3'-0" above the protective cover.
4. All Hand-holes shall have a hasp and locking plate installed so they can be locked with padlock.

C. Maintenance (Man) Holes

1. Precast concrete maintenance hole components shall be in accordance with ASTM C 478.
2. Maintenance hole components shall be designed for H-20 highway wheel loading and specific site conditions.
3. Maintenance hole bases may be either precast or cast-in-place, as appropriate for the application, with a formed recess shaped to match the first precast shaft section.
   a) The maintenance hole base shall extend 0'-10" below the bottom of the lowest pipe and 0'-6" above the top of the largest pipe.
4. Maintenance hole shafts shall be fabricated only from precast shaft sections, eccentric cone sections and grade rings.
5. Precast maintenance holes shall utilize either an integrally cast embedded pipe connector, or a boot-type connector installed in a circular block out opening in accordance with ASTM C 923.
   a) Connections to existing maintenance holes shall utilize a boot-type connector per ATSM C 923 installed in a cored opening.
   b) Cast-in-place bases shall incorporate a ring-type seal on the pipe to be imbedded in the concrete.

D. Concrete and Reinforcing Steel for Encasement

1. Furnish products following Division 03, except strengths as follows:
   a) Compressive Strength: 2500 psi at 28 days, class A
   b) Flexural Strength: 500 psi at 28 days
   c) Dye concrete encasement “orange” to identify communications conduit

E. The Contractor shall install conduit in excavations following drawings.

1. If directional boring is utilized, cable or flexible conduits can be attached to the unit and pulled back to the origination point (after the drilling unit reaches its destination).

F. The Contractor shall install watertight penetrations through foundation, hand-hole and maintenance-hole walls.
1. Wherever a hand-hole is used to simply pass through, the conduit entrances and exits will be situated at opposite ends of the hand-hole instead of 90° angles.

G. The Contractor shall assemble duct banks with non-magnetic saddles, spacers and separators.

1. Position separators for 0'-2" minimum concrete separation between outer surfaces of adjacent ducts, and:
   a) Make uniform required bends with a minimum 2'-0" radius for conduits less than 0'-3" diameter, and a minimum 4'-0" radius for conduits 0'-3" and larger.
   b) Maintain vertical or horizontal separations of 1'-0" of well-packed topsoil from any electrical service conduit run parallel to communications conduits.

H. Install concrete encasement fully surrounding reinforcing steel and ducts

I. Unless otherwise noted on the drawings, reinforce with longitudinal #5 steel bars placed at each corner and along each face at maximum parallel spacing of 1'-0" on center, and #5 tie-bars transversely placed at 1'-0" on center maximum longitudinal.

1. Maintain maximum clearance of 0'-2" from bars to edge of forms and ducts.

J. For duct banks that are being installed for future use, extend rebar well past end of concrete for future tie-in to future concrete pour to ensure that both sections are firmly tied together to prevent slippage between the two pours.

K. Add orange colorants at mixing site at the rate of 10 lbs per cubic yard for voice and data cable.

L. Place concrete with minimum 0'-2" cover surrounding ducts and reinforcement.

M. Maintain ducts in proper place during concrete placement.

N. For duct banks that are being installed for future use, all conduits shall be extended minimum of 1'-0" past the end of the concrete and capped.

O. Transition from nonmetallic to metallic conduit where duct banks enter structures or turn upward for continuation above grade

1. Where ducts enter structures such as hand-holes, maintenance holes, pull boxes, or buildings, terminate ducts in proper end bells, insulated L-bushings, Meyers hubs or couplings on steel conduits.
   2. Ducts shall be sealed to prevent water and debris from entering the building.

P. Extend below grade conduits to 0'-4" above the finished floor inside a building.

1. Cover or temporarily seal open conduit ends to prevent water and other foreign matter from entering conduit.

Q. Tag conduits entering pull boxes with stamped stainless steel tags following cable and conduit schedule.

R. Backfill after concrete cures 24 hours.

S. The Contractor shall pull a 1'-0" long mandrel (0'-¼" smaller than duct diameter) through ducts.

1. Pull a rag swab or sponge through to remove debris, until it shows clean.

T. Where fiber optic cables will be used and/or where indicated in the drawings, innerduct shall be provided.
U. The Contractor shall provide a metered pull tape in all underground conduits and innerduct:

1. Pre-lubricated, woven polyester, low friction, and high abrasion resistant yarn.
2. Minimum average tensile strength shall be 1130 lbs for 0’-1.5” and smaller conduits and innerduct.
3. Minimum average tensile strength shall be 1800 lbs for conduits larger than 0’-1.5”.

3.4 CLEANING
   A. Refer to section 27 00 00

END OF SECTION 27 05 43
SECTION 27 11 00 - COMMUNICATIONS ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes basic communications and equipment room design requirements and fittings including:
   1. Equipment cabinets, racks, frames and enclosures
   2. Cable management and ladder racks
   3. Telecommunications service entrance pathways
   4. Rack mounted power protection and power strips

B. Related Sections
   1. Section 270000 Communications
   2. Section 270526 Grounding and Bonding for Communications Systems
   3. Section 270528 Pathways for Communications
   4. Section 271500 Communications Horizontal Cabling

1.2 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer’s instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts
   1. Refer to section 270000

D. Codes and Standards (Most recent editions or as required in contract)
   1. ANSI/TIA-568-C: Commercial Building Telecommunications Wiring Standard
   2. ANSI/TIA-569-B: Commercial Building Standard for Telecommunications Pathways and Spaces
   3. ANSI/TIA-606-A: Administration Standard for Commercial Telecommunications Infrastructure
   4. ANSI/NECA/BICSI-607-A: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
   5. TIA-758-A: Customer-Owned Outside Plant Telecommunications Infrastructure Standard
   6. National Electrical Code (NEC), based upon year approval by local codes or AHJ
   7. BICSI Telecommunications Distribution Methods Manual (TDMM)
   8. Local, county, state and federal regulations and codes in effect as of date of purchase
   9. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.3 COMMUNICATIONS ROOMS

A. Communications rooms must be dedicated to designated equipment and services:
   1. Space shall not be used for storage of equipment not related to designated equipment and services.
2. Hazardous or corrosive materials shall not be stored in the space.
3. Piping, ductwork and distribution of power, not related to designated equipment and services shall not pass through or be located within the space.
   a) Foreign piping such as water pipes, steam pipes, soil pipes, sanitary drains, storm drains, A/C ducts, and other unrelated systems utilized for or containing liquids, or gases shall not be installed or pass through communication rooms.
   b) With the exception of fire sprinklers, all water pipes shall be routed around communications room.

B. Each communication room shall be equipped with fire detection, fire-extinguishing system and prevention devices. Connect detection devices to base building fire alarm system. A minimum of one (1) smoke detector shall be installed in each communications room.

C. Walls shall be covered with 0’-¾” X 4’-0” X 8’-0” AC-grade plywood backboard 1’-0” AFF (smooth side to interior of room mounted vertically), capable of supporting mounted hardware and equipment.
   1. Plywood shall be affixed to the studs in the walls with screws that penetrate the studs a minimum of 0’-1”, are spaced not greater than 1’-6” (18”) apart in each stud, and with screws 0’-0” from the top and bottom of plywood.
   2. Plywood shall be sealed against the wall and painted on all exposed sides with two coats of flat white non-reflective paint.
   3. If applicable fire-treatment verification stamps on plywood shall be left unpainted to be readable.

D. Communications room walls shall extend from floor slab to ceiling deck, with no drop ceilings installed.

E. Cable tray or ladder rack should be used to distribute cables between rooms through finished wall penetrations.

F. Cable ladder rack should be used to distribute cables within rooms, complete with cable bend limiters (drop outs).

G. To reduce static, floors should not have carpet, but be sealed concrete to prevent concrete dust from forming.

H. Communications rooms shall have only one lockable entrance door, a minimum of 3’-0” wide and 7’-0” high, that opens towards the outside of the room, and does not open into another room.
   1. Doors shall be provided with a lockset for the appropriate technology key with pinned hinges and anti-pry guards.
   2. Doors should have no windows or door seals.
   3. Communications rooms should have no exterior identifying markings.

I. Mechanical
   1. Install monitoring sensors with dedicated environmental controls operating 24 hours a day, 365 days a year in the communications rooms.
   2. Provide ventilation in the communications rooms to dissipate heat generated by active devices.
   3. Temperature and Humidity requirements:
      a) Maintain communication rooms at an average of 60°F to 70°F, with a relative non-condensing humidity of 30% to 50%.
b) The temperature range should be maintained within ± 9°

J. Plumbing
1. If “wet” fire suppression is used, install wire cages on sprinkler heads to prevent accidental operation.
2. Do not place sprinkler heads over equipment or cabling. In the event of a leak this will protect the equipment and cabling.
3. Drainage troughs are also recommended for leakage protection.

K. Electrical
1. One manufacturer’s product is recommended for each type of installation. The mixing of different manufacturer products for one item is not acceptable.
2. No electrical feeders/branch circuits shall be placed in or run through any communications room except as required to service those rooms.
3. The Contractor shall install a slot (a UL-approved fire-rated assembly) to accommodate cable runway entry from corridor and a fire-retardant system (bricks, boards, mechanical, etc). The formed slot shall have no burrs or sharp edges. This opening in the wall will be used to pass data and voice cabling from the corridor cable tray into the communications room.
4. The Contractor shall provide uniform illumination of at least 50 foot-candles (fc) 3'-0” AFF for communications rooms located a minimum of 8’-6” AFF.
   a) Light fixtures in communications rooms are to be positioned for maximum lighting. Do not install over cable tray, ladder rack, or 1’-7” (19”) standing racks.
   b) Provide enough power receptacles to support equipment and service. Coordinate power requirements of active equipment with electrical designer.

L. Relay Racks
1. 1’-7” (19”) X 7’-0” relay racks are to be used for mounting and termination of inter-building and intra-building fiber optic/ copper cables and components.
   a) The racks shall have adequate horizontal and vertical cable management for the 8P8C patch panels and switches.
   b) Racks with active electronics shall have rack mounted power strips.

1.4 SUBMITTALS
A. Refer to section 270000

1.5 QUALITY ASSURANCE
A. Refer to section 270000
B. Product Standards
1. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer’s latest standard design in satisfactory use for at least one year prior to bid opening.
2. Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Refer to section 270000
B. Coordinate layout and installation of equipment with owner's communications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1.7 PROJECT/SITE CONDITIONS
A. Refer to section 270000

1.8 WARRANTY
A. Refer to section 270000
B. At the start of the project, contractor shall register the project with the manufacturer to help insure and facilitate manufacturer’s warranty process.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. 1'-7” (19”) x 7” Floor-Mounted 4-post Equipment Racks (IDF)
   1. Chatsworth (CPI #55053-703)
   2. Owner approved equivalent

B. Floor-Mounted Equipment Cabinets (MDF)
   1. APC (NetShelter SX 45U 750mm Wide x 1070mm Deep Enclosure with sides black)
   2. Owner approved equivalent

C. Horizontal Runway and Support Components (ladder tray in MDF/IDF)
   1. Chatsworth (CPI #10250-7**, **: cable tray width)
   2. Owner approved equivalent

D. Horizontal Rack-Mount Cable Management
   1. Chatsworth (CPI, 1RU #30139-719, 2RU #30130-719)
   2. Owner approved equivalent

E. Vertical Rack-Mount Cable Management
   1. Chatsworth (CPI CCS, #30162-703; 7'-0”H x 6”W, #30163-703; 7'-0”H x 10”W)
   2. Owner approved equivalent

F. Labeling
   1. Refer to section 270000

G. Firestopping
   1. Refer to section 270000

2.2 ACCESSORIES
A. Rack-mounted Uninterruptible Power Supply (UPS)
   1. Owner furnished owner installed.

B. Rack-mounted Power Strips
   1. Owner furnished owner installed.
PART 3 - EXECUTION

3.1 EXAMINATION
   A. Refer to Section 270000

3.2 PREPARATION
   A. Refer to section 270000
   B. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
   C. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
   D. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.3 INSTALLATION
   A. Refer to section 270000

3.4 FIELD QUALITY CONTROL
   A. Refer to section 270000

3.5 CLEANING
   A. Refer to section 270000

3.6 ACCEPTANCE
   A. Refer to section 270000

END OF SECTION 27 11 00
PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the backbone cabling portion of a structured cabling system including:
   1. Copper backbone cabling
   2. Fiber backbone cabling
   3. Splicing
   4. Termination and patch cables

B. Provide all backbone cabling, terminating hardware, adapters, and cross-connecting hardware necessary to interconnect all system equipment including equipment located in Communications rooms.

C. Provide one (1) 48-strand OM4 MM fiber and one (1) Cat3 voice cables from MDF(server room) to each IDF. All plenum rated.

D. Provide one (1) 144-strand OM4 MM, one (1) 48-strand OS2 SM fiber, and one (1) 200-pair Cat3 from IT Demarc to MDF (server room). All plenum rated.

E. Provide one (1) 48-strand OM4 MM and one (1) 25-pair Cat3 from Annex IDF room to main building IT Demarc room. All OSP rated.

F. Related Sections
   1. Section 260000 Electrical (including related sub-sections)
   2. Section 270000 Communications
   3. Section 270526 Grounding and Bonding for Communications Systems
   4. Section 270528 Pathways for Communications
   5. Section 270543 Underground Ducts and Raceways for Communications Systems
   6. Section 271100 Communications Equipment Room Fittings
   7. Section 271500 Communications Horizontal Cabling
   8. Section 280000 Electronic Security (including related sub-sections)

1.2 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer’s instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts
   1. Refer to section 270000

D. Codes and Standards (Most recent editions or as required in contract)
   1. ANSI/TIA-568-C: Commercial Building Telecommunications Wiring Standard
   2. ANSI/TIA-569-B: Commercial Building Standard for Telecommunications Pathways and Spaces
   3. ANSI/TIA-606-A: Administration Standard for Commercial Telecommunications Infrastructure
   4. ANSI/NECA/BICSI-607-A: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
5. TIA/EIA-758-A: Customer-Owned Outside Plant Telecommunications Infrastructure Standard
6. National Electrical Code (NEC), based upon year approval by local codes or AHJ
7. BICSI Telecommunications Distribution Methods Manual (TDMM)
8. Local, county, state and federal regulations and codes in effect as of date of purchase
9. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.3 SUBMITTALS
A. Refer to section 270000
B. Cable Pulling Plan
   1. The contractor shall submit a cable pulling plan prior to installation.
   2. Submittal requirements:
      a) Indicate the installed backbone conduit layout in schematic format, including junction boxes and distances between junction boxes.
      b) Indicate contents of each conduit.
      c) Indicate the cable pulling calculations, conduit fill ratios and actual cable runs and tensions.
      d) Include detail and schedule showing the construction sequence of communications rooms.
      e) Installation of cabling shall not commence prior to approval of the pulling plan and calculations by the engineer.
C. Splice Plan
   1. The contractor shall submit shop drawings indicating the intended cable splice points, mounting method and equipment list prior to installation
D. Cable Testing Plan
   1. Refer to Section 270000
E. Cable Testing Reports
   1. Refer to Section 270000

1.4 QUALITY ASSURANCE
A. Refer to section 270000
B. Cable splicing personnel shall have a minimum of five years splicing experience and shall have completed a minimum of five major splicing projects.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Refer to section 270000
B. Storage temperature range: -40°F to 149°F (-40°C to 65°C)
C. Fiber cables shall be shipped on reels in lengths as specified with a minimum overage of 10%:
   1. The cable shall be wound on the reel so that unwinding can be done without kinking the cable.
   2. Two meters of cable at both ends of the cable shall be accessible for testing.
      a) All fiber shall be tested on the reel for continuity and distance compliance before installation.
3. Each reel shall have a permanent label attached showing length, cable identification number, cable size, cable type, attenuation, bandwidth, and date of manufacture.
   a) Labels shall be water resistant and the writing on the labels shall be indelible.

1.6 PROJECT/SITE CONDITIONS
   A. Refer to section 270000

1.7 WARRANTY
   A. Refer to section 270000

1.8 MAINTENANCE AND SUPPORT
   A. Refer to section 270000

PART 2 - PRODUCTS

2.1 ACCEPTABLE COPPER CABLE MANUFACTURERS
   A. Backbone (Riser) cableCat3
      1. CommScope
      2. Owner approved alternate

2.2 ACCEPTABLE FIBER CABLE MANUFACTURERS
   A. OSP (Outside Plant) armored cable (OM4 Multimode and OS2 Singlemode, armored, for all inter-building cabling)
      1. CommScope
      2. Owner approved alternate
   B. Plenum rated cable (OM4 Multimode and OS2 Singlemode, armored, for all intra-building cabling)
      1. CommScope
      2. Owner approved alternate

2.3 ACCEPTABLE COMPONENT MANUFACTURERS
   A. Fiber Connectors (LC)
      1. CommScope
      2. Owner approved alternate
   B. Fiber Duplex Patch Cables (Type OS2 SM and OM4 MM)
      1. CommScope
      2. Owner approved alternate
   C. Fiber adapter panels
      1. CommScope (1000 Type)
      2. Owner approved alternate
   D. Fiber Termination Shelf (Rack-Mounted)
      1. CommScope (SD Sliding)
      2. Owner approved alternate
   E. Fiber Distribution Cabinet (Wall Mounted)
      1. CommScope
2. Owner approved alternate

F. Building Entrance Terminals – 110in/110out – complete with 5 pin fast acting solid state protection modules for all terminated cable pairs.
   1. Circa
   2. Portasystems
   3. Emerson
   4. Owner approved alternate

G. Wall and/or Rack-mounted 110 Terminus Blocks
   1. Portasystems
   2. Owner approved alternate

H. Labeling
   1. Refer to section 270000

I. Firestopping
   1. Refer to section 270000

2.4 FIBER BACKBONE CABLELING

A. Fiber General Requirements
   1. Fiber shall be certified to meet all parts of TIA-455 and comply with TIA-492, ANSI/ICEA S-83-596 and ANSI/ICEA S-83-640 and the NEC.
   2. Fibers shall have D-LUX coating or approved equivalent to ensure color retention, minimize micro bending losses and improve handling. The coating shall be mechanically strippable.
   3. Cable installed in plenums or air-handling spaces shall meet UL 910 and shall be marked OFNP (optical fiber non-conductive plenum) in accordance with the NEC.
      a) Plenum Fiber rated cable consisting of multiple fibers shall have a Plenum PVC outer jacket.
         1) Each group of fibers shall have a color-coded Low Smoke PVC buffer.
         2) The buffered fibers are organized in subunits of fibers, reinforced with aramid yarn for extra strength and surrounded with a color-coded low smoke tube.
      b) Within the premises, all fiber shall be placed in plenum rated innerduct the entire length of the cable for protection. Use manufacturer plenum rated couplings for all connections.
   4. Riser cable shall meet UL 1666 and be marked OFNR (optical fiber nonconductive riser) in accordance with the NEC.
      a) Non-plenum, riser rated cable consisting of multiple fibers, shall have an orange, Polyvinyl Chloride (PVC) outer jacket.
   5. OSP (Outside Plant) Fiber
      a) Stranded loose tube dielectric fiber cable shall be utilized for underground conduit, direct buried, or aerial applications.
      b) Underground cable, including cable installed in conduits or duct banks, shall contain an additional moisture barrier in the form of a flooding compound.
      c) All OSP fiber strength members shall be dielectric without any metallic elements.
6. Fiber conductors shall follow standard color code schemes. Fiber numbers and binders shall correspond to the following color codes:
   a) Fiber/Binder No. 1 – blue
   b) Fiber/Binder No. 2 – orange
   c) Fiber/Binder No. 3 – green
   d) Fiber/Binder No. 4 – brown
   e) Fiber/Binder No. 5 – slate
   f) Fiber/Binder No. 6 – white
   g) Fiber/Binder No. 7 – red
   h) Fiber/Binder No. 8 – black
   i) Fiber/Binder No. 9 – yellow
   j) Fiber/Binder No. 10 – violet
   k) Fiber/Binder No. 11 – rose
   l) Fiber/Binder No. 12 – aqua

7. Cable Minimum Bending Radius:
   a) During Installation: 20X cable diameter
   b) After Installation: 10X cable diameter

8. Operating temperature range: -76°F to 185°F (-60°C to 85°C)

B. Multi-mode Fiber Requirements
1. Fibers shall have dual wavelength capability; transmitting at 850 and 1300 nm ranges.
2. 50/125 µm ± 2.5 µm core (OM 4)
3. Core non-circularity: = 5%
4. 125 µm ± 1 µm cladding diameter
5. Cladding non-circularity: =1%
6. Colored fiber diameter: 254 µm ± 7 µm
7. Buffering diameter: 890 mm ± 50 mm
8. Minimum tensile strength: 100,000 psi
9. Maximum Attenuation: 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm
10. Minimum Bandwidth: 2000 MHz per km with laser launch at 850 nm ensured by differential mode delay at 850 nm” in TIA-492AAAC and 500 MHz at 1300 nm.
11. Additional component and transmission requirements for a 50/125 µm fiber cable capable of supporting 10 Gb/s serial transmission up to 984’-0” (300m) using 850 nm nominal wavelength lasers. These cables are suitable for use in accordance with ANSI/TIA-568-B.1.

C. Single Mode Fiber Requirements
1. Fibers shall have dual wavelength capability, transmitting at 1310 and 1550 nm ranges.
2. 8.3 µm core
3. 125 µm ± 1 µm cladding diameter
4. Cladding non-circularity: = 1%
5. Core/cladding concentricity error: = .5 µm
6. Colored fiber diameter: 254 µm ± 7 µm
7. Maximum Attenuation: 1.0 dB/km at 1310 and 1550 nm (inside premises) and 0.5 dB/km at 1310 and 1550 nm (OSP)
8. Minimum Bandwidth: 20 GHz
9. The mechanical and environmental specifications for OSP fiber cable shall be in accordance with ANSI/ICEA S-87-640. OSP fiber cables shall be of a water-block
construction and meet the requirements for compound flow and water penetration as established by ANSI/ICEA S-87-640. Outdoor cable shall have minimum pull strength of 2670 N (600 lbf).

2.5 COPPER BACKBONE CABLING

A. Copper Cable Requirements

1. Contractor shall provide and install 25-Pair CAT 3 form MDF to each IDF.
2. 100 Ω balanced twisted-pair
3. Plenum-rated cabling: Cable installed in plenums or air-handling spaces shall meet UL 910 and shall be marked CMP (communications multipurpose plenum) in accordance with the NEC.
   a) Plenum cable shall consist of #24-AWG solid copper conductors insulated with color-coded FEP
4. Non-plenum riser-rated cabling shall meet UL 1666 and be marked CMR (communications multipurpose riser) in accordance with the NEC, and shall consist of 24 AWG copper conductors insulated with color-coded PVC copper cables.
5. ASP-filled multi-pair copper cables shall be utilized for underground conduit or direct buried applications.
   a) All OSP copper cable shall be transitioned to inside cable within 50'-0” of building entry.
   b) The metallic portion of the cables, if present, must be bonded to the building ground upon entry.
6. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation.

B. Coaxial Cable Requirements

1. All cable must be plenum-rated .500 hard line or RG-11
2. All cable shall be shielded, with a copper clad aluminum center conductor; expandable polyethylene dielectric; continuous aluminum outer conductor, and a flame retardant jacket.
3. All cable shall be tested and marked to comply with the NEC requirements for (CATVR) riser rating.

2.6 COPPER PATCH CABLES

A. Refer to Section 271500

2.7 FIBER PATCH CABLES

A. Verify exact quantities and lengths with Owner prior to purchase
B. Provide the appropriately-rated (matched to the installed cable plant) Modular Patch Cords for the appropriate location and equipment.
C. Multi-mode patch cables shall be a buffered, graded-index fiber with a 50 µm core and a 125 micron cladding
D. Single Mode patch cables shall be a stepped-index 8.3 µm core with a 125 µm cladding.
E. Duplex SC connectors shall meet the following specifications:
   1. Made and warranted by the manufacturer of the cabling system installed in this project and shall meet or exceed patch cord specifications as outlined in TIA standards.
   2. Patch cords shall be in original packaging when presented to the Owner.
F. Aramid yarn and a jacket of flame-retardant PVC shall cover the fiber cladding.

G. Multi-mode patch cables additional requirements:
   1. Mated Connector Loss: \( \mu = 0.3 \text{ dB}, \sigma = 0.2 \text{ dB} \)
   2. Connection Repeatability: 0.20 dB maximum changes per 100 re-connects

H. Single Mode patch cable additional requirements:
   1. Return Loss: -50 dB maximum
   2. Mated Connector Loss: \( \mu = 0.35 \text{ dB}, \sigma = 0.2 \text{ dB} \)
   3. Connection Repeatability: 0.20 dB maximum changes per 200 re-connects.

I. The Multi-mode connector (visible portion) and adapter/outlet shall be identified by the color beige.

J. The Single Mode connector (visible portion) and adapter/outlet shall be identified by the color blue.

2.8 LABELING
   A. Refer to Section 271500.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Refer to Section 270000
   B. Verify the following before proceeding:
      1. Conduits, cable trays and pull boxes are properly installed following section 270528
      2. Backboards in communications rooms are properly installed following section 271100
      3. Grounding system is properly installed and tested following section 270526
      4. Liquid-carrying pipes are not installed in or above voice and data system communications rooms.
         a) Do not proceed with installation in affected areas until removed.

3.2 PREPARATION
   A. Refer to section 270000

3.3 COPPER INSTALLATION
   A. Backbone Cable
      1. The Contractor shall install riser cables according to manufacturer’s instructions for compliance to warranty requirements.
   B. OSP Cable
      1. The Contractor shall verify pulling material (pull rope, mule tape, etc.) average breaking strength based on cable type and size, pulling distance and pathway, and other pertinent factors.
   C. Copper Cable and Connectors
      1. The Contractor shall install connectors according to manufacturer’s instructions for compliance to warranty requirements.

3.4 TERMINATION FOR COPPER BACKBONE
   A. Copper
1. 110-type Wiring Blocks using C5 clips, Insulation Displacement Connector Systems, with proper patch cord
   a) Compatible with all voice and data circuits
   b) Underwriter's Laboratories (UL) listed

2. Protector Panels shall be provided for all outside plant installed copper circuits. The protectors shall provide pair-for-pair protection and be mounted on a 0'–1/4” fire-rated wallboard.

3.5 FIBER INSTALLATION

A. Fiber Cable Installation
   1. Fiber cable shall be installed in innerduct from near end termination point to far end termination point.
      a) Only UL-approved plenum-rated innerduct shall be installed in all plenum areas.
      b) Metallic conduit may be used in lieu of innerduct in plenum-rated ceilings if it is bonded and grounded correctly.

   2. Only technicians certified by the product manufacturer shall perform terminations.
      a) Terminations shall be made in a controlled environment.
      b) Cables may be assembled off-site, although testing must be completed with the cable in its final installed condition.
      c) Test optical fiber on the reel for distance and continuity verification before installation.

   3. At each location where fiber cable is exposed to human intrusion, it shall be marked with warning tags.
      a) These tags shall be yellow or orange in color, and shall contain the warning "CAUTION FIBER OPTIC CABLE".
      b) The text shall be permanent, black, block characters, and at least 0’–.1875” high.
      c) A warning tag shall be permanently affixed to each exposed cable or bundle of cables, at intervals of not less than 5’–0”.
      d) Any section of exposed cable that is less than 5’–0” in length shall have at least one warning tag affixed to it.

B. Fiber Distribution Center
   1. Contractor shall provide sufficient spare adapter plates to fill the appropriate-sized FDC.

3.6 FIBER TERMINATION AND SPLICING

A. Interconnect Units and Distribution Shelves
   1. Modular in design and used in fiber interconnection, cross-connection, and splicing applications
   2. 1’–7” (19”) rack-mountable
   3. Accept 12-strand, 24-strand, 48-strand or 72-strand terminations
   4. Owner approved industry standard connector

B. Splicing and closures
   1. Fiber splice modules shall be utilized for all OSP terminations.
   2. The link shall consist of:
a) Fiber cable  
b) Splice  
c) Splice tray holder/closure  
d) Fiber panel/coupler  
e) Pre-manufactured fiber pigtail with pre-polished fiber connector  
f) Fiber jumper to connect the pigtail-coupled link to the appropriate electronic switch

C. Fiber Fusion Splice  
1. Fusion splices shall be mounted in protective trays within the closure.  
2. Fusion splices shall not exceed a maximum optical attenuation of 0.3 dB when measured in accordance with ANSI/TIA-455-34, Method a (factory testing) or ANSI/TIA-455-59 (field testing).  
   a) Fiber splices shall have a minimum return loss of 20 dB for Multi-mode  
   b) Fiber splices shall have a minimum return loss of 26 dB for Single Mode  
      1) Minimum Single Mode return loss for broadband analog video (CATV) applications is 55 dB.

3.7 INSTALLATION REQUIREMENTS  
A. All installation shall be done in conformance with ANSI/TIA-568-B standards, BICSI methods, and industry standard installation guidelines.  
   1. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities.  
   2. Failure to follow the appropriate guidelines shall require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation.  
   3. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.  
B. The Contractor shall provide service loops for cables terminating in the communications rooms.  
   1. A 10’-0” service loop shall be provided and secured in a neat and standards-compliant manner above the equipment racks or cable trays unless specified otherwise.  
   2. This allows for future changes or expansion without installing new cables.  
C. Documentation  
   1. All cable inventory data documentation shall be submitted in format coordinated with and approved by owner so that data can be incorporated into existing databases.  
   2. Documentation shall include cable identification number, source and destination, type of cable, length of cable and number of pairs or fibers.  
   3. Complete cross connect documentation is required. It shall include detailed documentation of each pair of all copper backbone cable and strand of fiber.  

3.8 FIELD QUALITY CONTROL  
A. Refer to section 270000  

3.9 COPPER POST-INSTALLATION TESTING  
A. Contractor shall test each pair or strand of every cable prior to acceptance.  
B. Refer to Sections 270000 and 271500
C. Copper Test Documentation
   1. Refer to Section 271500

D. Copper testing requirements
   1. Refer to Section 271500.
   2. Copper backbone shall exceed ANSI/TIA-568-B.2 Backbone Cabling requirements and meet the manufacturer’s specifications for the installed product.
   3. OSP cabling test equipment shall be capable of making frequency sweeps at an impedance of 135 Ω at the following frequencies (kHz): 20, 30, 50, 69, 90, 110, 138, 276, 400, 600, 800, 1000, and 1100.
      a) A far-end device shall be used for all frequency measurements.
      b) The loss at 138 kHz shall not exceed 46 dB.
      c) The test set shall have the ability to store 100 tests and be able to upload to a PC.
      d) The test set shall be able to measure resistance between the following conductors: tip to ring, tip to ground, and ring to ground.
      e) All measurements shall be greater than 999 Ω.

E. Copper Test Equipment
   1. Refer to Section 270000

3.10 FIBER POST-INSTALLATION TESTING
A. Provide all labor, materials, tools, field-test instruments and equipment required for the complete and proper test measurements of the installed fiber cabling.
B. Contractor shall have successfully attended a fiber testing training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof.
C. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing.
   1. Any testing performed on incomplete systems shall be redone on completion of the work.
D. Dust caps shall be placed on fiber endfaces or adapters for each optical fiber link after all testing is complete on the fiber link.
E. Pre-test Submittals
   1. Manufacturers catalog sheets and specifications for the fiber cable field-test instruments including
      a) OLTS (Optical Loss Test Set)
      b) OTDR (Optical Time Domain Reflectometer)
      c) End-face inspection capture device
   2. A schedule (list) of all fiber cables to be tested
   3. Fiber testing training program certificate
   4. Sample test reports
F. Fiber testing standards
   1. The Contractor shall meet or exceed the following standards and guidelines:
      a) ANSI/TIA-568-C.0 Optical Fiber Transmission/Test Requirements, and Annex E: Optical Fiber Field Test Guidelines (Tier 2)
1) Tier 2 testing is a higher level of testing that provides qualitative measures of the installed condition and performance of the cabling system

b) ANSI/TIA-568-B.3 Optical Fiber Cabling Components Standard
c) TIA/TSB-140 Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems

2. Multi-mode requirements
   a) ANSI/TIA-526-14-A, Method B
   b) ANSI/TIA-455-50B

3. Single Mode requirements
   a) ANSI/TIA-526-7, Method A.1: Optical Power Loss Measurements of Installed Single Mode Fiber Cable Plant-OFSTP-7

4. The cable installers shall have a copy of these references in their possession and be familiar with the contents

G. In order to conform to the overall project event schedule, the contractor shall survey and coordinate the optical fiber testing with other applicable trades.

H. In addition to the test regiment detailed in this document, the contractor shall notify the Owner of any additional tests that are deemed necessary to guarantee a fully functional system.

1. The contractor shall carry out and record any additional measurement results at no additional charge.

I. The contractor shall provide all test measurement results two (2) weeks prior to substantial completion in spreadsheet format and native file format from the test instrument.

1. Software shall also be provided to view the native results.

J. All tests performed on optical fiber cabling that use a laser or LED in a test set shall be carried out with safety precautions in accordance with ANSI Z136.2.

1. A visible fault locator (VFL) normally uses a Class 2 or 3 light source and should not be directly viewed.
2. Safe usage of the tool requires indirect viewing of the light source by pointing the end of the fiber at an adjacent surface (or introducing another surface in front of a fixed mounted connector) until the presence of light is determined.

K. Link attenuation measurement and allowance calculation

1. The measured link attenuation shall be less than the link attenuation allowance. The link attenuation allowance is calculated as:

a) Link Attenuation Allowance (dB) = Cable Attenuation Allowance (dB) + Connector Insertion Loss Allowance (dB) + Splice Insertion Loss Allowance (dB)

1) Connector Insertion Loss Allowance (dB) = Number of Connector Pairs X 0.4dB
2) Splice Insertion Loss Allowance (dB) = Number of Splices X 0.15dB
3) Cable Attenuation Allowance (dB) = Maximum Cable Attenuation Coefficient (dB/km) X Length (km)

L. Fiber Testing Requirements
1. All installed fiber links shall be field-tested and pass the following tests:
   a) OLTS (Optical Loss Test Set) length and dual wavelength attenuation
   b) OTDR (Optical Time Domain Reflectometer) traces and event tables
   c) Image captures of connector end-faces

2. OLTS (Optical Loss Test Set)
   a) The length and attenuation of each installed fiber link shall be measured and documented.
   b) System loss measurements requirements:
      1) 850 and 1300 nanometers for Multi-mode
      2) 1310 and 1550 nanometers for Single Mode
   c) Reflective events (connections) shall not exceed 0.75 dB.
   d) Non-reflective events (splices) shall not exceed 0.3 dB.
   e) The acceptable link attenuation for Multi-mode horizontal fiber is based on the maximum distance of 295’-0”.
   f) A horizontal link in a network with a consolidation point may be tested using a fixed upper limit for attenuation of 2.75 dB.
   g) Optical sources shall be turned on for a minimum of 5 minutes prior to referencing.
   h) Fiber links shall be measured and reported for attenuation in each direction and attenuation bi-directionally (averaged in both directions)
   i) Polarity shall be verified for duplex connector systems
   j) Mandrels
      1) Mandrels shall be used when testing attenuation of Multi-mode fiber cabling
      2) Where mandrels are used, secure the mandrel to the light source by some means such as a cable tie or tape.
      3) Care should be taken to ensure that the fiber jacket is not deformed or damaged when using a cable tie or tape.
      4) The light source shall be referenced to the meter a minimum of twice daily (i.e., in the morning and noon).

3. OTDR (Optical Time Domain Reflectometer)
   a) An OTDR trace shall be taken of each fiber link in one direction to ensure uniformity of cable attenuation and connector insertion loss
   b) Testing shall consist of a bi-directional end to end OTDR trace performed per TIA 455-61
   c) Individual connector, splice and fiber insertion loss shall be evaluated using the OTDR trace.
   d) Fibers shall be inspected at 250X for Multi-mode and 400X for Single Mode

4. End-face Image Capture
   1) An image of each fiber optic connector end-face shall be taken, recorded and provided as part of the records.

5. Maximum Attenuation
   a) Single Mode ISP (inside) 1.0 dB/km at 1310 nm and 1550 nm
   b) Single Mode OSP (outside) 0.5 dB/km at 1310 nm and 1550 nm
   c) Multi-mode 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm

6. Test Cords (Jumpers)
a) Testing of the cabling shall be performed using high-quality test cords of the same fiber type and core size as the cabling under test. Use a single patch cord reference for fiber testing.
   1) OLTS test cords shall be between 3’-3” (1m) and 16’-4” (5m).
   2) OTDR testing shall be approximately 328’-0” (100m) for the launch cable and at least 82’-0” (25m) for the receive cable. OTDR testing shall be Bidirectional with Pigtails installed.

b) The test jumper, the adapters, and fiber under test shall be cleaned immediately prior to each fiber being tested.
   1) After cleaning, cleaning solutions shall be given sufficient time to evaporate (approximately 30 seconds) prior to the mating of fiber test jumper to the fiber under test.

7. Test Failure
   a) Any fiber link that fails these requirements shall be diagnosed and corrected.
   b) Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link meets performance requirements

8. Acceptable Testers
   a) Fluke DTX CableAnalyzer
   b) Owner Approved equivalent

M. The Owner or the Owner’s representative shall be invited to witness, review or both witness and review field-testing.
   1. The Owner or the Owner’s representative shall be notified of the testing start date, five (5) business days before testing commences.
   2. The Owner or the Owner’s representative will select a random sample of 5% of the installed links and test that sample.
      a) The measured results obtained from the random sample shall be compared to the data provided by the contractor.
      b) If more than 2% of the sample results differ in terms of the pass/fail determination, the contractor under supervision of the Owner or Owner’s representative shall repeat 100% of the testing at no cost to the Owner.

N. Test Results
   1. The detailed test results documentation data is to be provided in an electronic database for each tested fiber strand and shall contain the following information:
      a) Identification of the customer site as specified by the end-user
      b) Name of the test limit selected to execute the stored test results
      c) Name of the personnel performing the test
      d) Date and time the test results were saved
      e) The manufacturer, model and serial number of the test instrument.
      f) The version of the test software and the version of the test limit database held within the test instrument.
      g) Fiber identification number
      h) Length for each optical fiber
      i) Index of refraction used for length calculation when using a length capable OLTS.
j) Test results to include OLTS attenuation link and channel measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).

k) Test results to include OTDR link and channel traces and event tables at the appropriate wavelength(s).

l) Length for each optical fiber as calculated by the OTDR

m) Overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements

n) Circuit IDs reported by the test instrument should match the specified label ID

3.11 CLEANING
   A. Refer to section 270000

3.12 ACCEPTANCE
   A. Refer to Section 271500.

END OF SECTION 27 13 00
PART 1 - GENERAL

1.1 SUMMARY
A. This section of the horizontal cabling portion of a structured cabling system includes:
   1. UTP Copper cabling
   2. Termination and patch cables
B. Provide all horizontal cabling, terminating hardware, adapters, and cross-connecting
   hardware necessary to interconnect all system equipment including equipment located in
   communications rooms.
C. Provide CommScope Uniprise Cat6 cabling system by CommScope certificated
   contractors with CommScope System Warranty.
D. Related Sections
   1. Section 270000 Communications
   2. Section 270526 Grounding and Bonding for Communications Systems
   3. Section 270528 Pathways for Communications
   4. Section 271100 Communications Equipment Room Fittings

1.2 REFERENCES
A. The publications listed below form a part of this specification. The publications are
   referred to in the text by basic designation only.
B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer’s
   instructions, or requirements of regulatory agencies shall mean the latest printed edition
   of each in effect at the date of contract unless the document is shown dated.
C. Conflicts
   1. Refer to section 270000
D. Codes and Standards
   1. Refer to section 270000

1.3 SUBMITTALS
A. Refer to sections 270000 and 271300

1.4 QUALITY ASSURANCE
A. Refer to section 270000

1.5 DELIVERY, STORAGE, AND HANDLING
A. Refer to sections 270000 and 271300
B. Storage temperature range: -40°F to 149°F (-40°C to 65°C)

1.6 PROJECT/SITE CONDITIONS
A. Refer to section 270000

1.7 WARRANTY
A. Refer to section 270000

1.8 MAINTENANCE AND SUPPORT
A. Refer to section 271300

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Labeling
1. Refer to section 270000

B. Firestopping
1. Refer to section 270000

2.2 ACCEPTABLE COPPER MANUFACTURERS

A. UTP Plenum Rated Cable Cat6
1. CommScope Uniprise (CS37P)
2. Owner approved equivalent

B. UTP OSP Rated Cable Cat6
1. CommScope Uniprise (CS34O)
2. Owner approved equivalent

C. Data/Voice Outlet Components Cat6
1. CommScope Uniprise (M series UNJ600)
2. Owner approved equivalent

D. Patch Panels (48-port)
1. CommScope Uniprise (M4800-1U-PS))
2. Owner approved equivalent

E. Copper Patch Cords Cat6 Pre-assembled
1. CommScope Uniprise (UNC6)
2. Owner approved equivalent

F. Faceplate for wall-mount telephones
1. CommScope (M10LWSP)
2. Owner approved equivalent

G. Standard wall-mount Faceplate
1. CommScope (M14L-xxx)
2. Color to match other elec faceplates. Submit product submittal to Architect for approval.
3. Owner approved equivalent

H. Stainless Steel wall-mount Faceplate
1. CommScope (M14SP)
2. Owner approved equivalent

2.3 ACCESSORIES

A. Mount one laminated full-size hard copy in color of an as-built floor plan designating workstation locations, pathways, and communications room locations. Confirm hard copy size with Owner.

B. Provide clear plastic lamination serving each communication room.
C. Install the laminated drawings within a protective Plexiglas encasement on the wall of the servicing communications rooms. To ease accessibility the Plexiglas encasement shall be in either flip-down format or file folder format.

2.4 HORIZONTAL COPPER CABLING

A. Recognized cabling for providing the signal medium from the work area to the communications room shall include the following:

1. Category 6 UTP cable

B. Category 6 UTP Cable Requirements

1. 23/24 AWG solid bare copper
2. Cable jacket shall comply with NEC Article 800 for use as a plenum cable and shall be UL and c (UL) Listed Type CMP (communications multipurpose plenum)
3. Cable shall terminate on an eight-pin modular jack at each outlet. All horizontal cabling shall meet or exceed the ANSI/TIA-568-C.2 Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components
4. Cables shall be marked as UL verified with a minimum of Category 6 rating
5. The cable shall support Voice, Analog Base band Video/Audio, Fax, Modem, Switched-56, T-1, ISDN, RS-232, RS-422, RS-485, 10BASE-T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, as well as all 77 channels (550 Mhz) of analog broadband video
6. The maximum horizontal cable tested length for Category 6 copper cable from the termination of the cable in the communications room to the outlet is 295'-0". It’s contractor’s responsibility to reroute as necessary to bring all cable runs within distance limit without additional cost to the project. Plan ahead and get approval or exception from Owner before pulling the cables that would ne over the distance limit.
7. Cable shall meet or exceed the following electrical characteristics:
8. Cable shall be specified to 250 MHz and shall meet the manufacturer’s guaranteed electrical performance and physical specifications.
9. Color Code: Blue for data, Green for camera, Yellow for WiFi AP, Purple for Access control

2.5 TERMINATION HARDWARE

A. Patch panels

1. Patch panels shall be rated to match installed cable plant
2. The wiring block shall accommodate #23 AWG cable conductors.
3. All modular cross connect panels shall be UL-listed.

B. Work Area Outlet Cat6

1. Universal eight-position jack pin/pair assignments
2. Jack Color:
   a) Color Code: Blue for data, Green for camera, Yellow for WiFi AP, Purple for Access control

C. Work Area Outlet Faceplates:
1. White or ivory to match electrical outlets.

2.6 PATCH CABLES

A. Verify exact quantities and lengths with Owner prior to purchase. Provide (1) workstation patch cord and (1) Communication Room patch cord for each data cable run installed.

B. Patch Cable requirements:
   1. Category 6, stranded UTP cable
   2. Standard modular non-keyed, 8-position 8-conductor plug
   3. 94V-0 rated
   4. UL listed
   5. Meets FCC Part 68
   6. Color Code: Blue for data, Green for camera, Yellow for WiFi AP, Purple for Access control

C. Provide 1'-0" long Patch Cords at the communications room for each installed port.
   1. Coordinate with Owner on the active equipment layout prior to purchase to ensure correct sizing of patch cords from patch panels to switching equipment.
   2. When connecting voice ports to a copper riser, provide a one-pair stranded 8P8C connector on one end and 110GS on the other end and shall be of appropriate length for application.

D. Provide a 10'-0" Station Cord for each work area outlet port.

E. Place each size/length patch cord in a separate container, and mark the containers that hold the patch cords with the length of patch cords contained within.

F. All cords shall conform to the requirements of ANSI/TIA-568-C.2 Commercial Building Telecommunications Cabling Standard, Horizontal Cabling Section, and be part of the UL LAN Certification and Follow-up Program.

G. Cords shall be equipped with an eight-pin modular connector on each end, wired straight through and shall be of appropriate length for application.

H. All rated patch cords shall be round, and consist of #23 AWG copper, stranded conductors, tightly twisted into individual pairs.

I. Patch cords shall be made and warranted by the manufacturer of the cabling system installed in this project and shall meet or exceed patch cord specifications as outlined in TIA standards.

2.7 IDENTIFICATION (LABELING) SYSTEM

A. Refer to sections 270000 and 271300.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Refer to Section 270000 and 271300

3.2 PREPARATION

A. Refer to section 270000

B. The Contractor shall check pathways, raceways, and other elements for compliance with space allocations, installation tolerances, debris, hazards to cable installation, and other conditions affecting installation prior to installation.
3.3 INSTALLATION REQUIREMENTS

A. Refer to section 270000

B. All installation shall be done in conformance with ANSI/TIA-568-C standards, BICSI methods, industry standards and manufacturer's installation guidelines.

1. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities.

2. Failure to follow the appropriate guidelines shall require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation.

3. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

C. Install cable using techniques, practices, and methods that are consistent with specified data cabling and the installed components and that ensure specified performance levels of completed and linked signal paths, end to end.

1. Pull cables in smooth and regular motions using methods that prevent cable kinking.

2. Pull cables simultaneously if more than one is being installed in the same raceway/pathway.

3. If necessary, use approved cable pulling lubricant.

4. Use fish tape, cable, rope, basket weave wire/cable grips, and other tools that will ensure no damage to the media or raceway.

5. Install open cabling parallel and perpendicular to surfaces or structural members following surface contours where possible.

6. Do not bend cable greater than a bend radius of 0'-1”.

D. Provide a 10'-0” service loop at the communications room and shall provide a 3'-0” service loop above the access ceiling or cable trays unless specified otherwise.

1. All service loops shall be a minimum of 1’-6” (18”) in diameter and be accessible for maintenance.

E. Coordinate loop placement and orientation with the technology consultant.

1. This allows for future changes or expansion without installing new cables.

F. Install cables in continuous “home run” lengths from work station outlet to specified patch panel.

1. No intermediate punch down blocks or splices may be installed or utilized between the communications rooms and the workstation outlet without written Owner permission.

G. All cable must be handled with care during installation so as not to change performance specifications.

1. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable.

2. There shall never be more than 0'-½” of unsheathed cable at either the wiring closet or the workstation termination locations.

H. All cabling and associated hardware shall be placed so as to make efficient use of available space.
1. All cabling and associated hardware shall be placed so as not to impair equipment's efficient use of their full capacity.

3.4 CABLING METHODS

A. The Contractor shall provide cabling in accessible spaces, cable tray, (surface and/or enclosed raceway), conduits, and/or J-Hook cable support system.
   1. Within consoles, racks, cabinets, desks, and counters, in accessible ceilings spaces and in gypsum board partitions where open cable method may be used.
   2. Use UL or ETL listed plenum rated cable in all spaces.
   3. Provide all necessary installation materials, hardware, tools and equipment to perform insulation displacement type terminations at all data outlets, patch panels, and voice termination materials.

B. Conceal raceway and cabling except in unfinished spaces as is practical.

C. Exposed Cable
   1. All station cabling shall be installed inside walls or ceiling spaces whenever possible.
   2. Exposed station cable will only be run where indicated on the drawings and will only be allowed when no other options exist.
      a) Owner must approve all exceptions.

D. The Contractor shall utilize conduits/cable tray as indicated on the drawings.

E. All cabling placed above drop ceilings must be supported by cable tray, J-hooks, caddy bags or conduit.
   1. The Contractor shall permanently affix cable supports to the building structure or substrates and provide attachment hardware and anchors designed for the structure to which attached and are suitably sized to sustain the weight of the cables to be supported.
      a) Attaching cable to pipes or other mechanical items is not permitted.
      b) Cabling shall not be attached to ceiling grid wires.
   2. Multiple cables are to be dressed every 5’-0” to 7’-0”.
      a) Maximum cable sag between cable hooks is 3”-6”.

F. The Contractor shall route data and voice cables separately in a neat and orderly fashion.
   1. No cable ties or wraps shall be used to secure the cables in the runway outside of the communications rooms. Cable ties shall be rated for the environment.

G. Keep all items protected before and after installation with dust and moisture proof barrier materials/envelopes.

H. If wiring is terminated on patch panels, data, voice jacks prior to painting, carpet installation, and general finish clean up, these jacks shall be placed in a protective envelope to ensure dust, debris, moisture, and other foreign material do not settle onto jacks’ contacts.
   1. Envelope will be removed on final trim out after other trades have completed their finish work.
   2. It shall be the Contractor’s responsibility to ensure the integrity of these protective measures throughout the life/installation of the project.
a) Cable bundles brought into the communications rooms shall be routed and dressed in such a manner that prior to termination the cables are not subject to damage and misuse such as installers walking on the bundles that are on the floor.

b) Cable pulling force shall not exceed 25 lbs of pulling tension or cable manufacturer’s recommended pulling tensions.

c) Do not leave cables on the floor unprotected or cable bundles hanging from the ceilings. Coil them up in a temporary manner and protect them from damage.

I. Communications room cables shall be combed and dressed in a manner as to prevent twists, “braiding” and crossed cables in the cable bundle from the communication room entrance to the termination point at the rear of the patch panel.

1. Behind the patch panel, the cable bundle shall be attached to the rear cable support bar, and shall drop out each cable in a neat, cascading manner to prevent crossed and/or interwoven cables to each patch panel port termination point.

   a) Use Velcro wraps instead of cables ties for all bundling in the communications rooms.

   b) Plastic/nylon tie-wraps are not allowed to permanently secure cables inside the communications room.

3.5 CABLING SEPARATION

A. Comply with TIA rules for separating unshielded copper communication and data-processing equipment cables from potential EMI sources, including electrical power lines and equipment.

B. Maintain a minimum spacing of 1’-6” (18”) from electrical feeders and/or branch circuit wiring including, but not limited to, light fixtures, sources of heat and EMI sources.

C. Maintain a minimum spacing of 1’-0” from auxiliary systems cabling.

D. Maintain a 1’-0” separation where cables must pass perpendicularly to electrical, plumbing, or other wiring, conduit, or piping systems.

   1. Use non-conduit bushings, if necessary to maintain separation, which allow for the addition of a reasonable number of cables in the future.

E. Maintain communications pathways away from electrical apparatus such as motor driven equipment and transformers, minimum separation distance of 10’-0” is recommended.

3.6 CABLING TERMINATION

A. Terminate cables in consistent consecutive order.

B. Terminate cables onto 8P8C modular patch panels without damaging twisted pairs or jacket.

C. Arrange cables on patch panels and voice termination hardware in ascending order of room numbers and outlet numbers within rooms.

D. Provide a 10’-0” service loop for horizontal cables at each rack in communications rooms.

   1. Locate loop at ceiling deck or on bottom of cable runway in minimum 1’-6” (18”) diameter.
E. Provide a 3’ service loop for horizontal cables at work area outlets. Locate service loop above or below data/voice outlet were vertical cable run transitions to horizontal run.

F. Maintain twists in cable pairs to within 0’-½” of termination.

G. Building Systems Cabling (BAS, FA, elevator line, etc)
   1. Coordinate exact placement and connectivity requirements with applicable trade prior to installation.
   2. Group all building systems cables in one group.
   3. Clearly label cable number and function, in the last positions on the horizontal cabling blocks in each communications room.

H. Limit cable-bending radius to 20X the cable diameter during installation, and 15X the cable diameter after installation.

I. Start numbering at the left of the main door to the room and continue in a clockwise direction around the room.
   1. The cables within the room will be terminated starting with the cables located to the left of the main door to the room and continue around the room in a clockwise direction.

3.7 TERMINATION HARDWARE

A. Station Hardware
   1. Flush mount jacks shall be mounted in a faceplate with back box.
   2. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches without prior Owner approval.
   3. 8P8C Jack Pin Assignments for work area outlets shall match the T-568B wiring scheme.

B. Patch panels
   1. Copper cables shall be terminated in eight position/eight conductor (8P8C) modular patch panels.
   2. All Modular jack panels shall match the T-568B wiring scheme.

C. Work Area Outlet
   1. 8P8C non-keyed modular outlets for applications up to one Gbps and ANSI/TIA-568-C compliant for the specified transmission requirements

D. Work Area Outlet Faceplates:
   1. Furnish and install blank plates in all unused ports.

3.8 SPECIAL CIRCUITS

A. The Contractor shall coordinate with the Owner on the cable termination plan for special circuits, including cables to wireless access point locations, security, elevators, fire alarms, etc.

B. Wireless Access Points
   1. Install two (2) cable(s) from dedicated wireless patch panel(s) in communications room to outlets having 8P8C connectors within a BISCUIT box.
   2. Enclosures shall be NEMA rated for the environment to which they are exposed.
   3. 30’-0” of cable slack shall be coiled and hung on a “J”-hook at the enclosure location.
3.9 IDENTIFICATION AND LABELING

A. Labeling system shall consist of a hand-held portable printer and labels appropriate to the application. Handwritten labels are not acceptable.

B. Labelling scheme shall meet Owner’s IT cabling standard and industry standards and best practices. Submit labelling scheme for approval before work to start.

C. Fiber termination hardware (designation strip) shall have a 0’-¼” x 0’-¼” thermal transfer printable label with a permanent acrylic adhesive.

D. All labels shall be permanent and shall not fade, peel, or deteriorate due to environment or time.

E. The Contractor shall provide a copy of the finalized plan in writing to the Owner representative and DBR for review and authorization to proceed.

1. Coordinate with Owner for specifications on labeling of all hardware, cabling, and related equipment prior to any testing.

F. Labeling requirements:

1. Label cable terminations on designation strips
2. Label all cable at each terminating point.
3. Label each port of the work area outlet.
4. Cable identification numbers shall not be duplicated.
5. Label patch panels in the communications rooms to match those on the corresponding voice and data outlets.

a) The font shall be at least 0’-1/8” in height.

6. Where a wireless access point is installed above an acoustical ceiling, label the ceiling grid frame below the access point, displaying the data port number and, if applicable, the access point identification number. Coordinate labeling of grid with Owner and Architect prior to application of labels.

7. Label each distribution rack, block and other terminating equipment unit and field within that unit within 0’-4” from the block or patch panel termination. Keep labels in a neat and orderly lineup.

8. Label each connector and each discrete unit of cable-terminating and connecting hardware within connector fields, in wiring closets and equipment rooms.

a) Where similar jacks and plugs are used for both communication and data-processing equipment, use a different color for jacks and plugs of each service.

9. Post the cable schedule in a prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations.

G. Location and termination field description

1. Room location
2. Rack-mount or Wall mount
3. Termination field type

a) Specific patch panel ports versus a separate dedicated patch panel

H. Unique identifiers
1. Segregation and position on equipment rack
2. Port color-coding
3. Unique labeling

I. Documentation

1. Provide electronic copy of final comprehensive schedules for project in software and format selected by Owner.
   a) All labels shall correspond to as-built drawings and to final test reports.

2. All cable inventory data documentation shall be submitted in format coordinated with and approved by Owner so that data can be incorporated into existing databases.

3. Documentation shall include cable identification number, source and destination, type of cable, length of cable and number of pairs or fibers.

4. Complete cross connect documentation is required.

3.10 FIELD QUALITY CONTROL

A. Refer to section 270000

3.11 POST-INSTALLATION TESTING

A. Contractor shall test each pair or strand of every cable prior to acceptance. (100% PASS)

B. Contractor shall submit acceptance documentation as defined below. No cabling installation is considered complete until test results have been completed, submitted and approved.

C. Standards Compliance and Test Requirements:

1. Cabling shall meet ANSI/TIA-568-C.2 Category 6 Horizontal cabling requirements.

D. Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin.

1. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements.

2. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards.

3. Length, propagation delay, and delay skew relative to the relevant limit.
   a) Length, propagation delay, and delay skew shall be tested relative to the relevant limit.
   b) Test shall also include mutual capacitance and characteristic impedance.

   1) Any individual test that fails the relevant performance specification shall be marked as a ‘FAIL’.

E. Cable Test Documentation:

1. Cable test documentation shall be submitted in hard copy and electronic formats.
   a) If proprietary software is used, disk or CD shall contain any necessary software application required to view test results.
b) Electronic reports shall be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report.

c) Certificate shall reference traceable circuit numbers that match the electronic record.

2. Each test record shall contain the cable ID as follows:

   a) “MEDIA TYPE – SOURCE ROOM – DESTINATION ROOM – STRAND/PAIR #”, e.g. MM-MC-HC23-001.

3. Test results saved within the field-test instrument shall be transferred into an accessible database utility that allows for the maintenance, inspection and archiving of the test records.

   a) These test records shall be uploaded to the PC unaltered, i.e., “as saved in the field-test instrument”.

   b) The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used.

4. Test reports shall include the following information for each cabling element:

   a) Wire map results that indicate that 100% of the cabling has been tested for shorts, opens, miss-wires, splits, polarity reversals, transpositions, presence of AC voltage and end-to-end connectivity.

   b) Length, propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

   c) Cable manufacturer, cable model number/type, and NVP

   d) Tester make & model, serial number, hardware version, and software version.

   e) Cable ID and project name

   f) Auto-test specification used

   g) Overall pass/fail indication

   h) Date of test

F. Cable Test Equipment

1. Contractor shall supply all of the required test equipment used to conduct acceptance tests.

2. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.

3. Testing equipment shall be UL-verified to meet Level III accuracy.

   a) The cable installers shall have a copy of this reference in their possession and be familiar with the contents.

4. Testing equipment shall be within the calibration period recommended by the manufacturer.

5. Testing equipment shall have the latest software and firmware installed.

6. Testing equipment of a given type shall be from the same manufacturer, and have compatible electronic results output.

7. Test adapter cables shall be approved by the manufacturer of the test equipment.
a) Adapter cables from other sources are not acceptable.
b) Adapter cables must be replaced after 1000 tests to ensure accuracy.

8. Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.
9. Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
10. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.
11. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.
12. Test equipment must include a library of cable types, sorted by major manufacturer.
13. Test equipment must be able to internally group auto tests and cables in project folders for good records management.

a) Test equipment must store at least 1000 auto tests in internal memory.
14. Test equipment must include DSP technology for support of advanced measurements.
15. Test equipment must make swept frequency measurements in compliance with TIA standards.
16. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector.
17. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.
18. Acceptable testers:

a) Fluke DTX CableAnalyzer
b) Owner approved equivalent

3.12 CLEANING
A. Refer to section 270000

3.13 ACCEPTANCE
A. Once all work has been completed, test documentation has been submitted and approved, and the Owner is satisfied that all work has been completed in accordance with contract documents, the Owner will notify Contractor in writing of formal acceptance of the system.
B. Contractor’s RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein.
C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and submittal and approval of full documentation as described above. Tests with the “* PASS” (asterisk) will not be acceptable.
1. These circuits must be repaired to meet “PASS”.

END OF SECTION 27 15 00
SECTION 273000: Area of Refuge/Elevator Landing - Two-Way Communication System

PART 1 – GENERAL

- SmartRescue Base Station, Call Boxes and Signage

1.0 Summary

1.1 The Base Station is to be located at a central control point on the first floor or as determined by local Authority Having Jurisdiction. Basis of Design: RATH® Call Boxes are to be located on all floors above and below the first floor, ideally next to a stairwell emergency exit or elevator landing on each floor.

1.2 The Base Station must be capable of handling a minimum of 5 RATH® Call Boxes. Visual indicators on the Base Station allow rescue personnel to know which Call Box needs assistance. The Base Station must allow rescue personnel to speak to all Call Boxes or individual Call Boxes.

1.3 The emergency communication hardware shall comply with the Americans with Disabilities Act (ADA). The Call Box shall have the ability to be programmed with up to 5 emergency phone numbers. Upon activation of the emergency push button, a call will be automatically placed to the Base Station. If no one answers at the Base Station, the Call Box must dial a secondary location outside the building to activate two-way off-site person to person voice communication via landline, cellular device (part # 2100-GSMLC or 2100-CDMALC), or IP (part # 2100-VOIP).

2.0 Submittals

2.1 Submit product data sheets. Include operation manuals.

2.2 Wiring or shop diagrams detailing wiring schematics, cabling.

3.0 Construction

3.1 The Base Station (models 2500) must have a Stainless Steel or powder coated steel housing, red coil cord emergency handset, be 24vdc or 120vac powered and include a rechargeable battery to maintain backup power for a minimum of 4 hours of talk time.

3.2 The Call Boxes (models 2100) must be in full compliance with ADA requirements. Call Boxes require a hands-free speakerphone with an LED to indicate status of call.

3.3 The Call Boxes must allow the programming in of a specific location message of the Call Box. This allows rescue personnel to know the location of the activated Call Box.

3.4 The Call Boxes are to be located no higher than 48” front reach, or 54” side reach to the center of the push button above ground level to ensure conformance with the ADA requirements.

3.5 The Area of Refuge Call Boxes must have a Braille face plate to ensure conformance with the ADA requirements.
3.6 The **Base Station** must provide an audible and visual indicator that a **Call Box** has been activated.

3.7 The 24vdc **Power Supply** part # 2500-PWR24 must be capable of supplying power to a minimum of 10 **Call Boxes** and the **Base Station**.

4.0 Mounting
4.1 The **Base Station** is to be mounted on a wall, surface or flush mounted.

4.2 **Call Boxes** are to be wall, surface or flush mounted.

5.0 Electrical
5.1 **Call Boxes** and **Base Station** are to be powered by RATH® 24vdc **Power Supply** part # 2500-PWR24. **Base Station** to have option of 120vac power.

5.2 Wiring from the **Base Station** to the **Call Boxes** shall be RATH® Custom Communication Cable (part # RP7500094). If CI 2 hour fire-rated cable is required, use RATH® Communication Cable part # RP6600300M.

5.3 **Call Boxes** must have built-in battery backup and include a rechargeable battery to maintain backup power for a minimum of 4 hours of talk time. If **Call Boxes** require protective covers per local municipal codes, use RATH® 2100-XXXSSRC2.

5.4 **Base Station** must have a built-in battery backup and include a rechargeable battery to maintain backup power for a minimum of 4 hours of talk time.

5.5 System shall be in compliance with all state and local Electrical Codes.

6.0 Communications
6.1 The **Call Boxes** shall have an ADA compliant and vandal resistant speakerphone.

6.2 The **Call Boxes** shall be hands-free and be a push-button-once to talk system. Once the button has been pushed, the **Call Box** will call the **Base Station**. If no answer at the **Base Station**, it will automatically call pre-programmed emergency numbers. The **Call Box** must be capable of being programmed with up to 5 emergency numbers.

6.3 **Call Box** shall have location message capability. **Call Box** must have a minimum 18 second recordable message capability, programmable to play 1 or 2 times. **Call Box** shall notify called party of the location of the call upon being received at the emergency dispatch center.

6.4 **Call Box** shall be capable of allowing the called party to replay the location message if necessary to ensure an understanding of the caller location.

6.5 If system is not attended 24 hours a day, the **Call Box** must dial a secondary location outside the building to activate *two-way off-site person to person voice communications*. 
6.6 Once call has been made (button pushed), the call can only be terminated by the called party.

6.7 *Call Box* must have a red LED that will light up upon push of the button. The light shall be a solid color when the *Call Box* is activated, and will flash when call has been answered.

6.8 The *Call Box* must be capable of being programmed and re-programmed on-site and remotely.

6.9 Standard *Call Box* features:
   6.9.1 Five number programming.
   6.9.2 Operating temperature of between -40°F to +150°F (-40° to +65° C).
   6.9.3 Programmable passwords.
   6.9.4 On-site or remote programmable.
   6.9.5 EEPROM memory to protect programming.

7.0 Signage
7.1 System shall consist of a minimum of one 120/277vac edge light sign (part # 7050 or 7050E), and a “location” and “instruction” sign (part # 7049SS) to clearly indicate location of designated area. A tactile sign (part # 7043/7044 or 7087) with raised letter and Braille shall be located at entrance to area.

8.0 Graphics
8.1 *Base Station* must include wording identifying the location of each *Call Box* and light an LED when a particular *Call Box* has been activated.

8.2 *Call Box* wording must include “Emergency Phone”, International Phone Symbol and raised Braille lettering.

9.0 Cabling
9.1 Cabling for two-way communication system shall meet the applicable requirements for pathway survivability. Cabling installation shall consist of one or more of the following:
   9.1.1 2 hour fire-rated circuit integrity (CI) cable – RATH® Part # RP6600300M (for a UL Listed option use part # RPP66010002)
   9.1.2 2 hour fire-rated cable system
   9.1.3 2 hour fire-rated enclosure or protected area

10.0 Warranty
10.1 The *Base Station* and *Call Boxes* shall be warranted for a period of three years.

END OF SECTION 27 30 00
SECTION 27 4116
INTEGRATED AUDIO-VIDEO SYSTEM AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This document covers the general requirements for the installation of audio-video (AV) systems.

1.02 RELATED DOCUMENTS

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

1.03 CODES

A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.

B. The equipment, materials, and installation shall conform to the latest version of all applicable codes, standards and regulations of authorities having jurisdiction including the following:
   1. NFPA 70, National Electrical Code.
   3. FCC Rules, Part 76.
   4. UL 50, Enclosures for Electrical Equipment.
   5. All applicable parts will be FCC Class B approved.
   6. All equipment, cable, devices, and accessories provided shall be listed and labeled by Underwriters Laboratories, Inc. for the intended use under the latest appropriate testing standard.
   8. Texas Accessibility Standards.
   10. State and Local Building Codes with Amendments.
   11. All requirements of the local Authority Having Jurisdiction (AHJ).

1.04 REGULATIONS

A. Comply with terms and conditions of Americans with Disabilities Act, especially regarding provisions for hearing impaired and wheelchair access in control areas.

1.05 ROOM DESCRIPTIONS

A. TRAINING LARGE ASSEMBLY ROOM

This space is will have flexible seating to accommodate up to 180 participants for a variety of internal meetings and training sessions. Divisible in to two (2) separate spaces. The space may also be utilized as a large emergency operations center by the city. Audiovisual fit out will include:

1. Display Systems:
1) Two (2) ceiling-mounted video projector, suspended from a recessed in-ceiling projector service box, housing power/data and devices associated with the display and room systems.

2) A recessed-style, ceiling suspended motorized projection screen with low-voltage controller at unit. Nominal 137”, 16:10 aspect ratio.

3) Two (2) nominal 75” diagonal flat panel displays, wall mounted on side walls. Display to be utilized when room is in EOC mode or as confidence monitor during presentations and training sessions.

2. Video Systems & Sources:
1) Wireless Presentation Appliance for BYO PC’s in the room and under various configurations of seating to accommodate presentation needs without unnecessary infrastructure for PC connectivity.

2) Wired presentation cabling for PC’s at the lectern position on either side of each projection screen.

3) Document camera for display of small objects, print outs or written notes by presenter.

4) Digital media decoders for local sources, CATV channels, CAD computer or other content.

5) CATV tuner to be OFE. CATV cabling to Equipment Rack by others.

3. Audio Systems:
1) Wireless Lavaliere microphones, digital encrypted

2) Wireless Handheld microphones, digital encrypted

3) DSP matrix processor to mix and route audio sources. With audio-conferencing interface to POTS or SIP phone lines.

4) Voice enhancement along with audio accompanying video sources reproduced over ceiling speakers.

5) Assisted Listening System, IR based for security, compliance with ADA and TAS guidelines.

4. Control Systems:
1) Control system processor for integrated room control

2) Interfacing to:
   a. AV devices
   b. Lighting control
   c. Enterprise network
   d. Control interface for end user control on audio, video, lighting and electrical window shade.

3) Wall mounted touch screen control for each room section, 10” nominal diag.

4) Connection to NBPD network for remote monitoring and control.

5. Other Systems & Integration:
1) All headend equipment including AV network switch to be located in wall-mounted rack in adjacent storage room.

2) OFE Lectern to accommodate local devices including laptop and document camera and video encoder.

B. COMMUNITY MEDIA ROOM
This space is will have flexible seating to accommodate up to 76 participants for a variety of community activities and meetings. It will also function as space for NBPD to interface with the press. Front wall to be covered with NBPD identification. Identification wall should be a neutral
color with no repetitive horizontal or vertical patterns for best recorded video imaging. Audiovisual fit out will include:

1. Display Systems:
   1) One (1) 85” main flat panel display, wall mounted at center of the front wall.
   2) Two (2) 75” flat panel displays, wall mounted, and flanking the main display.

2. Video Systems & Sources:
   1) Wireless Presentation Appliance for BYO PC’s in the room and under various configurations of seating to accommodate presentation needs without unnecessary infrastructure for PC connectivity.
   2) Wired presentation cabling for PC’s at the lectern position on any of the 3 floor box locations at front of the room.
   3) Document camera for display of small objects, print outs or written notes by presenter.
   4) Digital media decoders for local sources, CATV channels, CAD computer or other content.
   5) CATV tuner to be OFE. CATV cabling to Equipment Rack by others.

3. Audio Systems:
   1) Wireless Lavaliere microphones, digital encrypted
   2) Wireless Handheld microphones, digital encrypted
   3) DSP matrix processor to mix and route audio sources. With audio-conferencing interface to POTS or SIP phone lines.
   4) Voice enhancement along with audio accompanying video sources reproduced over ceiling speakers.
   5) Assisted Listening System, IR based for security, compliance with ADA and TAS guidelines.

4. Control Systems:
   1) Control system processor for integrated room control
   2) Interfacing to:
      a. AV devices
      b. Lighting control
      c. Enterprise network
      a. Control interface for end user control on Control interface on audio, video, lighting and electrical window shade.
   3) Wall mounted touch screen control, 10” nominal diag.
   4) Connection to NBPD network for remote monitoring and control.

5. Other Systems & Integration:
   1) All headend equipment including AV network switch to be located in wall-mounted rack in adjacent storage room
   2) OFE Lectern to accommodate local devices including laptop and document camera and video encoder.

C. BRIEFING ROOM
   This space is utilized to brief patrol officers prior to their shift. Seating is fixed and should be provisioned with power including USB to support the officer’s portable devices. Audiovisual fit out will include:

1. Display Systems:
   1) One (1) 85” main flat panel display, wall mounted at center of the front wall.
2. Video Systems & Sources:
   1) Wireless Presentation Appliance for BYO PC’s and other devices in the room.
   2) Wired presentation cabling for PC’s from (1) wall mounted AV input plate.
   3) Digital media decoders for local sources, CATV channels, CAD computer or other content.
   4) CATV tuner to be OFE. CATV cabling to Equipment Rack by others.

3. Audio Systems:
   1) Wireless Lavaliere microphones, digital encrypted
   2) Wireless Handheld microphones, digital encrypted
   3) DSP matrix processor to mix and route audio sources. With audio-conferencing interface to POTS or SIP phone lines.
   4) Voice enhancement along with audio accompanying video sources reproduced over ceiling speakers.
   5) Assisted Listening System, IR based for security, compliance with ADA and TAS guidelines.

4. Control Systems:
   1) Control system processor for integrated room control
   2) Interfacing to:
      a. AV devices
      b. Lighting control
      c. Enterprise network
      d. Control interface for end user control on audio, video, lighting.
   3) Wall mounted touch screen control, 10” nominal diag.
   4) Connection to NBPD network for remote monitoring and control.

5. Other Systems & Integration:
   1) All headend equipment including AV network switch to be located in Server Room rack (by others).
   2) OFE Lectern to accommodate local devices including laptop and video encoder.

D. EOC ROOM 2014
This space is utilized as Emergency Operation Center. Seating is flexible. Audiovisual fit out will include:

1. Display Systems:
   1) One (1) ceiling-mounted video projector, suspended from a recessed in-ceiling projector service box, housing power/data and devices associated with the display and room systems.
   2) A recessed-style, ceiling suspended motorized projection screen with low-voltage controller at unit. Nominal 137”, 16:10 aspect ratio.
   3) Two (2) 75” flat panel displays wall mounted on each side wall, and one (1) 65” flat panel display on the back wall serving as confidence monitor (total of 5).

2. Video Systems & Sources:
   1) Wireless Presentation Appliance for BYO PC’s and other devices in the room.
   2) Wired presentation cabling for PC’s from (1) wall mounted AV input plate.
   3) Document camera for display of small objects, print outs or written notes by
presenter.
4) Digital media decoders for local sources, CATV channels, CAD computer or other content.
5) CATV tuner to be OFE. CATV cabling to Equipment Rack by others.

3. Audio Systems:
1) Wireless Lavaliere microphones, digital encrypted
2) Wireless Handheld microphones, digital encrypted
3) DSP matrix processor to mix and route audio sources. With audio-conferencing interface to POTS or SIP phone lines.
4) Voice enhancement along with audio accompanying video sources reproduced over ceiling speakers.
5) Assisted Listening System, IR based for security, compliance with ADA and TAS guidelines.

4. Control Systems:
1) Control system processor for integrated room control
2) Interfacing to:
   a. AV devices
   b. Lighting control
   c. Enterprise network
   d. Control interface for end user control on audio, video, lighting.
3) Wall mounted touch screen control, 10” nominal diag.
4) Connection to NBPD network for remote monitoring and control.

5. Other Systems & Integration:
1) All headend equipment including AV network switch to be located in IDF Room rack (by others).
2) OFE Lectern to accommodate local devices including laptop and video encoder.

E. ADMIN CONFERENCE 2504
This admin conference room will have fixed seating with floor boxes under the desk. Audiovisual fit out will include:

1. Display Systems:
1) Two (2) 85” flat panel displays wall, one on front wall and one on back wall.

2. Video Systems & Sources:
1) Wireless Presentation Appliance for BYO PC’s and other devices in the room.
2) Wired presentation cabling for PC’s from two (2) floor boxes, one on each end of the desk.
3) Digital media decoders for local sources, CATV channels or other content.
4) CATV tuner to be OFE. CATV cabling to Equipment Rack by others.

3. Audio Systems:
1) DSP matrix processor to mix and route audio sources. With audio-conferencing interface to POTS or SIP phone lines.
2) Audio playback over ceiling speakers.

4. Control Systems:
1) Control system processor for integrated room control
2) Interfacing to:
   a. AV devices
b. Lighting control
c. Enterprise network
d. Control interface for end user control on audio, video, lighting.

3) Desktop touch screen control, 10” nominal diag.
4) Connection to NBPD network for remote monitoring and control.

5. Other Systems & Integration:
1) All headend equipment including AV network switch to be located in wall mounted equipment rack in adjacent storage room
2) Table cubbies (total of 2) for audiovisual, power and telecom connectivity.

F. CRIMINAL INVESTIGATION CONFERENCE 2504
These rooms will have conference table with floor boxes under the table.
Audiovisual fit out will include:

1. Display Systems:
   1) One (1) 85” flat panel displays wall on front wall.

2. Video Systems & Sources:
   1) Wireless Presentation Appliance for BYO PC’s and other devices in the room.
   2) Wired presentation cabling for PC’s from one (1) floor box.
   3) Digital media decoders for local sources, CATV channels or other content.
   4) CATV tuner to be OFE. CATV cabling to Equipment Rack by others.

3. Audio Systems:
   1) Audio playback over TV built-in speakers.

4. Control Systems:
   1) Control system processor for integrated room control
   2) Interfacing to:
      a. AV devices
      b. Lighting control
      c. Enterprise network
      d. Control interface for end user control on audio, video, lighting.
   3) Wall-mounted touch screen control, 10” nominal diag.
   4) Connection to NBPD network for remote monitoring and control.

5. Other Systems & Integration:
   1) All equipment will be located in in-wall box behind the FPD. No equipment rack.
   2) Table cubby for audiovisual, power and telecom connectivity.

G. TRAINING 2101
This room will have fixed seats (total of 12) without floor box.
Audiovisual fit out will include:

1. Display Systems:
   1) One (1) 85” flat panel displays wall on front wall.

2. Video Systems & Sources:
   1) Wireless Presentation Appliance for BYO PC’s and other devices in the room.
   2) Wired presentation cabling for PC’s from one (1) wall AV input plate.
   3) Digital media decoders for local sources, CATV channels or other content.
   4) CATV tuner to be OFE. CATV cabling to Equipment Rack by others.
3. **Audio Systems:**
   1) Audio playback over TV built-in speakers.

4. **Control Systems:**
   1) Control system processor for integrated room control
   2) Interfacing to:
      a. AV devices
      b. Lighting control
      c. Enterprise network
      d. Control interface for end user control on audio, video, lighting.
   3) Wall-mounted touch screen control, 10” nominal diag.
   4) Connection to NBPD network for remote monitoring and control.

5. **Other Systems & Integration:**
   1) All equipment will be located in in-wall box behind the FPD. No equipment rack.
   2) OFE Lectern to accommodate local devices including laptop.

**H. OFFICES WITH TV**
These offices will have TV for CATV channels and AV presentation.
Audiovisual fit out will include:

1. **Display Systems:**
   1) One (1) 75” flat panel displays wall on one wall.

2. **Video Systems & Sources:**
   1) CATV tuner to be OFE. CATV cabling to Equipment Rack by others.
   2) Hardwired HDMI connection from desk and/or other designated AV input location.

3. **Audio Systems:**
   1) Audio playback over TV built-in speakers.

4. **Control Systems:**
   1) Use flat panel display’s remote control for audio and video control.

5. **Other Systems & Integration:**
   1) All equipment will be located behind the FPD. No equipment rack.

**I. Breakrooms and Gym**
These rooms will have wall-mounted flat panel display for CATV channels only.
Audiovisual fit out will include (per TV location):

1. **Display Systems:**
   1) One (1) 75” flat panel displays at designated wall.

2. **Video Systems & Sources:**
   1) CATV tuner to be OFE. CATV cabling to TV by others.

3. **Audio Systems:**
   1) Audio playback over TV’s built-in speakers.

4. **Control Systems:**
   1) Use TV remote control for audio and video control.

5. **Other Systems & Integration:**
   1) No AV equipment rack.
J. MAIN LOBBY
This space will have flat panel displays for digital signage display.
Audiovisual fit out will include:

1. Display Systems:
   1) One (1) 70” flat panel displays on wall.

2. Video Systems & Sources:
   1) Wireless Presentation Appliance for digital signage.
   2) CATV tuner to be OFE. CATV cabling to Equipment Rack by others.

3. Audio Systems:
   1) Audio playback over TV built-in speakers.

4. Control Systems:
   1) Use TV remote control for audio and video control.
   2) Use Immersive software for wireless presentation control and switching.

5. Other Systems & Integration:
   1) All equipment will be located in in-wall box behind the FPD. No equipment rack is required.

K. INTERVIEW ROOMS
This space will have flat panel displays for local display.
Audiovisual fit out will include:

6. Display Systems:
   1) One (1) 70” flat panel displays on wall.

7. Video Systems & Sources:
   1) CATV tuner to be OFE. CATV cabling to Equipment Rack by others.

8. Audio Systems:
   1) Audio playback over TV built-in speakers.

9. Control Systems:
   1) Use TV remote control for audio and video control.

10. Other Systems & Integration:
    1) All equipment will be located in behind the FPD. No equipment rack is required.

1.06 SUBMITTALS

A. General
   1. Refer to Division 1.
   2. Submit in quantities, format and timetable as required by General Conditions.

B. Product Data Binders
   1. Minimum number of Sets: four (4) or one (1) electronic copy on CD.
   2. Timetable
      a. Submit within thirty (30) days after award of contract.
      b. Submit simultaneously with Shop Drawings.
      c. Allow minimum of ten (10) business days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of
C. Shop Drawings
1. Minimum Number of Sets: four (4) or one (1) electronic copy on CD.
2. Timetable
   a. Submit within thirty (30) days after award of contract.
   b. Submit simultaneously with Product Data Binders.
   c. Allow minimum of ten (10) business days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of complete sets. If second resubmit is required, Contract shall reimburse Owner for expenses incurred during additional review process.
3. Description:
   a. Shop Drawings shall be used for coordination between trades and updated as final record drawings.
   b. Bind all Shop Drawings together to form set. Loose drawings will not be accepted.
   c. Each drawing shall include: Project, Building, Location, Contractor Name, Architect, AV Consultant, Date and Revision Number.
   d. Number and title each drawing in logical manner as a set.
   e. Include cover sheet with listing of all drawings included in bound set.
   f. Ensure that labeling on Shop Drawings match labeling on equipment.
   g. Minimum Scale:
      1) Floor Plans: 1/8 inch = 1 foot.
      2) Rack Elevations: 1-½ inch = 1 foot.
      3) Plate/Panel Details: 6 inches = 1 foot.
      4) Loudspeaker Details: 1 inch = 1 foot.
   h. Include as a minimum:
      1) Floor plans indicating locations of all AV devices, vertical risers, pull boxes, and exposed wiring. Include Device ID (PRJ, SCREEN, FRK, FB, AVP, etc., as referenced in design contract documents), as appropriate for projectors, screens, racks, floor boxes, AV plates in walls, etc.
      2) Schematic diagram showing all primary and secondary devices, interconnectivity and signal flow.
      3) Plate details showing size, material, finish, connectors, engraving, etc.
      4) Mounting detail drawings of loudspeakers, racks, and overhead equipment. Hire services of professional structural engineer, licensed by the appropriate governing authority, to review shop drawings, building structural drawings, and any existing structures from which equipment is to be suspended. Include Structural Engineer’s stamped report with shop drawing submittal. Report shall include:
         a) Itemization of items reviewed by the Structural Engineer.
         b) Confirmation that proposed methods of suspending equipment as shown on the shop drawings conform to required safety factors.
         c) Confirmation that building structure from which equipment is to be suspended will support equipment including required safety factors.
      5) Rack elevations.
      6) Complete schematic diagram. One-line diagram with detailed descriptions of product inputs and outputs is acceptable. Include terminal strip details and cable
label information. If wiring diagram spans more than three (3) sheets, additionally provide simplified block diagram of entire system on one (1) sheet.
7) Electrical power wiring diagram. Include circuit, switching, and control details.
8) Wiring diagram of grounding and shielding scheme.
9) Drawings for custom-fabricated items (i.e., plates, panels, cables, and assemblies).
10) General construction drawings necessary for completion of work.

D. Operation and Maintenance Manuals
1. Minimum number of Sets: four (4).
2. Bind Operation and Maintenance Manuals using either GBC or 3-ring binders.
3. Format and Minimum Information below:
   a. Section 1 - System Operation.
      1) Introduction/overview to system components and their functions and locations. Include a brief listing of basic system functions.
      2) Complete but simple system operating instructions to accomplish basic system functions, written for non-technical personnel.
      3) Certificate indicating names of Owner personnel trained by AV Contactor, date of training, name of AV Contractor representative that provided training, and name of project.
   b. Section 2 - System Documentation.
      1) Simplified system one-line schematic diagram showing changes made during construction.
      2) Complete inventory of system components including serial numbers. Identify location (equipment rack, over stage, stored in control room, etc.) of each component.
      3) Cable and terminal strip documentation including cable numbers, functions, originating locations, terminating locations, and signal levels.
      4) All Shop Drawings corrected to reflect as-built conditions.
      5) Other data and drawings required during construction.
      6) Initial Tests and Adjustments data.
      7) Final Tests and Adjustments data.
      8) CD-ROM discs including all utilized manufacturer’s software and saved copies of software configurations (configurations as established during Final Tests and Adjustments).
   c. Section 3 - Manufacturer’s Documentation.
      1) For each equipment model at no additional costs to Owner, even if manufacturer does not include costs of such documentation with purchase of equipment item.
      2) Manufacturer’s Product Data.
      3) Operating instructions.
      4) Installation instructions.
      5) Service information.
      6) Schematic diagrams.
      7) Replacement parts list.
   d. Section 4 - Maintenance Information.
      1) Preventive maintenance schedule letter clearly stating target dates of six month and end-of-warranty preventative maintenance inspections, and list of maintenance tasks performed.
      2) Maintenance instructions including manufacturer’s recommended maintenance, recommended maintenance schedule and information concerning proper inspection, testing, and replacement of components.
3) Troubleshooting information complete with instructions for procedures during equipment failure.

e. Section 5 – Warranty Information
   1) System warranty letter.

4. Provide three (3) sets on CD-R disc that include all material in Operation and Maintenance Manuals in PDF format except for copyrighted material.

5. Submit one (1) set of Operation and Maintenance Manuals at least ten (10) days before Final Tests and Adjustments procedures (minus data from Final Tests and Adjustments). This set will be reviewed by Owner and returned to Contractor. Re-submit after Final Tests and Adjustments and include data. NOTE: Do not schedule Final Tests and Adjustments or perform training of Owner personnel before submitting Operation and Maintenance Manual.

6. Submit remaining number of complete manuals as required by General Conditions within ten (10) days after return of reviewed set(s). Include Final Tests and Adjustment data, warranty period letter, and any other data not included in first submission.

E. Samples.
   1. Request for Samples - Upon request, furnish samples (at no additional cost) to Owner and/or General Contractor of submitted items proposed as substitutes for specified items. Products will be reviewed to determine if proposed substitute items meet required function and quality.

   2. Product Tests
      a. Products submitted as samples may require testing by independent laboratory. Testing at expense of Contractor.
      b. Obtain written approval of tested products before incorporating into system.

1.07 QUALITY ASSURANCE

A. AV Contractor Qualifications.
   1. Be established AV System Contractor, regularly engaged in furnishing and installing AV systems. NOTE: Electrical or general contracting firms responsible for completion of this work, but not meeting above requirement, shall employ services of approved AV Contractor as subcontractor to perform work described herein.

   2. Be experienced in installations of similar size and scope within last five (5) years. Submit list of four (4) (minimum) installed jobs of similar magnitude, completed within last five years. For verification, submit complete information, including project name, project address, contact person, daytime telephone number plus month and year of project completion. At Owner’s request, accompany Owner or Owner’s representative on visit to any or all example completed projects submitted.

   3. Be Authorized Dealer for all major lines of equipment listed in Part 2 (Biamp, Chief, Crestron, JBL, Middle Atlantic, Shure, etc.) Must have at least one permanent staff member who is factory trained in the installation and maintenance of each major product line offered.

   4. Employ personnel (at all levels of work) experienced in projects of similar size and scope. Provide list of key personnel to be responsible for each of the following aspects of work: Project Management, Technical Documentation, Control System programming, DSP programming and Leadership of Field Work (one who is present for all field work). For each identified employee, indicate number of years employed by contractor, number of years experience in assigned responsibilities, and list of previously completed projects where similar responsibilities were required.

   5. Project manager assigned to this project must have a minimum of five (5) years experience in installing and integrating AV systems of similar scale. Project Manager shall also have either an AVIXA CTS-I or CTS-D certification.
PART 2 - PRODUCTS

2.01 GUIDELINES

A. Infrastructure Products – All conduits, basket tray/cable tray, pull boxes and associated parts required for infrastructure shall be installed by the electrical contractor unless specifically excluded in these specifications or drawings.

B. Performance - Regardless of completeness of descriptive paragraphs herein, each device shall meet its manufacturer’s published specifications. Verify performance.

C. Contract Documents - Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general the specifications determine the nature and quality of the materials, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to in the installation of the AV system components. If there is an apparent conflict between the drawings and specifications, the items with the greater quantity or quality shall be provided and installed. Clarification with the owner about these items shall be made prior to the ordering and installation.

D. Quantities – All quantities are indicated on AV drawings or in Part 2 AV Products list. Confirm quantities on final Contract Documents. If Contract Documents do not include quantities necessary to deliver complete working system, provide notification of disparity, and install required quantity of devices for complete working system.

E. Small Parts - Systems are described in terms of major products. Even if not specifically mentioned, provide and install patch cables, connectors, hardware, converters, power supplies, labels, terminals, mounting accessories etc. necessary for complete and working system meeting design intent of specifications.

F. Keys - Provide five (5) sets of keys for any AV system product requiring keys.

G. Condition - Provide and install products listed in this section in factory new condition, conforming to applicable provisions of American National Standards Institute.

H. Designations - Each major product item is given unique designation (such as MIX1 for mixer number 1). The product designations are unique in this section only and may be repeated in other specification sections.

I. Security Screws - Use Bryce Security Penta-Plus button-head screws and bits to secure rack components, LCD mounts, Projector mounts and any other location deemed necessary by Owner. Use nylon washers (not provided by Bryce) to protect equipment surfaces. Account for appropriate tip wear when ordering quantity and do no use a bit beyond the manufacturer’s recommendations. Provide ten (10) additional unused driver bits and deliver to the customer after completion.

J. AV Electrical Power - Coordinate with Electrical Contractor regarding proper placement of isolated-ground duplex outlets for any AV equipment. Electrical circuits should be connected (and outlets wired) by the Electrical Contractor to the AV system circuit breaker panel (N.I.C.).
Ensure that “Star” ground configuration is properly implemented by the Electrical Contractor. Ensure that ground wires from each outlet are isolated from conduit, neutrals, and each other.

K. AV Screens – For any screen specified, size as indicated in drawings. Unless otherwise indicated in drawings or specifications, set limits so projected images are 48” above finished floor, and include additional black drop as appropriate considering screen size and mounting height.

L. AV Racks:
1. Provide blank faceplate in any area marked BLANK in drawings.
2. Provide shelf for mounting of any device for which rack mount kit is not available.
3. Provide one (1) Panelcrafters DBR-XXXXX-RHIM-01 designer/integrator information plate or approved alternate per rack. Install information plate at the top of each rack unless 1RU space is not available. Contact Panelcrafters sales department to add AV Contractor graphic to the “integrator” section (approximately 8.5” x 1.75” of the right-hand side). All alternates must include AV Consultant graphic. Submit to AV designer for approval of final plate design prior to purchasing and installation.

M. AV Floor Boxes:
1. Clean floor boxes of all dust and debris prior to installation of any active or connectorized plate.
2. Any floor box with active or connectorized AV plates found to have any dust, debris or water in bottom of box are subject to replacement of all plates and components. A re-test of all associated components must be completed.

N. Wireless Microphones - Coordinate frequency selection with other radio-frequency sources in the area and with manufacturer’s recommendations.

O. Control System Programming:
1. Program each panel to provide simple, intuitive control of all basic AV functions including:
   a. program and speech volume levels
   b. video source and destination routing
   c. screen control
   d. video projector lift control (where applicable)
   e. AV system power
   f. media player transport functions
   g. video conferencing CODEC controls including call initiation (where applicable)
   h. video conferencing PTZ camera control (where applicable)
   i. combine/uncombine settings for all combinations of controlled rooms
   j. local lighting and blackout shade controls (where applicable)
2. Utilize AVIXA’s “Dashboard for Controls” concept and Crestron’s SMART GRAPHICS for touch panel layout unless directed otherwise by Owner.
3. Provide layout of each and every touch panel and hard-button panel pages in the product data submittal for approval by Owner.
4. Provide web-control for each touch panel in AV system. Include page tracking, and track current button feedback between touch panel and web-control panel.
5. Staff member certified by control system manufacturer shall program control system.
6. After programming is approved, all control system code and programming, including touch panel code and graphics, will become property of Owner. AV Contractor shall provide Owner both raw and compiled code on CD-R disc.
7. Provide follow up meeting with Owner after 6 months of operation to make updates as requested to control programming.
P. Audio System Programming - Owner shall coordinate layout and logical branching of DSP audio system. Include screen layout and menu branching drawings in AV submittal. After AV system is approved, all audio control system code and programming will become property of Owner. AV Contractor shall provide Owner both raw and compiled code on CD-R disc.

Q. AV Design Bid & Substitutions:
1. System design is around products listed in Part 2. Intent of product specification is to provide standard of quality and function for installed materials. Certain performance specifications are given to clarify job requirements.
2. Bid AV system with products specified in Base Bid section below unless noted otherwise from Owner.
3. No substitutions will be allowed without prior approval from Owner specific to proposed manufacturer and model numbers.
4. Equipment listed in Part 2 is based on performance criteria to meet Owner design requirements.
5. All requested substitutions need to meet or exceed performance of devices listed in Part 2. For each request provide manufacturer’s published specifications to verify performance and explain functional and cost impact.
6. Evaluation and approval of substitution requests will be performed by Owner.

2.02 ALL ELECTRONIC PRODUCTS
A. Shall operate on 120 to 240 VAC at 50/60 Hz.
B. Shall be capable of operating continuously for 12 hours over the external ambient temperature range of +10°C to +65°C (20% to 95% humidity, non-condensing) without permanent damage.
C. All programmed, software based microprocessor based control and DSP devices shall be powered by a UPS supply capable of providing ½ hr. minimum backup.

2.03 MANUFACTURERS
A. Any use of trade names in the equipment list (Appendix A) or on the bid document drawings is to establish a performance standard to be used. Unless noted on the equipment list, it is not intended to exclude other products whose performance, in the judgment of the Systems Designer, is equivalent to those named.
B. All proposed alternates and substitutions from the equipment list shall be submitted in writing for approval by the Owner and Consultant prior to submittal of bid documents. No substitutions shall be considered acceptable without written approval.
C. Materials: Supply materials and equipment that shall be new and shall meet or exceed the latest published specifications of the manufacturer.
D. Supply the latest model, available at the time of bidding, of each piece of equipment. The Owner may request, at their option, that the latest model of equipment, or new technology, available at the time of installation be provided. If a later model is requested, adjustments will be made to cover cost changes between the cost at bid submittal and the cost of the latest model at the time of installation.
E. The equipment list is furnished as a guide and does not represent all equipment required to accomplish the specification. Some listed equipment may require power supplies,
interfaces, cables, mounting hardware and/or other items to function and/or interface with other subsystems. The specification requires a complete working system. The quantities of pieces of equipment have been purposely left out. Equipment quantities are furnished if the quantities cannot be easily determined from the specifications or drawings.

2.02 MATERIALS
A. See Equipment Schedule in Appendix A for listing of specified equipment

PART 3 - EXECUTION

3.01 INSTALLATION

A. General Guidelines
1. Quality of Work - Perform labor to accepted industry standards and state and local codes to accomplish complete and working system.
2. Material and Labor - Provide specified products and other incidental materials, appliances, tools, and transportation required for complete and functioning systems. Provide personnel to perform labor who are skilled in techniques and can demonstrate technical knowledge of AV infrastructure system installations.
3. Documents at Job Site - Keep following documents at job site during entire construction period:
   a. Complete Specifications and Drawings.
   b. Approved Shop Drawings.
   c. Approved Product Data.
   d. Progress Set of Project Record Documents.
4. Mounting - Mount equipment and enclosures plumb and square. Ensure that permanently installed equipment is firmly and safely held in place. Design equipment supports to support loads imposed with project safety factor of five (5) or greater. For devices hung overhead, obtain review by Structural Engineer licensed by the appropriate governing authority prior to installation.
5. Dimension Verification - Verify dimensions and space requirements to assure that proper mounting, clearance, and maintenance access space is available for system components.
6. Clean-Up - Leave project clean each day. Place debris where designated by General Contractor. Debris includes but not limited to: solder splatter, cable ends, stripped insulation, spent crimp connectors, gypsum board and ceiling tile dust, and product wrappings and cartons. After completion of installation, thoroughly clean areas worked, including non-visible areas such as equipment rack interiors, rack top panels, and inside lockable floor and wall boxes.
7. Coordinate installation of AV infrastructure and equipment with other trades in order to follow project schedule.
8. Maintain any licensing required by the appropriate governing authority to install and terminate low voltage systems.

B. Labeling
1. Equipment Labels - AV Contractor shall provide engraved lamicoid labels on front and rear of rack-mounted equipment. Mount labels plumb and square. Include schematic reference design, item name, and system or area controlled by labeled component. On program preamps and mixers, provide label for each input indicating which source is controlled by
labeled channel. Unless otherwise indicated, provide permanently-mounted black labels engraved with 1/8-inch white block characters. Handwritten, self-laminating, or embossed plastic (Dymo) labels are not acceptable. Provide labels for major equipment with two (2) lines (minimum) of engraving, coded as follows:

a. Line 1: Generic name of device, such as MIXER AMPLIFIER.

b. Line 2: Schematic designation of device, such as AV-MSW-1.

2. Control Labels – AV Contractor shall provide engraved label over each user-operated control that describes the function or purpose of control. Provide label of proper size to fit available space.

3. Terminal Strip Labels - AV Contractor shall label each terminal strip with unique identification code in addition to numerical label (Cinch MS series) for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Documents.

4. Rear Equipment Labels - AV Contractor shall provide adhesive label on rear of equipment where cables attach, to indicate designation of cable connected at each point.

5. Cable and Wire Labels - Label cables and wiring logically, legibly and permanently for easy identification. Labels on cables shall be adhesive strip type, covered with clear heat shrink tubing. Factory stamped heat shrink tubing may be used. Hand-written or self-laminating type labels are not acceptable.

6. Cable Label Codes and Locations - Label each cable with unique alpha-numeric code. Locate cable designation at start and end of each cable run, within three (3) inches of termination point. For cable runs that have intermediate splice points, label cable with same designation throughout, with additional suffix to indicate each segment of run. Provide cable designation codes to schematic drawings included with Project Record Documents and Operation and Maintenance Manuals.

C. Power and Grounding

1. Power Coordination – Coordinate final connection of power and ground wiring to rack. Electrical contractor will provide power to AV systems. Before installation, verify load requirements for systems as accepted.

2. Bus Bars - Install 1-inch by ¼-inch copper ground bus bar, top to bottom in floor mounted AV racks. Ground and bond equipment chassis of each rack-mounted component without three-pin grounding plug to bus bars with #12 AWG insulated green wire using 6-32 or larger nuts, bolts, lock-washers, and appropriate NEMA connectors. Electrical Contractor (Division 16) shall provide and connect #4 AWG green insulated wire from Bus Bars to ground point in AV technical electrical panel.

D. Equipment Racks

1. Ventilation - Provide ventilation adequate to keep temperature in rack below 85 degrees Fahrenheit. Use “whisper” type ventilation fans in racks, adjusted to come on when temperature in rack rises above 85 degrees Fahrenheit, only if adequate cooling cannot be provided by Owner.

E. Wiring

1. Wiring Standards - Execute wiring in strict adherence to best AV engineering practices.

2. Field Connection Devices - Connect cable to active components through screw terminal connections and spade lugs when appropriate. For BNC connections use three-piece, dual crimp BNC properly sized for cable with insulating bushings. Wire nut or “Skotchlock” connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive

27 4116 - 16
INTEGRATED AUDIO-VIDEO SYSTEM AND EQUIPMENT
backed tape. Punch connectors or telephone-style punch blocks are not acceptable anywhere in the installation unless specifically authorized by Owner.

3. Run cable in ceiling plenums neatly parallel to building walls, supported every three feet to structure with plenum rated ties.

4. Raceways - Run vertical wiring inside rack in Panduit (or equivalent) plastic raceways with snap-on covers, sized to allow at least 50% future wiring. Mount raceways on full length ¾-inch flat black plywood backboards, attached to rack sides. If between-rack wiring chases are provided, Panduit raceways are not required. Horizontal wiring in rack shall be neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack, but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Individually bundle excess AC power cable away from rack mounted equipment with plastic cable ties. Electrical tape and adhesive backed cable tie anchors are not acceptable.

5. Accessibility - Ensure that wiring and connections are completely visible and labeled in rack. Mount termination resistors, if required, on terminal strips, fully visible and not concealed within equipment or connectors.

6. Loudspeaker Polarity - Connect loudspeakers electrically in phase, using same wire color for loudspeaker wiring throughout project.

7. Physical Damage Prevention - Take necessary precautions to prevent physical damage to cables and equipment. Damaged cables or equipment will not be accepted. Separate, organize, and route cables to restrict channel crosstalk and feedback oscillation.

8. Racks - Looking into the rack from the rear, locate AC power, control, data and speaker wiring on the left; line level audio, control, video, and RF wiring on the right. Keep several inches of space between power cables and other signals.

9. Other Connections - Make connections using rosin core solder or approved mechanical connectors. Where spade lugs are used, crimp properly with ratchet type crimping tool. Solder spade lugs mounted on #22 AWG or smaller cable after crimping.

3.02 STORAGE AND HANDLING

A. Power up any electronic equipment to ensure its proper functioning before its arrival onsite.

B. Ensure that materials (especially electronic and electro-acoustic devices) are protected against physical, environmental, and electronic damage until final acceptance by Owner.

C. Schedule delivery to minimize delays in the project.

D. Provide storage protection against temperature and humidity extremes, theft, vandalism, physical damage, and environmental damage.

3.03 WARRANTY

A. Refer to Division 1.

B. Warranty - Submit letter providing warranty covering labor and materials supplied under this contract. Bind in Operation and Maintenance Manuals. Terms as described in General Conditions. Minimum terms as follows:

1. System - Systems shall be free of manufacturing or installation defects for a minimum period of one (1) year from the date of final acceptance. Clearly designate begin and end dates of system warranty period.
2. Parts and Labor - Provide parts and labor to repair defects in materials and workmanship during system warranty period.

3. Response Time - Within system warranty period, provide initial on-site service response within one (1) business day of service call. Provide resolution to any system defects within 72 hours or within 48 hours of receipt of repaired or replaced product from manufacturer.

4. Replacement Products - If any item must be removed for repair during system warranty period, provide replacement item of similar quality at no charge.

5. Repair Limit - Do not repair any piece of equipment found defective during installation or system warranty period more than two (2) times. After second repair, replace defective item with similar approved item at no additional cost to Owner.

6. Extended Manufacturer’s Warranties – Identify products with manufacturer’s warranties extending beyond one (1) year. Provide terms and conditions of such warranties.

7. Service Personnel Information - Provide name(s) and telephone number(s) of service personnel to be contacted regarding repair and maintenance.

C. Extended Warranty - Provide cost to extend complete AV system warranty from one (1) year to three (3) years. Included a list of all provided services including maintenance schedules.

3.04 INITIAL TESTS

A. Purpose – These tests are to ensure that the AV system is installed and functioning as specified, and to ensure the system is ready for Final Tests and Adjustments (described later).

B. Testing Standards – Perform testing in accordance with ANSI standards.

C. Inspection - Verify prior to beginning actual tests and adjustments on systems:
   1. Proper grounding of all electronic components (through third prong of power connector or separate connection between component chassis and ground bus bar).
   2. Cables dressed, routed, and labeled, connected with proper polarity.
   3. Insulation and shrink tubing in place.
   4. Dust, debris, solder splatter, etc. removed.
   5. Proper frequency settings (or modules) at crossovers and controllers.
   6. All equalizer bands and tone controls set for flat frequency response.
   7. Survey temperatures of each piece of equipment after four (4) hours use (minimum). Note and report any hot equipment.

D. Electrical Power Quality - While all sound and AV system components are unplugged from electrical power outlets, AV Contractor shall turn on power to outlets, and confirm proper voltages at each outlet across the following pairs of terminals: hot and neutral, hot and ground, and neutral and ground (zero volts across neutral and ground). AV Contractor to document measurements.

E. General Function Tests - Test each piece of equipment to ensure that it performs its intended function. Include all portable equipment in tests. Intent of initial tests is to verify complete, functioning system before Final Tests and Adjustments. Correct problems found during initial testing before beginning Final Tests and Adjustments. Document whether all pieces performed intended functions; note any unresolved malfunctions.

F. Initial Tests and Adjustments Data - Submit written report of Initial Tests and Adjustments data upon completion to Owner. Include printed name(s) of technician(s) performing tests, date(s) and time(s) of tests, model and serial numbers of test equipment, results of each initial test,
3.05 FINAL TESTS AND ADJUSTMENTS

A. Purpose – These tests are to be witnessed by AV Consultant to determine if system is complete and functioning as designed and specified. Also, AV Consultant will perform listening and viewing tests and witness adjustments of all images for optimum clarity.

B. Timetable - Coordinate with Owner, General Contractor, and AV Consultant to schedule Final Tests and Adjustments after submittal of Initial Tests and Adjustments data.

C. System and Site Conditions – AV Consultant will witness Final Tests and Adjustments. Have systems fully functional and ready for observation and testing upon AV Consultant’s arrival. Coordinate with all trades for quiet conditions throughout the listening areas and for the duration of the test schedule. If upon AV Consultant’s arrival, systems do not meet criteria, site is not sufficiently quiet, or if Owner or AV Consultant is required to make additional trips to job site to witness additional testing or perform additional reviews of installed equipment, Contractor shall reimburse Owner for labor and expenses incurred by having incurred costs deducted from payments to contractor.

D. Test Labor - Provide technician familiar with this project’s AV systems and operation of test equipment to perform testing. Provide additional technician to assist in the tests and to perform troubleshooting, repairs, and adjustments. Include labor for these technicians to be present for one (1), eight (8)-hour day during Final Tests and Adjustments.

E. Tools - Provide standard hand tools including screwdrivers, pliers, wire strippers, nut drivers, soldering iron, and other tools appropriate for troubleshooting system problems.

F. Ladders and Scaffolds - Provide ladders and scaffolds to inspect/adjust loudspeakers and rigging points.

G. Verification of Initial Tests and Adjustments - Verify that Initial Tests and Adjustments have been performed and meet criteria. During Final Tests and Adjustments, AV Consultant may require portions of the Initial Tests and Adjustments to be repeated. Repeat measurements as requested without claim for additional payment.

3.06 FINAL ACCEPTANCE BY OWNER

A. Certificate – Submit Certificate of Final Acceptance form signed by Owner verifying complete installation and proper operation of systems upon fulfillment of all requirements and upon recommendation by Owner.

B. General Adjustments – Adjust, balance, and align equipment for optimum quality, meeting manufacturers published specifications.

C. Input/Output Jack Demonstration – Demonstrate proper performance and phase of each system input and output jack (all audio input and output jacks) as received at AV and network systems.

D. Inventory – Inventory all installed and portable equipment for correct quantities.
E. Functional Demonstration – Demonstrate operation of each function of each major piece of equipment.

F. Other Tests - Perform any other tests on any part of the AV system as requested by Owner.

G. Final Equipment Settings – Record final settings of all equalizer bands, tone controls, filters, delays, limiters, etc., including those established through computer software settings. Include descriptions of settings (including software settings) in Operation and Maintenance Manual. Include software copy of configuration file(s) in Operation and Maintenance Manual.

H. Security Inspection – Inspect equipment for security from tampering (covers, shaft-locks, etc.).

I. Review of Labels – Review installed labels on cables, equipment, controls, and terminal strips.

3.07 OWNER TRAINING

A. Provide Owner training as described in General Conditions. As a minimum, provide eight (8) hours instruction (within two (2) trips to site) regarding AV Systems operation to Owner-designated personnel. Schedule instruction time(s) with Owner to occur after completion of Final Tests and Adjustments. Coordinate with Owner in advance to schedule instruction time. Document date, time, and attendees of the training session and include documentation in Operation and Maintenance Manuals to serve as record of trained personnel.

3.08 SUPPORT DURING OWNER’S FIRST USE OF COMPLETED SYSTEM

A. Provide personnel familiar with design, installation, and operation of each system to be present at Owner’s first use of each completed system (up to eight (8) hours total in a single session). During first use of each system, respond to Owner requests for troubleshooting, adjustments, and additional training. If no one contractor employee or representative can provide expertise in all aspects of the system, provide multiple personnel for the eight (8) hours per session as required. Schedule presence of personnel in advance with Owner. Should significant elements of the new system be operational prior to final completion, Owner may elect to schedule contractor presence for Owner function prior to final completion of system. Should Owner exercise this option, contractor presence will not be required at first use following final completion.

END OF SECTION
SECTION 27 41 31 – CATV SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes the requirements for provision and installation of the community antenna television (CATV) system components. This shall include directional couplers, feeder cable, drop cable and required accessories for a complete and operable system. System head-end components will be provided by others. Contractor shall coordinate with head-end provider for connection to and testing of the system.

B. Provide RG6/11 plenum rated Coaxial cable home run from each TV outlet to IDF room.

C. Provide 0.5” coax trunk cable from MDF(server room) to each IDF room.

D. Related Sections include the following:
   1. 27 05 00 Common Work Results
   2. 27 05 26 Communications Grounding and Bonding
   3. 27 05 28 Communications Pathways

1.3 SUBMITTALS

A. Shop Drawings:
   1. System block diagram.
   2. Details of system equipment installed in the communications room racks and on walls, including wiring diagrams.
   3. Details of connections to power sources, including power supplies and grounding.
   4. Details of interconnection to signal transmission media.

B. Product Data: Submit cut-sheets including name of manufacturer, trade name, and model number of each component. Indicate related specification section number, specification paragraph numbers, and reference standards for each product.

C. Loss Calculations: Submit loss calculations for the entire system including tap values.

D. Record Drawings: Furnish CAD drawings of all installed cabling and equipment.

E. Contractor shall submit a testing plan that meets the requirements of paragraph 3.3 in this Section.

F. Contractor shall submit test results consisting of tabulated measurements of all ports.
on the active and passive system components as well as any final gain settings and attenuator values used to optimize the system.

G. Contractor shall submit Operation and Maintenance Manuals for the equipment provided under this project. The manuals shall be inclusive all documentation and software supplied with each product. Include the training syllabus and training materials to be provided for the training required under paragraph 3.4. Operations manuals shall be submitted for approval a minimum of 10 days before scheduled training.

1.4 REFERENCES

A. The publications listed within this specification form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer’s instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts
   1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
   2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

D. References
   2. Society for Cable Television Engineers (SCTE), Publications and industry standards.
   4. Underwriters Laboratories (UL) Cable Certification and Follow Up Program
   5. National Electric Code (NEC), section 820
   6. UL Testing Bulletin

1.5 QUALITY ASSURANCE

A. All components installed for this distribution system shall be industrial grade equipment designed for commercial CATV systems.

B. Contractor Qualifications
   1. The Contractor must adhere to the engineering, installation and testing procedures provided by the manufacturer and utilize the authorized manufacturer components and distribution channels in provisioning this Project.
   2. Must provide three references for projects of equivalent scope, type and complexity of work completed within the last three years. The Contractor shall use only qualified installation personnel experienced in similar type installations.
3. The Contractor shall possess the required license classification, performance history, and experience in installation of CATV systems. The Contractor shall submit written proof that the following experience requirements are being met.

4. Hardware Manufacturer’s Experience: All components shall be produced by manufacturers who have been regularly engaged in the production of CATV systems and components of the types to be installed for at least five years.

1.6 CONTRACTOR DUTIES

A. Perform all work; provide all products, systems integration, engineering, design work, and testing required for the project in order to ensure fully operative systems and proper installation of equipment.

B. Provide system documentation and submittals.

C. Provide warranty and maintenance support.

D. Provide calculations and analysis to support design and engineering decisions as specified in submittals.

E. Provide and pay for all labor, materials, and equipment. Pay required sales, gross receipts, and other taxes.

F. Secure and pay for plan check fees, permits, fees, and licenses necessary for execution of work as applicable for the project.

G. Provide required notices.

H. Comply with codes, ordinances, regulations, and other legal requirements of public authorities that bear on performance of work.

I. The Contractor shall perform pre-delivery testing, site testing, and adjustment of the completed CATV system. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing.

J. The Contractor shall calibrate and test all equipment, verify CATV system operation, place the integrated system in service, and test the integrated system. The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations, including written certification to the Project Manager that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure.

K. All equipment shall be installed in a professional manner by a certified technician, in accordance with good construction and engineering practices. Test results and as-builts drawings shall be delivered to the Owner or upon completion of the project.

1.7 MAINTENANCE AND SUPPORT
A. Base: The Contractor shall provide maintenance and support of all hardware and software associated with this system for the first year. The maintenance services to be provided by the Contractor shall include preventive, routine, and emergency maintenance services as defined below under optional maintenance and support.

B. Optional: The Contractor shall provide option pricing for maintenance and support for five years following the warranty period. The option pricing shall be given as a guaranteed maximum annual cost. This service is to include parts, labor, licenses, and all other Contractor costs required to keep the equipment operational. Pricing shall be provided for the following two levels of support:
   1. Twenty-four hour a day, seven day a week telephone support, plus eight hour on-site emergency support
   2. Twenty-four hour a day, seven day a week telephone support, plus two hour on-site emergency support

C. Preventive and Routine Maintenance: During the first year, preventative and routine maintenance services shall be provided in accordance with the provisions of the maintenance manual the Contractor issues for each component. Preventative maintenance services shall include inspection, test, necessary adjustment, lubrication, parts cleaning, and software upgrades. Routine maintenance services shall include scheduled overhauls as recommended by the equipment and software manufacturer.

1.8 WARRANTY

A. The warranty on all cabling and connecting hardware of the distribution system to this specification shall be for a period of not less than five years. The connecting hardware shall have a lifetime extended warranty against defects in material and workmanship. If items supplied as part of this project have longer warranties, Contractor shall supply longer warranty.

B. The warranty on all distribution electronics, including taps and passives of the distribution system to this specification shall be for a period of not less than one year. If items supplied as part of this project have longer warranties, Contractor shall supply longer warranty.

C. The warranty shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s).

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the specification include, but are not limited to, the following:

1. Arris
2. Scientific Atlanta
3. Blonder Tongue
4. Toner
2.2  EQUIPMENT REQUIREMENTS

A.  Power Supply
   1.  Wall mountable
   2.  60 V AC @ 3.5 A, max 8 A

B.  Power Inserter
   Frequency range, 5 MHz to 1 GHz
   1.  Shall be capable of passing 15A, 60/90 V AC, 50/60 Hz
   2.  Insertion loss shall not be greater than
       a.  0.6 dB @ 5MHz
       b.  1.4 dB @ 1GHz

B.  Bi-Directional Couplers
   1.  Arris Regal series or submitted and Owner approved equivalent.
   2.  Frequency range, 5 MHz to 1 GHz
   3.  Output shall have a flat insertion loss of 8.5 dB on high loss leg. Low loss leg shall have an insertion loss not greater than:
       a.  1.7 dB @ 5 MHz
       b.  3.0 dB @ 1 GHz

C.  8-Port Taps
   1.  Arris Regal series RMT 2000 or submitted and Owner approved equivalent.
   2.  Frequency Range, 5 MHz to 1 GHz

D.  Amplifiers
   1.  Blonder Tongue BIDA 5800 series - BIDA 100A-30 (gain as required per system calculations) or equivalent.
   2.  Minimum Frequency Gain: 30 dB
   3.  Forward pass band from 54 – 862 MHz
   4.  60 and 90 V AC powering capability
   5.  15 ampere (steady state) and 25 ampere (surge survivability)

E.  EQUIPMENT PERFORMANCE REQUIREMENTS
   1.  The CATV system shall be capable of delivering CATV channels 2 through 135.
   2.  The CATV system shall be two-way compatible with the ability to transmit all frequencies between 5 and 40 MHz from the wall plate back to the head-end.
   3.  The forward signal level at each wall outlet shall have no greater than a 10 dB tilt across the bandwidth of the distribution system, 54 to 862 MHz. The signal level shall not fall below 3 dBmV and shall not exceed 8 dBmV.

2.2  MATERIAL

A.  Contractor is responsible for all hardware, connectors, tools, and test equipment of any kind necessary to accommodate the system installation, operation, testing, or maintenance.

B.  All connecting hardware installed for this distribution system shall be industrial grade components designed for commercial CATV systems and designed to be used with the installed cable.
1. The “F” connectors used for RG-6 or RG-11 drop cable shall be a one-piece connector that must be crimped on the cable with a hexagon style crimper.

C. All equipment associated with the system shall operate from 5 MHz to 1 GHz as a minimum.

D. **Coaxial drop cable for lengths less than 150 feet shall be RG-6 plenum cable, F6 series** as manufactured by Comm/Scope, Inc, or submitted and Owner approved equivalent.

E. Coaxial drop cable for lengths greater than 150 feet shall be RG-11 plenum cable, F11 series as manufactured by Comm/Scope, Inc, or submitted and Owner approved equivalent.

F. Non-locking 75-Ohm terminators shall be installed on all unused ports on splitters, directional couplers, and multi-port taps.

G. Coaxial trunk cable shall be 2312K (P3 500 JCAP) plenum cable, or P3 625 for inter-building application, as manufactured by Comm/Scope. Contractor is cautioned to exercise care in handling this 1/2 inch cable as it can be easily damaged. Install with wide-sweeping turns.

### PART 3 – EXECUTION

#### 3.1 GENERAL

A. Verify backboards are properly installed.

B. Verify cable pathways are properly installed.

C. Verify main grounding system is properly installed and tested.

#### 3.2 INSTALLATION

A. Install work following drawings, manufacturer’s instructions and approved submittal data.

B. The CATV system installation shall meet all applicable national and local codes pertaining to low voltage cable system installations.

C. The Contractor shall adhere to the installation schedule of the General Contractor and should attend all construction meetings scheduled by the General Contractor.

D. The installation will include coordination, testing and problem resolution with the system vendors.

E. The Contractor shall provide all test equipment necessary to properly install, maintain, and troubleshoot the system. Any equipment purchased for this contract shall become the property of the Owner upon completion of the project.

F. All cables shall be labeled in accordance with the Owner’s standard numbering scheme and labeling standards.

G. Cable labels shall be placed in the following locations: on jack face plates, on cable inside back boxes, junction boxes, access points, on cable above the terminations in the communications rooms, and every fifty-feet when not in conduit. Conduits shall be labeled “COMMUNICATIONS” every fifty-feet and at the origination and destination.

#### 3.3 FIELD QUALITY CONTROL

A. Manufacturer’s Testing
   1. **Coaxial Cable testing**
      a. Testing of all coaxial cabling shall be performed prior to system startup. One hundred percent of the distribution and customer drop cable shall be tested for length, opens, shorts, and presence of AC voltage. The Contractor, at no charge to the Owner, shall correct all discrepancies. Complete end-to-end
test results must be submitted to the Owner.

b. At a minimum, the Owner or the Owner’s Designated Representative shall randomly perform unannounced, on-site reviews during the installation. In addition, the Owner or the Owner’s Designated Representative shall perform a final inspection and a complete review of the test results before the installation is accepted.

B. The Owner or the Owner’s Designated Representative shall be given the opportunity to test the completed system for proper installation and operation. Any cable or component found improperly installed, damaged, with loose connector, or with Radio Frequency Interference (RFI) leakage shall be repaired, and if necessary, replaced with new cable, connectors, and components at no cost to the Owner.

C. System Testing

1. Upon completion of the installation, the Contractor shall test the signal strength using a signal strength meter at 55 MHz (channel 2) and 550 MHZ (channel 78) at the input and output of each system component and at the outputs of all taps. These test results shall be submitted to the Owner in Microsoft Excel 97 format, or ASCII, comma delimited files with fields in identical order. It shall also be documented on the as-built CATV system drawing.

2. The television distribution system as a whole shall be tested in accordance with National Cable Television Association (NCTA) Recommended Procedures and Practices for Measurements on Cable Television Systems, 2nd Edition (or the most current edition), by the installer to provide the following:
   a. +3 dBmV minimum output at all taps for each channel.
   b. +12 dBmV maximum output at all taps for each channel.
   c. 20 dB minimum isolation between ports.
   d. Lines terminated in characteristic impedance.
   e. F-Type self-terminating connectors at all unused ports.
   f. A picture free of interference, ghosts and smear, with clear audio, on all channels and at all taps.
   g. An overall signal-to-noise ratio of 40 dB for a 6 Mhz band-width.
   h. Variations in ambient temperatures of -20 degrees F to +140 degrees F (except for converters) shall not cause more than +/- 1.0 dB change in outlet voltage.
   i. Amplifiers and system must be capable of handling both forward and reverse path.
   j. Conduct and document a Cumulative Leakage Index (CLI) check of the completed system once it is connected to the local TV signal. A copy of this report will be submitted to the Owner. The installer will repair all RF leaks.
   k. If the signal strength at the input and output of the system components is outside of the designed specifications, the Contractor shall make the necessary corrections to the system.

3.4 TRAINING

A. The manufacturer's authorized and factory trained personnel must provide up to eight hours of training at the Owner's designated site location.

B. The training may be waived, deleted or reduced in the number of hours only with Owner approval.

C. The training must include at a minimum:
   1. Preventive maintenance service techniques and schedules.
   2. Overall system concepts, capabilities and functions.
   3. Explanation of all control functions.
4. Methods and means of troubleshooting and replacement of all distribution and drop wiring and devices.

D. Manuals, drawings and technical documentation must be used in training and shall be left with the Owner, or its designated representative at the completion of training for the Owner’s use in the future.

E. The use of proprietary equipment does not justify failure to provide technical documentation, such as programming information, electronic schematic drawings and technical description, as part of training and documentation.

F. Specialized equipment necessary to perform preventative maintenance and service, as used in the manufacture’s training program shall be provided by Contractor as a cost add-option to the owner.

END OF SECTION 27 41 31
SECTION 27 51 29 – EMERGENCY RADIO COMMUNICATION ENHANCEMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of the General Conditions, Supplementary Conditions, Division 1, Division 20, and Drawings apply to all Work herein.

B. Requirements of the following Division 20-28 Sections apply to this section:
   1. Design Criteria - Section 20 05 02
   2. Basic Division 20-28 Requirements - Section 20 05 03
   3. Schedule of Submittal Data - Section 20 05 04
   4. General Division 20-28 Materials and Methods - Section 20 05 05
   5. Scope of Work - Section 28 05 01
   6. Fire Alarm System – Section 28 31 00

1.2 SCOPE

A. Provide an in-building radio signal amplification system to provide complete coverage in the building for the public safety agencies as required by the local fire department and other agencies and authorities having jurisdiction. System users shall receive and transmit radio broadcasts from their portable radio units within the building. This shall be accomplished utilizing the following components:
   1. Bi Directional Amplifiers (Signal Boosters)
   2. Plenum rated Coaxial Cable
   3. Antennas
   4. Cable taps
   5. Connectors
   6. Power dividers
   7. Other components and interconnecting circuitry as required


C. The entire system shall meet with approval of the Fire Department, the Building Department and all other agencies and authorities having jurisdiction (AHJ).

D. The work in this section shall include the responsibility for all filings with the AHJ. Where filings require engineer’s signature, documents shall be submitted for his review and signature. This responsibility shall include furnishing of required quantities of floor plans, descriptive notes and/or specifications, wiring diagrams, shop drawings and amendment forms.

E. Early completion of the in-building emergency radio communication enhancement system will be required as to permit a Certificate of Occupancy to be obtained in a timely manner.

F. Any permits necessary for the installation of the work shall be obtained prior to the commencement of the work. All permit costs and inspection fees shall be included as the part of the required work.

H. All conductors shall be installed in conduit. Conduit installation shall be as specified in the Conduit Section.

I. **Related Sections:** Other Division 20-28 Sections contain requirements related to the work of this Section. These may include, but not be limited to, the following sections:

1. Conductors - Section 26 05 19
2. Conduit - Section 26 05 33 and 26 06 34
3. Outlet Boxes - Section 26 05 33

1.3 **QUALITY ASSURANCE**

A. **Basis:** To establish the type, quality and features of the system required, the equipment specified is that of the Notifier Fire Systems. All references to manufacturer or supplier model numbers and other pertinent information herein is intended to establish a minimum standard of quality, performance and features required. All equipment proposed as an EQUAL to that specified shall COMPLETELY conform to the Specifications herein.

B. **Manufacturers:** If they comply with these specifications and requirements, products of the following manufacturers will be acceptable:

1. Notifier Fire Systems (Provided by Fire Tron)
2. Or Engineer approved equal.

C. **Contractor Qualifications:**

1. The equipment supplier shall be an authorized and designated representative of the In-building Radio System Manufacturer to sell, install, and service the proposed manufacturer’s equipment. The equipment supplier shall have technical factory training specifically for the system proposed.

D. **Codes and Standards:** The system shall comply with the applicable Codes and Standards as follows:

1. National Fire Protection Association Standards:
   a. NFPA 70 National Electrical Code
   b. NFPA 72 National Fire Alarm Code
   d. NFPA 1221 Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems

2. The Americans with Disabilities Act (ADA).
3. The Texas Accessibility Standards.
4. Local and State Building Codes.
5. Requirements of Local Authorities having Jurisdiction.
1.4 SUBMITTALS

A. The installing contractor and/or equipment manufacturer shall provide complete and detailed shop drawings and include:

1. Riser wiring diagram with associated conduit sizes.
2. Complete floor plan drawings locating all devices and interfaces associated with the fire alarm system. Floor plan drawings shall include conduit and wiring routing complete with conduit sizing and number of conductors by type.
3. Factory data sheets on each piece of equipment to be used and so marked as to model, dimensions, size, voltage and configuration.
4. Detailed written system description in this Specification format describing system functions and operation. All specification variations and deviations shall be clearly noted and marked.

B. All submittal data shall be in bound form with contractor's name, supplier's name, project name, and state fire alarm license number adequately identified.

C. Only basic equipment devices have been shown on the contract drawings. Specific wiring between equipment/devices has not been shown. It is the contractor's responsibility to submit for approval the Complete Engineered System Configuration and Layout showing all devices, wiring, conduit, and locations along with other required information as specified herein.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

A. In-building emergency radio communication enhancement systems for emergency responders are an integral component of the life safety equipment of a building or structure. The primary function is to provide reliable emergency responder communications at the required signal strength within the specified areas.

B. Critical Areas such as Fire Command Center, fire pump room, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations and similar critical areas shall be provided with 100% floor area radio coverage.

C. General building areas shall be provided with 95% radio coverage, or as specified by AHJ.

D. The In-building emergency radio communication enhancement systems must provide the following signal strengths:

1. Downlink - Minimum signal strength of -95 dBm throughout the coverage area.
2. Uplink - Minimum signal strength of -95 dBm received at the AHJ Radio System.

E. The system shall be complete with all components and wiring required for compliance with all applicable codes and regulations, and for its operations described hereinafter.

F. EC shall sub-contract an approved manufacturer or a qualified and approved vendor to supply, test and determine locations of components which are required for proper operation as well as to supply,
deploy, test and certify the performance of the complete system. Vendor qualifications must be acceptable to the AHJ.

G. All tests shall be conducted, documented, and signed by a person in possession of an FCC General Radio Telephone Operators License. All testing personnel shall be certified and authorized by the signal booster manufacturer in the installation and operation of their equipment. Personnel qualifications must be acceptable to the AHJ.


I. Assembly and installation of all components of the Emergency Responder Radio Communication Enhancement System shall comply with all applicable sections of the National Electrical Code.


K. The system must comply with all applicable sections of the FCC rules. Signal booster shall have FCC certification prior to installation.

L. Antenna isolation shall be maintained between the donor antenna and all inside antennas (D.A.S.) to a minimum of 20dB under all operating conditions

2.2 PERFORMANCE REQUIREMENTS


B. The signal booster shall be a Class B Public Safety type as designated by the FCC and as required by the AHJ.

C. The secondary power supplies, battery chargers and system monitoring shall be fully compliant with NFPA 72, 2013 edition and NFPA 1221,2016 edition. The signal booster shall have both the primary and the secondary power supplies built in a fully sealed NEMA-4 type approved enclosure.

D. All signal boosters and other active system components must have FCC certification prior to installation. The equipment FCC ID must be shown on the product datasheets and technical submittals. The ID must also be displayed on the product as required by the FCC.

E. The signal booster shall be set and tuned by the equipment manufacturer to pass frequencies as specified by the local fire department.

F. To reduce the possibility of unwanted interference affecting the operation of the system, signal boosters shall be band or channel selective type with a maximum 3dB channel bandwidth of 200KHz (Fc +/- 100KHz). Wide-band signal boosters shall not be accepted, unless required to cover multiple channels within the same band.
G. Signal Boosters shall have oscillation prevention circuitry to protect the public safety radio system in case of signal booster malfunction.

H. Signal Booster gain shall be rated at minimum of 80dB and the gain shall be adjustable in a minimum of 25dB range. System gain shall be set and documented at the time of the final system test.

I. Maximum Propagation delay of the signal booster system shall be 14μs (microseconds) or as specified by AHJ.

J. The signal booster system shall include built-in automatic alarming of malfunctions of the signal booster and battery system as per NFPA 1221 2016 Edition Section 9.6, NFPA 72, 2013 Edition, Sections 24.5.2.6.1, and 24.5.2.6.2. Aftermarket equipment add-ons and modifications to comply with this specification will not be accepted.

K. A dedicated supervised monitoring panel shall be provided within the emergency command center or other location as designated by AHJ to announce the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:

1. Normal AC power
2. Signal booster trouble
3. Antenna Failure
4. Loss of normal AC power
5. Failure of battery charger
6. Low battery capacity

L. The signal booster system shall include a built-in addressable monitor module tied to the Building Fire Alarm Panel for monitoring the signal booster.

M. The vendor shall verify the system monitoring requirements with the AHJ prior to system installation. System monitoring shall be fully compliant with the AHJ requirements.

N. External filters, attachments or other aftermarket modifications of the original equipment shall not be accepted.

O. All signal booster components shall be contained in a NEMA4-type approved waterproof cabinet. All enclosures shall be painted red with signage in bright yellow or as required by AHJ.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the in-building radio system with all trades including, but not exclusive of: electrical contractor, sprinkler contractor, and HVAC/controls contractor. Adequate coordination shall be provided to insure proper installation and interface to all peripheral items required to interact with the fire alarm and communication system to provide a complete and functional life safety system.
B. The in-building radio system contractor shall be responsible for coordinating all devices, panels and other equipment requiring 120V input power with the Electrical Contractor prior to bid. Provide a dedicated 120 volt 20 amp emergency circuit for this equipment.

C. Assembly and installation of all components of the Emergency Responder Communication Enhancement System shall comply with all applicable sections of the National Electrical Code, NFPA 70 and the National Fire Alarm and Signaling Code, NFPA 72, NFPA 1221 current enforceable editions.

D. At least two independent and reliable power supplies shall be provided as specified below.


F. The emergency responder radio coverage enhancement system shall be equipped with a secondary source of power. The secondary source of power shall be a battery system with a dedicated battery charger powered by a separate, dedicated twenty (20) ampere branch circuit. The secondary power supply shall supply power automatically when the primary power source is lost. The secondary source of power shall be capable of operating the emergency responder radio coverage enhancement system for a period of at least 24 hours. The battery system shall automatically charge in the presence of external power input. Battery charger and all other electronic components must be fully enclosed in a non-vented NEMA4 Type approved enclosure. Batteries shall be enclosed in a separate, vented NEMA 3R Type approved enclosure.

G. The signal booster shall be designed to allow degraded performance in adverse conditions, such as high temperatures in the event of heat from a nearby fire, voltage fluctuations or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) are not acceptable. External UPS (Uninterruptable Power Supplies) are not acceptable. It is the purpose of this specification to assure the maximum possible level of communications to public safety personnel depending upon the signal booster, even to the extent of damaging the signal booster, as long as some communications benefit can be provided during the emergency.

H. System design shall be such that neither the failure of the normal power source, the transfer to an emergency source, nor the re-transfer to the normal source shall cause a change in system status.

I. The amplifier shall be housed in a 2-hour fire rated room or other suitable space as approved by the Engineer, or where specifically shown on the drawing.

J. Radiating cable, if used, shall be run without conduit. All other cable can be run in conduit.

K. RF Coaxial Cable shall be a fire-resistant, low-smoke type, UL classified as plenum. The classification shall be clearly marked on the outer surface of the cable regular intervals.

L. All vertical wiring for the BDA system shall be located within a 2-hour enclosure.

M. The remote annunciator shall be located adjacent to the fire alarm control panel.
N. All wiring shall be in accordance with NFPA 72, the National Electrical Code, Local Codes, and Article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.

O. All conductors shall be U.L. Listed FPL for LIMITED ENERGY (300 volt) and fire alarm applications and shall be installed in conduit.

P. All conductors for intelligent/addressable circuits shall be of the TWISTED/SHIELDED type to guard against outside RF interference and induced noise. Alarm and telephone communications circuits shall also be of the twisted/shielded type. Conductor size shall be determined by calculated voltage drop and circuit loading but shall not be less than #18 AWG.

Q. All wiring shall be run in a supervised fashion (i.e., no branch wiring or dog-legged wiring) per NFPA requirements such that any wiring disarrangement will initiate the appropriate trouble signals via the main control panel per NFPA and U.L. requirements.

R. Conduit and raceway system shall be installed as specified under the CONDUIT Section of the specifications, and per NEC.

S. Minimum conduit size shall be 3/4” EMT. Install conduit per engineered shop drawings.

3.2 TEST AND REPORTS

T. Acceptance testing for an in-building radio system is required upon completion of installation.

U. The coverage testing shall be done in accordance with NFPA 72, National Fire Alarm and Signaling Code, 2013 edition, NFPA 1221 2016 edition and as required by the local AHJ.

V. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio Operator License.

W. All test records along with system diagrams, equipment specifications, user manuals, RF link budget calculations, battery backup calculation and other design data shall be submitted upon completion of the project.

3.3 WARRANTY

X. The in-building radio system shall be free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of acceptance or beneficial occupancy, whichever shall occur first. Any equipment shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner.

Y. The equipment manufacturer shall be represented by a local organization and the name of such shall be furnished to the Owner, Architect, and Engineer.

Z. Additions required to the in-building radio system shall not affect or void any warranty to the existing system provided that said additions are installed by an authorized manufacturer’s dealer. All additions to such shall be of compatible components to match existing manufacturer’s components.
3.4 WARRANTY

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

END OF SECTION 27 51 29
SECTION 28 00 00 – ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 PROJECT SUMMARY/OVERVIEW

A. This document covers the general requirements for work to be performed to provide electronic security and surveillance.

B. The contents of this document, along with related drawings and other documentary material, are critical to the security of this project and Owner and shall remain secure and confidential.
   1. Confidential information shall not be deliberately or inadvertently disclosed to anyone other than the Contractor's personnel and subcontractors who require disclosure to perform their portion of the work.
   2. This confidential information shall be tracked to ensure that copies are accounted for and properly destroyed when no longer needed to perform the work.

C. The security systems shall consist of the following integrated subsystems as specified herein:
   1. Electronic Access Control
   2. Intrusion Detection
   3. Video Surveillance
   4. Emergency Intercommunications and Duress
   5. Wire and Cable

D. Provide complete turnkey systems with the exception of those items noted within this specification as being provided by others.

E. Related Sections include:
   1. Section 087100 Door Hardware
   2. Section 260000 Electrical (including related sub-sections)
   3. Section 270000 Communications (including related sub-sections)
   4. Section 281000 Access Control System
   5. Section 282000 Video Surveillance System
   6. Section 283100 Intrusion Detection System
   7. Section 284600 Fire Alarm and Smoke Detection

1.2 GENERAL REQUIREMENTS

A. Upon completion of commissioning testing and Owner acceptance, DBR bears no liability or responsibility for the continued proper operation of the installed systems.

B. The Items described herein shall not be modified or substituted without consent of DBR and/or the Owner.

C. Electronic security systems integrator (security subcontractor) manager/supervisor shall attend meetings arranged by the Contractor, Architect, Owner or other parties affected by the work of this Section 280000.

D. If the manufacturer of security devices or connecting hardware has supplied post manufacture performance data, copies of such are to be kept for inclusion in the documentation and made available to the Owner upon request.

E. All materials are to be new unused and of the latest series of model number, unless otherwise indicated by the Owner or security system designer.

F. All security integrator personnel must be manufacturer certified and capable of an installation that falls under the manufacturer's guidelines necessary to obtain a manufacturer warranty.
1. The integrator shall provide all components/materials essential for a complete and functional security access and surveillance system.

G. Security integrator shall issue a two (2) year warranty on installation and workmanship.

H. These Specifications and Drawings are intended for bidding purposes only, No part shall be copied or used for any purpose other than bidding on this project.

1. This package shall be contractual upon bid award.

I. Drawings and Specifications are to be used in conjunction with one another and to supplement one another.

1. In general Specifications determine the nature and quality of the materials and tests, and drawings establish the quantities, details and give characteristics of performance that should be adhered to in the installation of the security system components.

2. If there is an apparent conflict between the drawings and specifications, or within the specifications themselves, the items with greater quantity or quality shall be estimated and installed.

3. Clarification with the Owner/Designer about these items shall be made prior to purchase and installation.

4. Questions regarding the Specification or system requirements should be directed in writing to DBR or the Owner.

J. Security integrator shall adhere to Division 1 general requirements and written security Specifications and Drawings within this construction package and shall be responsible for complying with all local, state and federal laws or regulations applicable to the work being performed, even though said law, rule or regulation is not identified herein.

K. Security integrator shall arrange and pay for any inspections required by the public agencies having jurisdiction in the area.

L. The security contractor shall procure and maintain for the duration of this agreement, insurance against claims for injuries to persons or damages to property which may arise from, or conjunction with, the performance of the work hereunder by the security integrator, his agents, representatives, or employees.

1. The security integrator shall pay the cost of such insurance.

M. The security integrator will respect and protect the privacy and confidentiality of the Owner, his employees, processes, products, and intellectual property to the extent necessary, consistent with the legal responsibilities of the State of Texas and the Owner.

N. If required the security integrator shall sign a non-disclosure agreement and abide by its requirements to keep confidential all information concerning bid documents and this Project.

O. Furnish submittals and manuals in accordance with Division 1.

P. Furnish a detailed material list complete with suppliers (distributors) list of components and distributors name, address, and phone number.

Q. Refer to Specifications issued by Architect, Division 1, for Project and cost payments.

1.3 REFERENCES

A. The publications listed below form a part of this Specification. The publications are referred to in the text by basic designation only.

B. Specific reference in Specifications to codes, rules, regulations, standards, manufacturer’s instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.
C. For conflicts between referenced requirements and contract documents comply with the one that is more stringent.

1. Federal, State, and Local codes, regulations and ordinances
4. NFPA 730: Guide for Premises Security
5. NFPA 731: Standard for the Installation of Electronic Premises Security
7. Building Codes (UBC) (IBC), latest editions
8. Occupational Health and Safety Act (OSHA)
9. Americans with Disabilities Act (ADA)
10. Local Governing Authorities Having Jurisdiction
11. Underwriters Laboratory (UL) Applicable Standards for Safety and Security
12. Institute of Electrical and Electronics Engineers (IEEE) Applicable Standards
13. Telecommunications Industry Association (TIA) Applicable Standards

D. Related Documents

1. Security Drawings
2. General provisions of contract
3. Uniform general conditions
4. Supplementary general conditions
5. Architectural plans & specifications
6. Requirements of Division I
7. Electrical / Mechanical / Telecommunications specifications and plans.

1.4 DESCRIPTION OF SYSTEM WORK

A. Furnish and install all materials, tools, equipment, and services for all electronic security/surveillance devices to provide functioning systems in accordance with performance requirements specified and any modifications resulting from reviewed shop and field coordinated drawings.

1. Access Control System
   a) This system replaces the typical mechanical key controlled door lock with a door locking system that uses an access card as the access credential.
   b) The system includes an electric door-locking mechanisms, card reader located adjacent the door, door status sensor, door prop alarm and a request to exit device.
   c) Typical system configuration is card or schedule controlled entry with free exiting.

2. Intrusion Detection System
   a) This system monitors areas for unauthorized entrance or intruder.
   b) This system can consist of motion sensors, door status sensors, glass break sensors and one or more control keypads.
   c) The keypad is used to arm/disarm system by entering a numeric code on the keypad.

3. Video Surveillance System
   a) This system is used to provide video surveillance through the use of cameras of security sensitive areas and target items.
   b) The system shall allow for the viewing and recording of images.
4. Emergency Intercommunications and Duress Systems  
   a) Duress Buttons  
      1) These buttons, also known as panic buttons, are installed in locations where potential personal safety or security threats exist.  
      2) Depressing the button sends a silent priority alarm signal to assigned monitor with location and specific alarm information  
      3) The panic button is usually located in the knee space underneath a desk or service counter.

B. RACKS AND ENCLOSURES  
   1. Wall mounted enclosures, data gathering panels, and power supply panels shall be installed as per manufacturer’s requirements.  
      a) Coordinate pathways and power with Electrical and Telecommunications Contractors  
      b) Furnish all labor, materials, tools, equipment, and services for all control consoles, equipment racks, cabinets, and enclosures not provided by others in accordance with contract documents.  
      c) Completely coordinate with work of other trades to avoid duplication in purchasing.  
      d) Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, and devices incidental to or necessary for a sound, secure and complete installation.

   2. The installation of the relay racks/cabinets for Electronic Surveillance shall be by the Telecommunications Contractor.  
      a) Coordinate locations with G.C.

   3. The designated security space will provide an area reserved for rack and wall mounted security equipment.  
      a) The rack area allows for vertical relay rack(s).  
      b) Backboard wall area of 8'-0” X 8'-0” shall be reserved for wall-mounted components.  
      c) Cable tray/ ladder shall be by the telecommunications contractor and is provided to facilitate cable access into both wall and rack mounted equipment.

C. Provide all supplementary or miscellaneous items and devices incidental to or necessary for a sound and complete installation.

D. Drawings are representative and show general arrangement of systems and equipment, except when dimensioned or detailed.  
   1. For exact locations refer to dimensioned architectural drawings.  
      a) Field measurements take precedence over dimensioned drawings.  
      b) Field verify locations and arrangement of all systems and equipment.  
      c) Coordinate all work with other trades and Contractor.

E. Circuit Supervision  
   1. Supervise all signal and data transmission lines, links with other systems, and sensors.  
      a) Indicate circuit and detection device faults with both protected zone and trouble signals.
b) Initiate an alarm in response to opening, closing, or shorting of a signal or data transmission line.

F. Electronics systems work as specified in this Section and Sections 281000, 282300, 282600 shall include:

1. A project kick-off/pre-submittal meeting with the Architect, Designer, and Contractor to review security design package.
   a) Additional participants shall include:
      1) Division 8 subcontractors
      2) Division 26 subcontractors

2. Preparation of pre-installation submittals, including point-to-point wiring information for security equipment to interface to work by others prior to start of any installation work. Include lock permit requests in submittals for review.

3. Furnishing and installation of all security devices, components and accessories.

4. The furnishing and coordination on installation of special back boxes for security equipment and field devices as required.

5. Furnishing, installation and termination of all copper wiring and cabling including any special purpose wire and cable for electronic security systems.
   a) Coordinate all network and fiber optic cable interface provided by telecommunications subcontractor.

6. Coordinate raceway and power distribution systems provided by Division 26.

7. Provide and install 12/24 VAC/DC input power to all field devices as required.

8. Coordination with other trades and Owner required to facilitate the installation of the security equipment including:
   a) Division 08 (doors)
   b) Division 26 (power, raceways, and fire alarms)
   c) Division 27 (telecommunications network interface).

9. Wiring and termination of electrified door hardware by security subcontractor shall be concurrent with the installation of these electrified components by the door hardware subcontractor.

10. Programming of all security control equipment and prior coordination with the Owner’s security and telecommunications personnel.

11. Preparation of “As-Built” documentation.

12. Warranty service for completed work.

1.5 SUBMITTALS

A. Refer to Requirements of Division 1.

B. Pre-Installation Submittal Requirements

1. Submittals for electronic security shall be complete and submitted at the same time.
   a) No partial submittals will be accepted for review.
   b) Allow 2 weeks for consultant review of submittals.

2. General Requirements
   a) A functional description of each system.
   b) All cable and wiring types for each device type used.
   c) Certification that lock wiring and access control systems requirements have been coordinated with electrified door hardware, fire alarm systems,
automatic door controls, and overhead door controls specified in other sections and other packages.

d) Power supply points listing with devices and maximum loads to prevent overloading.

e) Battery backup calculations to show load and back-up times for UPS and power supplies with batteries.

f) Equipment schedules listing all system components, manufacturer, model number and quantities of each.

g) Qualifications and proof of work history (with references).

3. Product Data Cut-sheets

a) Complete manufacturer’s technical data including manufacturer warranty information, descriptive literature, illustrations, and installation instructions for all components included within this project indicating compliance with applicable referenced standards, size, dimensions, model number, electrical characteristics, support requirements, connection requirements and all applicable information verifying that submitted components comply with Contract Documents.

4. Shop Drawings

a) Floor plans necessary to identify specific device locations, cable routes and quantities, cable types, riser locations, and references to installation details and diagrams.

b) Riser diagram showing routes between floors or other areas that are not easily identified on the floor plans.

c) Security One-line diagrams showing all input and output points of the system.

1) The Contractor shall make any corrections required by the consultant team, file with him two corrected copies and furnish such other copies as may be needed.

2) The consultant’s approval of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless he has in writing called the Architect's attention to such deviations at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings or schedules.

5. Warranty

a) The Contractor shall provide the appropriate documentation to comply with the requirements described in the WARRANTY section.

6. Qualifications

a) The Contractor shall provide the appropriate documentation to comply with the requirements described in the QUALITY ASSURANCE section.

C. As-Built drawings shall be in current AutoCAD format, same version as used by the Architect.

1. Dimensions and scale of the drawing sheets submitted shall match the size of the drawing used for the contract documents, and shall include the following.

a) Utilize normally recognized drafting procedures that match AutoCAD standards, Architect, and Designer guidelines and methodology.
b) The As-Built drawings shall incorporate all changes made to the building identified in, but not limited to, Addenda, contemplated change notices, Site Instructions or deviations resulting from site conditions.

c) Dimensioned plan and elevation views of all security components.

d) Cable routing paths of security cables to identified infrastructure pathways.

e) All rack, cabinet, and enclosure locations and labeling thereof.

f) One-line diagrams of equipment/device interconnecting cabling of the security systems.

g) Standard or typical installation details of installations unique to Owner’s requirements.

h) Submit one soft and one hard copy with project deliverables within 30 days of project completion.

D. Security integrator shall provide three (3) paper copies and one (1) electronic copy (PDF format) of a properly indexed O&M Manual at the conclusion of the project, which will include, but not be limited to the following requirements:

1. Ring binder with project title, properly indexed, and contractor’s name on cover and spine including:

   a) Sequence of operations, design philosophy, and specific functions

   b) System block diagram

   c) Equipment list including:

      1) A brief description

      2) Model

      3) Total number of each item used in the project.

   d) Camera schedule including:

      1) Number

      2) Location

      3) Camera model/manufacturer

      4) View

      5) Lens

      6) Power source

      7) Multiplexer/input

      8) Settings entered on site

   e) Manufacturers’ data sheet and O&M manual for associated equipment.

   f) Maintenance requirements for equipment, inspections and preventative maintenance schedules.

   g) As-built drawings for each floor plan layout and rack and wall elevation layouts. Each drawing shall show:

      1) Cable type and identifier

      2) Actual cable routing pathway

      3) Device number (camera, etc.),

      4) Device input/output number.

   h) Final test data (measured video levels, day & night camera snapshots in JPEG format and other significant operating parameters).

   i) List of system associated mechanical locking keys with key codes and tamper resistant hardware types.

1.6 QUALITY ASSURANCE
A. Electronic security systems integrator (security subcontractor) shall meet the following minimum requirements.

1. Maintain a valid Type B license from the Texas Private Security Bureau.
2. Have successfully completed three (3) projects of similar size and complexity that have been in proper operation for a period of one (1) year.
3. Technicians shall be factory trained and certified in specified systems.
4. The Project manager and supervising/lead technician shall have been regularly engaged in the installation and testing of the products specified for not less than five (5) years and maintain manufacturer certification.
5. The security integrator must maintain an operating facility in the local area (50 mile radius) of the Project location to provide service to the Owner for the warranty period.
   a) At the Owners request for service, the security integrator shall dispatch a service technician to the location to affect the required repairs or adjustments.
6. The contractor shall maintain a spare parts inventory necessary to resolve component failures of the system.
   a) Refer to individual specification section for a list of specifically required parts provided to the owner and stored on site. These parts will become the property of the owner.
      1) At the end of the warranty period the security integrator shall test the owner’s spare parts and repair or replace as needed to bring the parts up to proper operation.
7. A BICSI RCDD shall approve all on-site work as a recognized member of the Contractor’s installation team.
   a) All installation team members must demonstrate knowledge and compliance with all BICSI, TIA/EIA, UL, and NEC methods, standards and codes.

B. Security integrators desiring approval must comply with Division 1 requirements.

C. Security integrator must be cognizant of site conditions, verify locations of new and existing equipment, and determine exact requirements for connection and interface.

1.7 PRE-INSTALLATION MEETINGS

A. Attend and/or arrange a scheduled pre-installation conference prior to beginning any work of this section.

1. Agenda
   a) This venue is to ask and clarify questions in writing related to work to be performed, scheduling, and coordination with the Project manager/Owner representative and consultant.

2. Attendance
   a) The security project manager/supervisor shall attend meetings arranged by General Contractor, Owner’s representatives, and other parties affected by work of this document.
   b) All individuals who will be installers of the electronic security system and equipment in an on-site supervisory capacity, including project managers and lead installers, shall be required to attend the pre-installation conference.
c) Individuals who do not attend the conference will not be permitted to install, or supervise the installation of, any component of the security system.
1) This includes supervisors, project managers, and lead installers of this project.

1.8 POST INSTALLATION MEETINGS
A. At the time of substantial completion the contractor shall call and arrange for a post installation meeting to present and review all submittal documents to include but not be limited to As-Built Drawings, Warranty paperwork, etc.
1. Attendees to be invited shall include:
a) Project manager/Owner representative
b) DBR Inc.
c) General Contractor
d) Other trades that the GC deems appropriate.
2. At this meeting the contractor shall present and explain all documentation, asking for feedback on its completeness.
3. Any discrepancies or deviations noted by and agreed to by participants shall be remedied by the contractor and resubmitted within one week of the meeting.

1.9 DELIVERY, STORAGE AND HANDLING
A. Equipment and components shall be delivered properly protected and undamaged with original containers, packaging, and labels intact.
B. Store, handle, and protect all related materials and equipment in accordance with Manufacturer's recommendations.
C. Provide additional protection during handling as necessary to prevent breaking, scraping, marring, or otherwise damaging products or surrounding areas.
D. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants.
1. Equipment damaged prior to system acceptance shall be replaced at no cost to the owner.
E. Protect all equipment and components that are to be installed from theft, vandalism, or use by unauthorized persons.

1.10 PROJECT/SITE CONDITIONS
A. Security integrator is responsible for conducting a site survey prior to the commencement of work to determine locations of all existing security devices and verify the proposed locations of the new components to be installed.
B. Security integrator will coordinate all work through the Contractor and schedule work to cause as little interference or interruption of existing services as possible.
C. Security integrator will arrange and pay for all necessary permits, licenses, and inspections.
1. Security integrator shall prepare all information necessary to obtain a permit for Electronic Locking Mechanisms in compliance with the Owner requirements.
D. Verify with Division 26 installer all conduits and special back box requirements in a timely manner.

1.11 WARRANTY
A. See requirements in Division 1 Specifications.
B. The Security Integrator shall warrant all completed work, including all materials and labor, to be free from defects in design, workmanship, and/or materials for a period of two (2) years from final acceptance date.

1. System acceptance is defined as the completion of all functional performance testing and the resolution of all punch list items.

C. Warranty Service

1. In the event that defects in the materials and/or workmanship are identified during the warranty period, the contractor shall provide all labor and materials to correct the deficiency.
2. All service work shall be performed by factory certified technicians.
3. All warranty service shall include the replacement of all parts and or components as required to restore normal system operation.
   a) If parts or components need to be repaired, a loaner will be supplied and installed until the part or component can be repaired and reinstalled.
4. Immediately following a warranty service request, the Contractor shall provide written documentation to Owner which details the service work completed, cause of trouble, and any outstanding work required to restore a complete and normal system.

D. Warranty service requests shall be responded to within 4 hours of notification with a qualified service technician on site.

E. All repairs shall be completed within 48 hours upon site arrival.

1. If the failure exceeds 48 hours, the Owner reserves the right to require the contractor provide on-site manufacturer support at no additional cost to Owner.

F. Extended warranties on equipment components offered by the manufacturer shall be passed through to the Owner.

1. Warranty provisions shall be fully transferable only at the direction of the Owner, in the event that ownership of the installed security systems is transferred.

1.12 SYSTEMS STARTUP AND TRAINING

A. After all systems have been tested, accepted and turned on for operation, the Security integrator shall provide “User Training” to Owner personnel.

1. The onsite training shall cover all newly installed electronic security components, devices and systems. The training classes shall total a minimum of twenty (20) hours for up to eight (8) people of the Owner’s choosing.
2. Two (2) separate training sessions will be conducted, one for system operators and one for system administrators.
3. The contents of the manuals will include:
   a) Title page with subject, system name, owner’s name, and an owner approved confidentiality notice.
   b) Table of contents.
   c) Manual that details system and sub-system operation.
   d) Manuals that details system administration procedures and tasks.
   e) Manuals that fully detail all programming commands.
4. Provide ten (10) Bound hardcopy System Operation training manuals and one electronic copy (PDF format).
5. Provide two (2) Bound hardcopy System Administration training manuals and one electronic copy (PDF format).
PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Acceptable Manufacturer’s are shown in individual specification sections.
B. Equipment manufacturers and model numbers indicated in individual specification sections are identified as minimum equipment requirements.
C. All substitutions shall meet or exceed these minimum requirements and must be approved by the Owner/Architect prior to purchase.
D. All manufacturers’ equipment shall be available through a nationally recognized supplier network.

2.2 EQUIPMENT
A. Provide security fasteners on all equipment, device plates, etc. within public areas.
   1. Allen head with center pin, hardened steel.
   2. Provide four (4) fastener tools to Owner.
B. Equipment installed in exterior applications shall be fitted with fasteners and exposed surfaces of stainless steel or other corrosion resistant material.
C. All materials and equipment used must be new and unused, prime quality products.
D. All equipment or components installed on the exterior of a building where the equipment is subject to adverse weather/elements shall be enclosed in weatherproof enclosures.

2.3 WIRE AND CABLE
A. All wire and cable shall be U.L. approved for its intended application and shall meet or exceed manufacturer’s recommendations for the components connected.
B. All conductors and cable shall meet individual security system manufacturer specifications.
   1. Provide shielded conductors and cable as required by the manufacturer or as required to provide for interference-free signals.
   2. Color coding shall be accomplished by using solidly colored insulation.
      a) Grounding conductors, where insulated, shall be colored solid green or identified with green color as required by NEC.
C. Increase conductor sizes on cables as required to be consistent with circuit current ratings, length of wire runs, and manufacturers’ recommendations.
   1. Alarm device field wiring shall be in accordance with the equipment manufacturer’s specifications.
   2. Low voltage power circuits shall use conductors as required by the equipment manufacturer’s specifications.
   3. Plenum rated cable shall be used as required by code.
D. UTP Structured Cabling Systems for IP cameras and intercoms (including pulling, terminating, and testing) by Division 27 Telecommunications contractor.
   1. Intra-building data communications circuits shall utilize UTP cable as specified in Telecommunications specifications.
E. Patch Cables
   1. Provide pre-manufactured patch cables (cable, connectors, boots, etc.) as required to connect security systems to voice and data communication outlets.
2. Patch cables shall be certified for their specific use to meet or exceed applicable industry specifications.
3. Provide cable lengths as necessary to neatly route cables through cable management systems and other cable organization systems.
4. Provide connectors as required for proper termination.
   a) Provide boots for connectors where applicable to prevent snagging.

F. The minimum conductor sizes are for distances as per the manufacturer’s specifications from security device to security panel.
1. The contractor shall size the conductor accordingly for longer runs.
2. Minimum Conductor and Cable Types and Sizes.
   a) Alarm device field wiring shall be 18/20 AWG stranded copper conductors.
   b) Low voltage power circuits will use 18 AWG stranded copper conductors.
      1) Increase conductor gauge consistent with circuit current requirements.

PART 3 - EXECUTION
3.1 INSTALLATION
A. All personnel working on this project shall be experienced, highly skilled installers with a minimum of three (3) years work on similar type projects.
B. Changes in location of any work require the written approval of the Architect/Owner prior to initiation.
C. Changes in indicated sizes shall not be made without the written approval of the Owner/Architect.
D. Install all equipment in accordance with manufacturer’s recommendations.
E. All systems shall be designed and installed to provide 24 hour a day, 7 days a week operation.
F. Primary pathways
   1. All security cabling run from rack/enclosure head-end equipment to security devices shall follow primary telecom routing pathways.
   2. Security wire non-UTP cabling shall be kept separated from the data cabling
   3. Security wire non-UTP cabling shall be routed in bridle rings secured to the outside of the telecom tray where applicable.
      a) Arlington loops or J hooks shall be used where telecom pathways are not present
   4. Provide all necessary anchoring devices and supports.
      a) Use structural supports suitable for equipment, or as indicated.
      b) Check loading and dimensions of equipment with shop drawings.
      c) Do not cut or weld to, building structural members.
G. Secondary pathways
   1. Arlington loops or J hooks shall be used for secondary pathways
   2. Security wire non-UTP cabling shall be kept separated from the data cabling
   3. Provide all necessary anchoring devices and supports.
      a) Use structural supports suitable for equipment, or as indicated.
      b) Check loading and dimensions of equipment with shop drawings.
c) Do not cut or weld to, building structural members.

H. Coordinate extension and connection to commercial, emergency/UPS power circuits provided by Division 26.
   1. Make power connections in accordance with Division 26.

I. Shielded and/or screened cables shall be grounded per the hardware manufacturer’s instruction.
   1. Single point shield grounds shall be grounded at the field panel feeding the device or sub panel and insulated from ground at the termination end of the cable.

J. All installation of security systems shall be complete at least thirty calendar days prior to occupancy.

3.2 RACK AND CABINET INSTALLATION

A. Coordinate rack/cabinet installation with Telecommunications contractor and follow provisions in Section 281000.

B. Rack/cabinet installation by Telecommunications contractor.

C. After racks are installed, install all required components to support rack mounted security equipment.
   1. Extend UPS/emergency power to rack mounted equipment as required.

D. Install all conduits, back boxes, wire and cable management as required for interconnection of security equipment, data gathering panels, power supply enclosures, and distribution panels in the Security room.

E. Extend commercial/emergency/UPS power circuits as required to security components as required.

F. Neatly lace and dress all cables in each rack.
   1. All wiring and cable shall be properly supported.
   2. Utilize suitable cable management devices, no tie-wraps for UTP structured cabling allowed.

3.3 GROUNDING AND BONDING

A. Equipment Cabinets and Racks
   1. To provide electrical continuity between rack elements, paint-piercing grounding washers shall be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack.
   2. A horizontal busbar shall be installed at the top and back of each rack for floor fed cabinets/racks.
   3. A vertical busbar shall be installed to the rear of the right-hand side rail with thread-forming screws to ensure metal-to-metal contact.
   4. Each rack shall be provided with a minimum # 6 AWG insulated ground wire.
   5. Do not bond racks serially (loop from rack to rack).
   6. Each rack bay against a wall shall be bottom/side ground feeds from the wall.
      a) Wall ground feeds/raceways to racks shall not be exposed on the walls.
      b) Exception
         1) Some rack bays will require the ground to be fed from the ceiling raceway. Refer to drawings for details.

7. The Contractor shall provide a ground strap for each equipment rack and bond to the nearest Telecommunications Bonding Backbone (TBB) connection. Furnish all required bonding materials and hardware manufactured for this purpose.
a) Follow NEC bonding procedures/specifications.

8. All ground raceways within each rack shall be an insulated metallic flex type raceway and shall not interfere with equipment mounting frames or equipment mounting brackets.

9. Each ground feed shall provide proper installation allowances and penetration depths to provide conversion fittings from solid metallic to insulated metallic flex conduit raceways.

10. To bond each rack to ground, burnish clean a one square inch area, drill, tap, apply an adequate amount of antioxidant joint compound mixed for the metal surface types affected, and bolt connectorized conductor to burnished and compounded area.

a) Ensure proper conductivity.

B. Cable Runway, Cable Raceway and Support System Grounding

1. The Contractor shall provide communications cable tray and cable runway systems with a communications isolated ground from the TBB.

2. All cable tray needs to be electrically continuous per NEC 250.96.

a) Metal raceways, wire-mesh cable trays, cable armor, cable sheath, enclosures, frames, fittings, and other metal non-current-carrying parts that are to serve as an alternate grounding path, with or without the use of supplementary equipment grounding conductors, shall be effectively bonded where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed on them.

b) Any nonconductive paint, enamel, or similar coating shall be removed at threads, contact points, and contact surfaces, and be connected by means of fittings designed so as to make good bonding points.

3. The Contractor shall provide and install #6 AWG insulated ground wire to bond one end of each cable tray/runway system to the #2/0 TBB.

4. For electrically non-continuous conduits that contain only grounding conductor, the Contractor shall bond the conduit and conductor together at both ends to ground to nearest TGB with grounding bushings or ground clamps.

3.4 Labeling

A. Provide labeling for all security equipment components using waterproof, self-adhesive computer printed labels.

1. Coordinate with Owner on numbering/labeling scheme.

B. Provide labeling for all security cable/wiring using waterproof, self-adhesive computer printed labels.

1. Coordinate with Owner on numbering/labeling scheme.

2. Label all cables/wiring on both ends.

3. At multi conductor cable terminations label each conductor.

4. At a minimum, each cable/wire label shall designate:

a) Origination Point

b) Alarm point description

c) Opening description (if applicable)

C. Provide a complete cable/wire identification plan/list with project completion submittal.

D. Conduit and junction box exteriors may be identified with unique color paint, but shall not be identified with written words that easily identify the function of the conduit and boxes.

3.5 POWER REQUIREMENTS
A. 120 VAC emergency power dedicated to security will be provided. (By Electrical Contractor)

B. Back-up power for all equipment and devices shall be for at least 4 hours unless otherwise specified.
   1. When generator backup power is available, provide a UPS, rated to maintain the load for a minimum of 15 minutes for all 120VAC equipment.

C. Rack-mounted Uninterruptible Power Supply (UPS)
   1. Provide a UPS to support 120% of the required load to allow for future load expansion and age related deterioration of the battery performance.
   2. The UPS interface port shall have an RS-232 communications port and a 10 Base-T Ethernet for LAN management.
      a) Provide the necessary data connection, hardware and software to remotely monitor the UPS
      b) Provide user configurable computer operating system shutdown capability
   3. The control panel shall have a LED status display for load and battery bar graphs in addition to replace battery and overload indicators.
      a) Rack-mounted surge suppression shall be vertically mounted and made for this orientation.

D. All electronic locks shall be 12/24VDC (By Division 08)

E. Connect to AC power and provide UL listed power supplies and transformers to distribute low voltage power to the system components as required.
   1. Provide uninterrupted battery backup power for the duration required above.

F. All equipment connected to AC circuits shall be protected from power surges.
   1. The devices shall be installed and grounded per manufacturer instructions.
   2. Equipment protection shall meet requirements of ANSI C62.41.
   3. Fuses shall not be used for surge protection.

G. All non-fiber optic data circuits that serve devices exterior to the buildings will be protected by surge protectors at the device and the termination.
   1. The devices shall be installed and grounded per manufacturer instructions.
   2. Equipment protection shall meet requirements of ANSI C62.41.
   3. Fuses shall not be used for surge protection.

3.6 Testing
A. Ensure that all provisions and requirements of this specification are met.
   1. Verify through inspections, demonstrations and tests.

B. Perform required tests to demonstrate workmanship, operation, and performance.
   1. Conduct tests with Architect/Owner and if required, inspectors of agencies having jurisdiction present.
   2. Arrange test dates in advance and give all parties a minimum of 48 hours notice.

C. Repair or replace equipment or systems found defective or inoperative and re-test until 100% satisfactory results are obtained.

D. Verification inspections will be made of all equipment components and installations for proper functioning of locking hardware and lock controls, mounting/placement of sensors, and cameras, etc. to guarantee requirements of the Contract Documents are complied with.
1. The Owner’s quality control representative shall have the opportunity to witness all inspections, or to conduct installation inspections of his own.

3.7 Functional Performance Test

A. The Functional Performance Test (FPT) will be conducted at the end of the project and prior to system acceptance by the Owner.

1. The security integrator will provide all necessary staff and communications needed to fully test all functions of the system.
2. The contractor will submit for approval by the Architect and Owner, a comprehensive test plan that will include testing of every function on every door and security device thirty (30) days prior to the scheduled start of the test.
3. The system will not be considered for acceptance prior to the successful completion of the FPT and completion of punch list items.

B. Pre-Testing

1. Following installation and prior to the FPT, the security integrator shall individually test each component and field device and verify the proper functioning of each component within a particular sub-system.

   a) The contractor shall also test each sub-system until all detection zones, alarm assessment components, alarm reporting, surveillance and display components; along with access control functions have been verified.
   b) Prior to the FPT all deficiencies must be corrected.
   c) After sub-system verification is complete, test the entire system to assure that all elements and subsystems are compatible and function properly as a complete system.

C. Upon completion of the outlined tasks and tests the security integrator shall schedule the FPT with the Architect and Owner.

1. The security contractor must demonstrate that the security system components and sub-systems operate together as a system and meet specification requirements in the “As-Installed” operating environment.
2. On conclusion of the FPT the test report document will be submitted to the architect for approval.
3. The FPT will be observed by the architect’s and Owner’s representatives.
4. The FPT may be stopped at any time by these representatives if they believe the failure rate is too high or the system is not performing to contract document requirements.
5. The FPT will only resume when all deficiencies have been corrected.
6. Retesting will be required of all failed tests.

3.8 System Operational Test

A. Upon completion of the FPT, conduct a formal test to be known as the System Operational Test (SOT), in which all components and sub-systems of the security system are demonstrated to operate error and failure free together as a system.

1. This test is to be performed over a continuous seventy-two (72) hour period.
2. A formal test plan and test procedures shall be prepared by the security subcontractor and submitted to the Owner/Architect for approval.
3. The Security integrator must demonstrate that the system components and sub-systems meet specification requirements in the “As-Installed” operating environment and operate error and failure free for the duration of the test.
4. If a system failure does occur, the failure must be documented and repaired, after which the seventy-two hour SOT period will restart.

B. In the event that the Owner, Architect, or Contractor are required to witness a retest at a later date because the Security integrator is not properly prepared to conduct the acceptance tests or because the systems being tested have failed such tests, which shall be solely determined by the Architect or Owner witnessing the tests, the cost of witnessing additional tests shall be borne exclusively by the Security integrator.

1. Costs are to be based on time and materials at the established rates of the Architect or Owner.

END OF SECTION 28 00 00
SECTION 28 02 00 – BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons, therefore, shall be submitted to the Architect for approval as soon as practicable. No such departures shall be made without the prior written approval of the Architect.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form the complete and functioning systems in all of its various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The contractor shall review all pertinent drawings, including those of other contracts prior to commencement of Work.

B. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Electrical items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building, and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

E. All discrepancies within the Contract Documents discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.
F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each, and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning heating, ventilating and air conditioning system shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. Contractor shall participate in the commissioning process; including but not limited to meeting attendance, completion of checklists and participation in functional testing.

J. Refer to 26 03 13 for demolitions requirements.

1.3 RELATED SECTIONS

A. General Conditions

B. Supplementary Conditions

C. Division One

1.4 COOPERATION WITH TRADES:

A. Cooperation with trades of adjacent, related, or affected materials or operations shall be considered a part of this work in order to affect timely and accurate placing of work and bring together in proper and correct sequence, the work of such trades.

1.5 REFERENCES

A. National Electrical Code (NEC)

B. American Society for Testing and Materials (ASTM)

C. Underwriter's Laboratories, Inc. (UL)

D. Insulated Cable Engineer's Association (ICEA).

E. National Electrical Manufacturer's Association (NEMA).

F. Institute of Electrical and Electronics’ Engineers (IEEE).


H. National Fire Protection Association (NFPA).

1.6 COMPLETE FUNCTIONING OF WORK:

A. All work fairly implied as essential to the complete functioning of the electrical systems shown on the Drawings and Specifications shall be completed as part of the work of this Division unless specifically stated otherwise. It is the intention of the Drawings and Specifications to establish the types of the systems, but not set forth each item essential to the functioning of the system. In case of doubt as to the work intended, or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for supplementary instructions, Drawings, etc.

B. Contractor shall review all pertinent Drawings and adjust his work to all conditions shown thereon. Discrepancies between Plans, Specifications, and actual field conditions shall be brought to the prompt attention of the Architect.

1. Approximate location of transformers, feeders, branch circuits, outlets, lighting and power panels, outlets for special systems, etc., are indicated on the Drawings. However, the Drawings, do not give complete and accurate detailed locations of such outlets, conduit runs, etc., and exact locations must be determined by actual field measurement. Such locations will, at all times, be subject to the approval of the Architect.

2. Communicate with the Architect and secure his approval of any outlet (light fixture, receptacle, switch, etc.) location about which there may be the least question. Outlets obviously placed in a location not suitable to the finished room or without specific approval, shall be removed and relocated when so directed by the Architect. Location of light fixtures shall be coordinated with reflected ceiling plans.

C. Additional coordination with mechanical contractor may be required to allow adequate clearances of mechanical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.7 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the approved shop drawings.

1.8 CONTRACTOR’S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:

1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.

2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

3. Perform work by persons qualified to produce workmanship of specified quality. Persons performing electrical work shall be required to be licensed. Onsite supervision, journeyman shall have minimum of journeyman license. Helpers, apprentices shall have minimum of apprentice license.

1.9 DATE OF FINAL ACCEPTANCE
A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the architect, owner and contractor.

1.10 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 1.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its subcontractor or Sub-contractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to
dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances) or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by 1993 ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct properly protected from incidental damage and weather damage.

C. Damaged equipment shall be promptly removed from the site and new, undamaged equipment shall be installed in its place promptly with no additional charge to the Owner.

1.12 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty day period. The Architect or Engineer shall
not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

1. A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.
2. An index page with a listing of all data included in the Submittal.
3. A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.
4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.
5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.
6. Identification of each item of material or equipment matching that indicated on the Drawings.
7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.
8. Additional information as required in other Sections of this Division.
9. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 1 for additional information on shop drawings and submittals.

C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.
E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

1. REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.

2. REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.

3. NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not approved, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.

4. REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.

5. CONTRACTOR’S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor’s stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.

6. MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

H. Furnish detailed shop drawings, descriptive literature, physical data and a specification critique for each section indicating "compliance" and/or "variations" for the following items:

- Fire Alarm System
- Intrusion System

I. Refer to each specification section for additional requirements.
1.13 OPERATION AND MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 and in addition to the requirements specified in Division 1, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

1.14 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:
   a. Wall and type locations.
   b. Clearances for installing and maintaining insulation.
   c. Locations of light fixtures and sprinkler heads.
   d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
   e. Equipment connections and support details.
   f. Exterior wall and foundation penetrations.
   g. Routing of storm and sanitary sewer piping.
   h. Fire-rated wall and floor penetrations.
   i. Sizes and location of required concrete pads and bases.
   j. Valve stem movement.
   k. Structural floor, wall and roof opening sizes and details.
2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.
C. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 RECORD DRAWINGS

A. Maintain a continuous record during the course of construction of all changes and deviations in the work from the contract drawings. Upon completion of the work, purchase a set of "Auto Positive Tracings" on vellum and make corrections as required to reflect the electrical systems as installed. Location and size of all conduit shall be accurately shown to dimension. Submit three prints of the tracings for approval. Make corrections to tracings as directed and deliver "Auto Positive Tracings" to the Architect. Record drawings shall be furnished in addition to shop drawings. Symbols on the Record drawings shall correspond to the identification symbols on the contract drawings and equipment identification plates and tags.

B. The Contractor shall maintain a set of clearly marked black line record "AS-BUILT" prints on the job site on which he shall mark all work details, alterations to meet site conditions and changes made by "Change Order" notices. These shall be kept available for inspection by the Owner, Architect or Engineer at all times.

C. Refer to Division 1 for additional requirements concerning record drawings. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect. Mark the drawings with a colored pencil. Delivery of as-built prints and reproducible is a condition of final acceptance.

D. The record prints shall be updated on a daily basis and shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents which are required for coordination. All dimensions shall include at least two dimensions to permanent structure points.

E. Submit three prints of the tracings for approval. Make corrections to tracings as directed and delivered "Auto Positive Tracings" to the architect. "As-Built" drawings shall be furnished in addition to shop drawings.

F. When the option described in paragraph F., above is not exercised then upon completion of the work, the Contractor shall transfer all marks from the submit a set of clear concise set of reproducible record "AS-BUILT" drawings and shall submit the reproducible drawings with corrections made by a competent draftsman and three (3) sets of black line prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The reproducible record "AS-BUILT" drawings shall have the Engineers Name and Seal removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS

DATE:

(NAME OF GENERAL CONTRACTOR)

BY: ________________________________
1.16 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 26.

1.17 MAINTENANCE MANUALS

A. Coordinate with Division 1 for maintenance manual requirements, unless noted otherwise bind together in “D ring type” binders by National model no. 79-883 or equal, binders shall be large enough to allow ¼” of spare capacity. Three (3) sets of all approved shop drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and labeled for easy reference and shall utilize the individual specification section numbers shown in the Electrical Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 26 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

B. Prepare maintenance manuals in accordance with Special Project Conditions, in addition to the requirements specified in Division 26, include the following information for equipment items:

1. Identifying names, name tags designations and locations for all equipment.
2. Fault Current calculations and Coordination Study.
3. Reviewed shop drawing submittals with exceptions noted compliance letter.
4. Fabrication drawings.
5. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
6. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

7. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.

8. Equipment name plate data.


10. Exploded parts views and parts lists for all equipment and devices.

11. Color coding charts for all painted equipment and conduit.

12. Location and listing of all spare parts and special keys and tools furnished to the Owner.

13. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

C. Refer to Division 1 for additional information on Operating and Maintenance Manuals.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer a minimum of 14 working days prior to the beginning of the operator training period.

1.18 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include 12 hours of onsite training in three 4 hour shifts.

B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

C. Refer to other Division 26 Sections for additional Operator Training requirements.

1.19 SITE VISITATION

A. Visit the site of the proposed construction in order to fully understand the facilities, difficulties and restriction attending the execution of the work.

B. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

C. Understand the existing utilities from which services will be supplied; verify locations of utility services and determine requirements for connections.

D. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.
1.20 WARRANTY

A. The undertaking of the work described in this Division shall be considered equivalent to the issuance, as part of this work, of a specific guarantee extending one year beyond the date of completion of work and acceptance by Owner, against defects in materials and workmanship. Materials, appliances and labor necessary to effect repairs and replacement so as to maintain said work in good functioning order shall be provided as required. Replacements necessitated by normal wear in use or by Owner's abuse are not included under this guarantee.

B. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, freight/shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service call required to diagnose warranty problems.

1.21 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner’s risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney’s fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data’s creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be Contractor’s sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect’s written consent.

1. It is agreed that “MEP” hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The contract documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.

2. If the client, Architect or Owner of the project requires electronic media for “record purposes”, then AutoCAD/ Revit documents will be prepared by Engineer on
electronic media such as removable memory devices, flash drives or CD’s. These documents can also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

3. At the Architect/Owner’s request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a “.rvt” or “.dwg” format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. The names and manufacturers and model numbers have been used in the Contract documents to establish types of equipment and standards of quality. Where more than one manufacturer is named for a specific item of equipment, only one of the specified manufacturers will be considered for approval. Where only one manufacturer is mentioned with the phrase "or approved equal", Contractor may submit an alternate manufacturer for consideration, provided the following conditions are met:

1. Submit alternate equipment with complete descriptive data in shop drawing form. Provide sample of equipment upon request for review by Architect. Samples will be returned if requested in writing.
2. Alternate equipment must be equal from the standpoint of materials, construction and performance.
3. Alternate submittal must be presented to the Engineer/Architect ten (10) days prior to bid date for approval.

B. The Architect and Engineer shall be the sole judge of quality and equivalence of equipment, materials and methods.

2.2 All materials and products used on this project shall be listed by Underwriters' Laboratories.

2.3 ACCESS DOORS

A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:

1. Plaster Surfaces: Milcor Style K.
2. Ceramic Tile Surfaces: Milcor Style M.
3. Drywall Surfaces: Milcor Style DW.
4. Install panels only in locations approved by the Architect.

2.4 EQUIPMENT PADS

A. Unless noted otherwise 4" high concrete pads for floor mounted equipment shall be installed under Division 3. Pads shall conform to the shape of the equipment with a minimum of 3" margin at equipment supports. Top and sides of pads shall be troweled to a smooth finish, equal to floor. External corners shall be bull nosed to a 3/4" radius, unless shown otherwise.
2.5 ESCUTCHEONS
A. Provide heavy chrome or nickel plated plates, of approved pattern, on conduit passing through walls, floors and ceilings in finished areas. Where conduit passes through a sleeve, no point of the conduit shall touch the building construction. Caulk around such conduit with sufficient layers of two hour rated firesafing by Thermafiber 4.0 P.C.F. density, U.S.G. fire test 4/11/78 and seal off openings between conduit and sleeves with non-hardening mastic prior to application of escutcheon plate. Escutcheons shall be Gravler Sure-Lock, or approved equal.

2.6 SPACE LIMITATIONS
A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with Code requirements. Physical dimensions and arrangement of equipment shall be subject to the approval of the Architect.

2.7 PAINTING
A. All factory assembled equipment for electrical work, except light fixtures, that normally is delivered with a factory applied finish shall be delivered with a hard surface factory applied finish such as baked-on machinery enamel which will not require additional field painting. The finish shall consist of not less than 2 coats of medium gray color paint USA No. 61 Munsell Notation 8-3G, 6. 10/0.54 enamel. This Contractor shall protect this finish from damage due to construction operations until acceptance of the building. He shall be responsible for satisfactorily restoring any such finishes or replacing equipment that becomes stained or damaged.

2.8 RACEWAY IDENTIFICATION
A. Conduit Systems: Provide adequate marking of major conduit which is exposed or concealed in accessible spaces to distinguish each run as either a power or signal/communication conduit. Use red banding with black lettering except as otherwise indicated. Provide self-adhesive or snap-on type plastic markers. Locate markers at ends of conduit runs, on pull boxes, on junction boxes and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors or enters non-accessible construction and at spacings of not more than 50 feet along each run of conduit.

B. Underground Cable Identification: Bury a continuous, preprinted, bright colored plastic ribbon cable marker with each underground cable (or group of cables), regardless of whether conductors are in conduit, duct bank, or direct buried. Locate each directly over cables, 6 to 8 inches below finished grade.

C. Identification of Equipment:
1. All major equipment shall have a manufacturer’s label identifying the manufacturer’s address, equipment model and serial numbers, equipment size, and other pertinent data. Care shall be taken not to obliterate this nameplate in any way.
2. Prohibited Markings: Markings which are intended to identify the manufacturer, vendor, or other source from which the material has been obtained are prohibited for
installation within public, tenant, or common areas within the project. Also, prohibited are materials or devices which bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters’ Laboratories, Inc.), and approval labels are exceptions to this requirement.

3. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.

4. Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical system, provide tags of plasticized card stock, either preprinted or hand printed.

PART 3 - EXECUTION

3.1 EXCAVATING AND BACKFILLING

A. Trenching and backfilling and other earthwork operations required to install the facilities specified herein shall conform to the applicable requirements of Division 2 (95% of maximum standard density). Where trenching or excavation is required in improved areas, the backfill shall be compacted to a condition equal to that of adjacent undisturbed earth and the surface of the area restored to the condition existing prior to trenching or excavating operations. Provide a minimum of 3” of sand underneath all conduits. The plans indicate information pertaining to surface and sub-surface obstructions; however, this information is not guaranteed. Should obstructions be encountered whether or not shown, the Contractor shall alter routing of new work, reroute existing lines, remove obstructions where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of new work and leave existing surfaces and structures in a satisfactory and serviceable condition. All work shall comply with OSHA Standards.

3.2 WORKMANSHIP AND CONCEALMENT

A. The work of this Section shall be performed by workman skilled in their trade. Installation shall be consistent in completeness whether concealed or exposed. Each item of electrical work shall be concealed in walls, chases, under floors and above ceilings except:

1. Where shown to be exposed.
2. Where exposure is necessary to the proper function.

3.3 SLEEVES, CUTTING AND PATCHING

A. This section shall be responsible for placing sleeves for all conduit passing through walls, partitions, sound walls, beams, floors, roof, etc. Sleeves through below-grade walls shall use water-tight fitting manufactured by O-Z/Gedney.

B. All cutting and patching will be done under another Division, but this Section will be responsible for timely performance of this work and layout of holes and setting sleeves.

C. All un-used sleeves shall be sealed with 2 hour UL approved fire sealant manufactured by “3M” or approved equal.

D. Refer to 26 05 33 for additional requirements.
3.4 CONTROL PANELS

A. Install all Panels in accordance with the National Electrical Code, industry standards and as shown on the drawings.

B. Panels mounted in telecom, MDF, IDF, mechanical/electrical rooms shall be mounted at a working height not requiring a ladder when wall space is available. Installation of these devices at greater elevations shall be approved by the Engineer. Contractor shall provide a coordination sketch of each mechanical/electrical room noting locations and mounting heights of all electrical devices (note bottom and top elevations) shown to be installed. Sketches shall be provided to the Engineer for review and the general contractor for coordination with other trades working in these rooms.

3.5 CLEANING

A. Touch-up and refinish scratches and marred surfaces on panels.

3.6 CORROSIVE AREAS

A. In areas of a corrosive nature, which include but are not limited to the following: pool equipment rooms, cooling towers and areas subject to salt air, etc., provide NEMA 4 X stainless steel or fiberglass reinforced enclosures for contactors, panel boards, controllers, starters, disconnects and materials used as supporting means (i.e. plastibond unistrut, pipe, fittings). The use of spray on coating may be acceptable in some applications.

3.7 TESTS AND INSPECTIONS

A. Tests and inspection requirements shall be coordinated with Division I.

B. Date for final acceptance test shall be sufficiently in advance of completion date of contract to permit alterations or adjustments necessary to achieve proper functioning of equipment prior to contract completion date.

C. Conduct re-tests as directed by Architect on portions of work or equipment altered or adjusted as determined to be necessary by final acceptance test. No resultant delay or consumption of time as a result of such necessary re-test beyond contract completion date shall relieve Contractor of his responsibility under contract.

D. Put equipment into service under normal conditions, collectively and separately, as may be required to determine satisfactory operation. Demonstrate equipment to operate in accordance with requirements of these specifications. Perform tests in the presence of Architect. Furnish instruments and personnel required for tests.

E. Final Inspection:

1. At the time designated by the Architect, the entire system shall be inspected by the Architect and Engineer. The contractor or his representative shall be present at this inspection.
2. Panels shall be cleaned and in operating condition.
3. Certificates and documents required hereinbefore shall be in order and presented to the Architect prior to inspection.
4. Panel covers, junction box covers, etc., shall be removed for visual inspection of the wire, bus bars, etc.
5. After the inspection, any items which are noted as needing to be changed or
corrected in order to comply with these specifications and the drawings shall be accomplished without delay.

END OF SECTION 28 02 00
SECTION 28 10 00 – ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY/OVERVIEW
A. This section provides specifications for the installation of Electronic Access Control (AC), and related components.
B. Related Sections
1. Section 087100 Door Hardware
2. Section 260000 Electrical (including related sub-sections)
3. Section 270000 Communications (including related sub-sections)
4. Section 280000 Electronic Safety and Security
5. Section 282000 Video Surveillance System
6. Section 283100 Intrusion Detection System
7. Section 284600 Fire Alarm and Smoke Detection

1.2 REFERENCES
A. See Section 280000 Electronic Safety and Security.

1.3 SYSTEM COORDINATION
A. The Security Integrator shall completely coordinate all relevant work of other trades/systems including, but not limited to:
   1. Door Hardware
   2. Fire Alarm System
   3. Electrical Systems(s)
   4. Telecommunications System(s)
B. Electric Locking Mechanisms
   1. The security integrator and door hardware contractor shall coordinate all door hardware, door and door frame design.
   2. The security contractor shall verify all specified door hardware is appropriate for the security application and verify the sequence of operations for each access controlled opening.
C. Fire Alarm and Life Safety
   1. The security integrator shall coordinate the access control system design with the life safety consultant to insure compliance with applicable codes and requirements.
   2. This includes, but is not limited to:
      a) Fire alarm interface
      b) Fail safe/fail secure locking mechanisms
      c) Delayed egress

1.4 GENERAL SYSTEM DESCRIPTION
A. General Requirements
   1. Furnish all labor, materials, tools, equipment, and services for a complete security system as indicated and in accordance with provisions of the contract documents.
   2. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, and devices incidental to or necessary for a sound, secure and complete installation.
3. Comply with the provisions of Division 1 for General Requirements.
   a) In the event of a conflict between the provisions of this Section and Division 1, the more stringent provisions shall apply.

4. All system devices and components included shall be compatible.

B. The project shall be equipped with a new system that is maintained by the police department.
   1. All work required within the project for new AC system head end shall be furnished and installed by the project security contractor.

C. The AC system will support the needs of the project in accordance with these specifications.
   1. The AC system shall have the capability for future expansion to support the security needs of the completed complex.

D. The AC system shall be interfaced with the Fire Alarm system (by others) as required to comply with all building code requirements.

E. Emergency/UPS power will be utilized to power the AC system’s computer workstation (client) at the Security head end equipment location.

F. Emergency/APS power will be utilized to power the AC system’s Data Gathering Panels and control components as required throughout the facility.

1.5 ACCESS CONTROL SYSTEM

A. The AC system will consist of card readers, door position switches, and request-to-exit sensors operating in conjunction with associated electric door hardware.
   1. Card readers and adjunct devices shall be provided as shown on the drawings.
      a) Provide card readers, Data Gathering Panels <DGP>, and alarm input and output devices connected to the security management system via Local Area Network (LAN).
      b) The security integrator shall coordinate network and IP address requirements with Owner to identify the Media Access Control (MAC) address (Layer 2) of each provided device, the location to be installed, and the port configuration needed for communication.
      c) Furnish all labor, materials, tools, equipment, and services for a complete system as indicated and in accordance with provisions of the contract documents.
      d) Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, and devices incidental to or necessary for a sound, secure and complete installation.

B. Card readers will work such that upon presentation of a valid AC card, the unique card data shall be transmitted to an associated control panel where the data is compared to an authorized user database and access is approved or rejected accordingly.
   1. A valid authorization will activate operation of the electric lock and shunt the door position switch. The alarm shunt will not affect supervision of the detection circuit.
   2. Coordinate with owner on card format and other pertinent details.

C. Card readers shall support Magnetic Stripe, 125 KHz proximity, and 13.56 MHz smart card technologies

D. Door position switches at card reader controlled location serve to indicate the open/closed status of the associated door and shall establish the basis for reporting a door-propped or unauthorized entry condition.
1. Security contractor is responsible for coordinating the contact configuration (SPDT) (DPDT) and rating for door position switches, and for connection of switches with the AC.

2. The Division 08 contractor shall be responsible for providing all flush mounted door position switches as indicated on drawings.

E. Electrified door hardware for card reader controlled doors will include electrified locksets, electric exit devices, and electric power transfer as shown on the drawings.

1. All electrified door hardware shall be provided under the work of Division 08 unless otherwise noted.

2. Security subcontractor shall provide all security cables and, low voltage power supplies for operation of electrified door hardware associated with card reader controlled doors.

F. Request-to-exit (REX) devices at designated card reader controlled doors shall cause the associated door position switches to be shunted.

1. The alarm shunt shall not affect the supervision of the alarm detection circuit.

2. Electrified Lockset shall have an integral REX switch.

3. Electrified Exit devices shall have an integral REX switch.

4. Magnetic Locks shall have a Passive InfraRed (PIR) motion sensor REX device.

   a) Wire the PIR to the Door REX Input. The configuration on this motion shall be non-resettable and activate for only 2 seconds.

   b) A second set of output contacts for the REX motion sensor shall be wired in series with the power to the lock, disconnecting power to the lock when motion is sensed.

   c) The PIR REX shall be mounted and the sensor positioned to avoid detection more than three feet from the door and at the door bottom sweep.

      1) Deter under door spoofing attacks by pointing the sensor away from the door threshold. Position the sensor to detect motion at the door handle or door push plate.

   d) Connect to REX switch in exit device (by Division 8).

      1) Coordinate with Division 8 to ensure proper REX switch configuration

      2) Wire the REX switch as described for the above motion sensor to disconnect power to the lock and activate the REX input on the DGP.

   e) Doors with out exit devices, a UL listed double pole pushbutton exit switch shall be provided as a redundant REX device.

      1) It shall be wired as described for the above motion sensor to disconnect power to the lock and activate the REX input on the DGP.

      2) Locate within 6’-0” of the door push-plate/handle.

1.6 SUBMITTALS

A. Follow provisions of Section 280000 additional requirements.

B. Field Test Reports

   1. Upon completion and testing of the installed system, test reports shall be submitted in booklet form and electronic media showing all field tests performed on, and
adjustments made to each-any component and all field tests performed to prove compliance with the specified performance criteria.

2. Indicate and interpret test results in written form and verbally to owner/DBR for compliance with performance requirements at a pre-scheduled meeting.

C. Battery calculations to show the expected loads and backup duration for power supplies and UPS devices for all active AC equipment.

D. Security Contractor is responsible to prepare and submit as required to the Authority Having Jurisdiction (AHJ) any and all information to obtain an Electronic Locking Mechanisms permit.

1.7 QUALITY ASSURANCE

A. Follow provisions of Section 280000.

B. Spare Parts:
   1. Provide two (2) spare components for every model and configuration of electronic components and devices used on the project as spare parts inventory.
      a) The security integrator will turn over the new and unused components and devices to the owner at project closeout.

1.8 DELIVERY, STORAGE AND HANDLING

A. Follow provisions of Section 280000.

1.9 PROJECT/SITE CONDITIONS

A. Follow provisions of Section 280000.

1.10 WARRANTY

A. Follow provisions of Section 280000.

B. All devices and components shall comply with applicable U.L. standards.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SYSTEM MANUFACTURERS

A. AC System Platform Software
   1. Open Options DNA Fusion
   2. Gentec Synergis

B. System Platform Server (By Owner)
   1. Dell
   2. Hewlett Packard
   3. IBM
   4. Owner Approved Equivalent

C. Workstation (OFE)

2.2 ACCEPTABLE ACCESS CONTROL MANUFACTURERS

A. Access Control Data Gathering Panels <DGP>
   1. Mercury LP1502
   2. Owner Approved Equivalent

B. Access Control Sub-controller
   1. Mercury MR52, MR50
2. Owner Approved Equivalent

C. Access Control Input/Output Modules
1. Mercury MR16IN, MR16OUT
2. Owner Approved Equivalent

D. Proximity Card Readers <CR>
1. HID iClass SE RP40 (Wall-mount)
2. HID iClass SE RP15 (Mullion-mount)
3. Owner Approved Equivalent

E. ID credential printer (with card stock and consumables to produce 250 credentials)
1. Fargo
2. Nisca
3. Datacard
4. Magicard
5. Owner Approved Equivalent

F. Door Position Switches <DC>
1. Concealed Magnetic Door Position Switch
   a) Sentrol 1076D
   b) Magnasphere MSS-19C/L / MSS-25C/L
   c) Owner Approved Equivalent

2. Surface Mounted Door Position Switch <SDC>
   a) Sentrol 2707AD-L
   b) Owner Approved Equivalent

3. Overhead Door Position Switch <ODC>
   a) Sentrol 2317AH
   b) Owner Approved Equivalent

G. Video Intercom Door Station
1. AXIS A8004
2. AXIS A8207-VE MKII (with key pad and HID support)
3. Owner Approved Equivalent

H. Duress Button
1. United Security HUB-2B
2. Owner Approved Equivalent

I. Door Release Button
   Provide and install the following pieces for each door release button:
   1. Contact Block, Schneider Electric Product No. ZBE101
   2. Plastic Push Button, Schneider Product No. ZB5AA3
   3. Provide Polycarbonate enclosure sized for the required number of buttons. Provide multiple enclosures if required. Schneider Harmony Control Station Enclosures:
      1-Button – XALD01
      2-Button – XALD02
      3-Button – XALD03
      4-Button – XALD04
      5-Button – XALD05

J. Electric Locking Mechanism Power Supply

ACCESS CONTROL SYSTEM
K. Electric Locking Mechanisms (By Division 08)
1. Sargent
2. Schlage
3. Von Duprin
4. Locknetics
5. Owner Approved Equivalent

L. Electric Power Transfer (By Division 08)
1. Security Door Controls (SDC)
2. Schlage
3. Von Duprin
4. Owner Approved Equivalent

M. Uninterruptible Power Supply <UPS>
1. Eaton UPS
  a) 5S series for workstations
  b) 9170 for rack mounted equipment
2. APC Smart-UPS Series
  a) SMT series for workstations
  b) Smart-UPS on-Line series for rack mounted equipment

N. Wire & Cable
1. Belden
2. Windy City
3. General Cable
4. Owner Approved Equivalent

PART 3 - EXECUTION
3.1 GENERAL REQUIREMENTS
A. Power Supplies
1. Power supply requirements
   a) A switch and on/off indicator within the power supply cabinet.
   b) Four hours of sealed gel battery backup to provide continuous operation during power failure.
      1) Provide batteries as required to provide specified battery backup time for a fully loaded power supply, regardless of the connected load.
   c) A battery charger to maintain the battery.
   d) Low battery and power fail contacts to monitor the status of the input power and the battery.
      1) Connect each power supply low battery and power fail alarm as a separate alarm input into DGP.
   e) Key lockable wall mount metal enclosure with tamper switch.
2. Additional DGP Power Supply Requirements
   a) The DGP power supply provides power only to DGP’s and shall not provide power for locks or any other low voltage device.

3. Additional Electric Locking Mechanism Power Supply Requirements
   a) Fail secure electric locking mechanisms shall remain locked during power failure and fire alarm conditions.
   b) Connect fail safe locking devices in accordance with applicable life safety codes to unlock automatically under the following conditions:
      1) Loss of power to the power supply
      2) Failure of the power supply
      3) Fire alarm activation
   c) Provide power distribution boards with independently fused output relays and fire alarm control panel interface.

4. Additional Device Power Supply Requirements
   a) Provide device power supplies for other security system devices requiring power (e.g. card readers, local alarms, motion sensors, etc.)
   b) Provide power distribution boards with independently fused outputs.

B. Video Surveillance System Integration
   1. Automatic Video Call-up
      a) All alarms shall call up all cameras in the area of alarm to the screen of the ACID alarm operator workstation to allow for operator assessment of the alarm.

   2. Pre and Post Alarm Video
      a) The operator shall be able to view up to 10 seconds of video before the alarm and 30 seconds after the alarm for all cameras associated with the alarm.
      b) This feature is to be integrated with the operator alarm notification to assist in alarm assessment.
      c) This feature shall be displayed as an option on the alarm notification screen and will not require operator to make a manual video search.

   3. Recording
      a) All cameras whose field of view that include images of the area affected by the alarm, shall be recorded when an alarm is detected for use in forensic analysis, including the pre and post alarm video.

   4. Duress and Emergency Intercommunications Integration
      a) Calls from emergency intercoms/phones with cameras shall provide the above video call-up and the pre and post alarm video capabilities.

C. Tamper Resistant Screws
   1. Provide appropriate screw heads for each application (e.g. countersunk heads for recessed cover plate screws, flat head screws for standard junction box covers, etc.).
   2. The security integrator shall provide Torx® tamper resistant screws for:
      a) Junction boxes located above doors
      b) Junction boxes located below ceiling height and/or within reach of hatch ladders
c) Security device cover plates  
d) Surface mounted door position switches and armored cable

3.2 ENCLOSURE INSTALLATION

A. Enclosures shall be lockable with a tamper switch and installed in a manner to be accessible with clearance to fully open enclosure door.

B. All security panels shall be wired through a dedicated power supply with battery backup.
   1. Power to the data gathering panels is to be hardwired utilizing EMT or rigid conduit in accordance with the Electrical specifications.
   2. A circuit from the Fire Alarm panel must be installed to each lock power distribution panel.

C. Enclosures shall be installed on designated wall fields in a neat and compact manner to allow for future growth.

D. Enclosures shall be sized to allow for 20% growth in each panel.

E. All panels and boards shall be installed in enclosure(s) suitable to their environment and have sufficient size and orientation to include all system components.

F. Each panel shall be labeled accordance with Owner standards.
   The label for each panel shall be posted on the exterior of the panel door.
   a) Each panel shall have a list of devices connected to it located on the inside cover.
   b) A detailed device layout drawing will be located on the inside of the panel door in an appropriate sleeve and keeper.

3.3 FURTHER REQUIREMENTS

A. Refer to provisions of Section 280000.

B. Furnish and coordinate installation of all special device back boxes and AC field devices as shown on the security drawings and as specified in this section.

C. The exact installation locations of all equipment shall be coordinated and verified with the Contractor prior to installation.
   1. Subcontractor shall notify the Contractor if any location appears to be unsuitable.

D. Provide low voltage power supplies for electric locking devices and AC devices and components as shown on the security drawings and specified in this Section.

E. Coordinate with the Telecommunications Subcontractor for data network connections, IP address requirements, and telephone circuits as required.

F. Prepare all systems for user operation.
   1. The security system must be complete and ready to operate prior to Owner final acceptance of the system.

G. Coordinate with the Owner for all system programming requirements.

H. Perform database programming as required to support the card reader, alarm point, surveillance system integration, and control panel configuration as required.

END OF SECTION 28 10 00
SECTION 28 20 00 – VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY/OVERVIEW

A. This section provides specifications for the installation of an IP based Video Surveillance System (VS) and related components.

B. Related Sections
   1. Section 260000 Electrical (including related sub-sections)
   2. Section 270000 Communications (including related sub-sections)
   3. Section 280000 Electronic Safety and Security
   4. Section 281000 Access Control System
   5. Section 283100 Intrusion Detection System

1.2 REFERENCES

A. See Section 280000 Electronic Security.

1.3 SYSTEM DESCRIPTION

A. The project will be equipped with a new Video Management System (VMS) as a Stand Alone System.
   1. Provide Network Video Recorder (NVR) and Network Attached Storage (NAS) located in relay rack in the MDF of the project site.
      a) The new system shall provide for recording, local monitoring, and remote monitoring of IP cameras.

B. The security integrator shall furnish and install the surveillance system, consisting of camera assemblies, NVR, wiring & cabling, and low voltage camera power supplies.
   1. All active surveillance equipment and communication devices shall be on emergency/UPS power.

C. Camera assemblies include camera, lens, housing, and mount. Provide and install wiring and low voltage power from the security wall field/rack to the camera locations.
   1. Scope of work shall be complete from point of origin (camera) to point of termination (security rack).

D. Provide rack mount 1U monitor/keyboard/track ball drawer with 20” LCD monitor for display and programming, keyboard, track ball, and integrated four-port KVM switch.
   1. Provide additional KVM ports as required plus two spare ports if Work includes more than two NVRs.

E. Coordinate all work that must be performed in security head end spaces with the General Contractor, the Electrical Contractor, and the Telecommunications contractor. (if applicable)

F. Camera images shall support H.264 compression formats.
G. The NVR shall not be loaded to exceed 50% of the camera and/or storage capacity to allow room for expansion.

H. Camera lenses for fixed cameras shall be varifocal and sized to provide the owner approved field of view. The lens shall be IR corrected and have megapixel resolution.

I. Surveillance camera audio functions shall not be installed and/or disabled unless specifically requested by Owner.

J. Data cables from camera to network switches will be provided by div 27. If div 27 contractor is not available, camera system contractor shall provide all data cables runs as needed to provide a complete functioning system.

1.4 SUBMITTALS

A. Follow provisions of Section 280000 for additional requirements.

B. Project Data
   1. Provide a description of system operation indicating the purpose and capability of each device/component of the system with a functional diagram indicating all interfaces to other systems.

C. IP: Video Quality test reports shall be provided for all cameras to confirm an optimum high definition video signal.

D. Shop drawings shall reflect all requirements associated with Owner provided or existing equipment and materials that will be used as part of this system.

E. Video Storage calculations to show the system capacity can accommodate the specified video retention.

F. Battery calculations to show the expected loads and backup duration for camera power supplies and UPS devices for all active surveillance equipment.

G. System programming, camera titles, descriptions, camera images and database
   1. Camera titles and descriptions prior to system programming
   2. Programming/database prior to performance testing
   3. Provide a cross reference between specified camera numbers and programmed camera numbers
   4. Final programming, camera images and system documentation on electronic media to Owner

H. Product Data
   1. Manufacturer’s technical data sheets and specifications

1.5 QUALITY ASSURANCE

A. Follow provisions of Section 280000.

B. Spare Parts:
   1. Provide two (2) spare components for every model and configuration of electronic components and devices used on the project as spare parts inventory.
a) The security integrator will turn over the new and unused components and devices to the owner at project closeout.

1.6 DELIVERY, STORAGE AND HANDLING

A. See Section 280000.

1.7 PROJECT/SITE CONDITIONS

A. See Section 280000.

1.8 WARRANTY

A. See Section 280000.

PART 2 - PRODUCTS

2.1 CAMERA SPECIFICATIONS

A. All cameras shall be a Dome Camera unless otherwise specified
   1. Compatible with the VMS
   2. Vandal resistant with polycarbonate dome
   3. Wide Dynamic Range Feature: All exterior cameras and interior cameras that have exterior lighting or headlights in their field of view shall have a Wide Dynamic Range feature to improve picture quality in situations with strong backlighting.
   4. Multi-stream so that recording and viewing can be at different frame rate and compression.
   5. Day-night Color/B&W camera with cut filter
   6. Exterior cameras:
      a) Shall be outdoor rated
      b) Include a heater to permit fog-free viewing in low temperatures
      c) Fan to prevent overheating in high temperatures (as required)

B. Interior Fixed Dome Cameras:
   1. Shall be IP, PoE IEEE 802.3af
   2. Day-night Color/B&W camera with cut filter
   3. Smoked lower dome
   4. Include an SD card sized to allow for scheduled and event based storage of images
   5. Resolution shall be a minimum of 2MP (1080p) at 30 FPS
   6. Vari-focal auto-iris fixed lens sized to provide the owner approved field of view
   7. Shall have a minimum sensitivity of 0.05 Lux at:
      a) 30 IRE
      b) 75% reflectance
      c) AGC off
      d) 1.2 f-stop
      e) Sense-Up off

C. Interior/Exterior Fixed Wide Angle Lens Cameras:
   1. Resolution shall be a minimum of 5.0 MP at 30 FPS
   2. Dome Camera is preferred over a Box Camera
   3. Include an SD card sized to allow for scheduled and event based storage of images
   4. Auto-iris wide angle lens
a) Shall be Rectilinear Lens to minimize barrel distortion
b) C/CS mount removable lens
c) Wide horizontal field of view minimum of 90 degrees
d) Size lens to provide the owner approved field of view

5. Size camera and lens for facial recognition at a minimum of 60 pixels per foot at the target location
6. Shall have a minimum sensitivity of 0.05 Lux at:
   a) 30 IRE
   b) 75% reflectance
c) AGC off
d) 1.2 f-stop
e) Sense-Up off

D. Exterior Fixed Dome Cameras:
1. Shall be IP, PoE IEEE 802.3af
2. Clear lower dome, unless otherwise specified
3. Include an SD card sized to allow for scheduled and event based storage of images
4. Resolution shall be a minimum of 2MP (1080p) at 30 FPS
5. Vari-focal auto-iris fixed lens sized to provide the owner approved field of view.
6. Shall include remote focus and zoom over the network
7. Shall have a minimum sensitivity of 0.05 Lux at:
   a) 30 IRE
   b) 75% reflectance
c) AGC off
d) 1.2 f-stop
e) Sense-Up off

E. Exterior Pan Tilt Zoom (PTZ) Dome Cameras
1. Shall be IP
2. Clear lower dome
3. Include an SD card sized to allow for scheduled and event based storage of images
4. Resolution shall be a minimum of 1.3MP (720p) at 30 FPS
5. Auto-iris
6. Zoom - 18 x optical zoom lens and 12 x digital zoom.
7. Operator controlled panning speed shall be at least 300 degrees per second and 360 degree continuous pan rotation.
8. 50 presets minimum
9. Shall have a minimum sensitivity of 0.04 Lux at:
   a) 30 IRE
   b) 75% reflectance
c) AGC off
d) 1.2 f-stop
e) Sense-Up off

F. License Plate Cameras:
1. Shall be IP, PoE IEEE 802.3af or 802.3at
2. Include pole and wall mount accessories
3. Include infrared (IR) illuminator accessory
4. Include camera housing with sunshield, heater/blower to meet IP66, IP67 and NEMA 4
5. Include an SD card sized to allow for scheduled and event based storage of images
6. Camera resolution shall be a minimum of 2MP (1080p) at 30 FPS
7. Include IR corrected, varifocal CS-mount lens. Provide lens sized to provide the owner approved field of view. Size camera and lens to view a minimum of 60 pixels per foot at the target location
8. Camera shall have remote focus and zoom over the network
9. Camera shall have a minimum sensitivity of 0.22 lux (color) and 0.02 lux (B/W) at 50 IRE
10. Locate camera perpendicular to the viewing surface

2.2 NETWORK VIDEO RECORDER

A. The Network Video Recorder shall be compatible with the existing video management system along with the following minimal requirements:
   1. Provide hot swappable storage drives in a RAID 5 array
   2. Support dual stream cameras
   3. Include a dual Network Interface Card (NIC) that supports:
      a) Full duplex
      b) Fault tolerance
      c) Link aggregation
      d) Load Balancing
      e) Traffic prioritization
      f) Hot swap
   4. Native support of H.264 compression that does not require the use of additional software or equipment
   5. Provide a 20 inch 1080P service monitor and keyboard at each NVR equipment rack
   6. Provide video storage capacity for 30 days using the following minimum criteria
      a) All cameras using H.264 compression
      b) Interior cameras: Use native camera resolution
      c) Exterior cameras: Use native camera resolution
      d) Wide angle lens cameras: Use native camera resolution
      e) Motion triggered recording
         1) Assume that motion will be detected 50% of the day
         2) Motion detection will be configurable by camera and schedule to mitigate nuisance triggers
         3) Record video at 12 FPS when motion is detected
         4) Record video at 1 FPS when no motion is detected
   B. Coordinate with owner on the number of user licenses required
   C. Provide UPS for backup power to the NVR and peripheral equipment
      1. Follow provisions of Section 28000 for UPS power requirements
      2. Coordinate with Division 26 to provide a dedicated Emergency Power circuit

2.3 PoE NETWORK SWITCH (OFOI)

2.4 ACCEPTABLE MANUFACTURERS
A. Video Management System (VMS) Platform Software
   1. Milestone Systems
   2. Salient Systems
   3. Video Insight
   4. Owner Approved Equivalent

B. NVR Server: Compatible with VMS Requirements
   1. NVR specification compliant hardware

C. Workstation Hardware:
   1. Dell
   2. HP
   3. Owner Approved Equivalent

D. Video Monitor:
   1. Viewsonic
   2. Samsung
   3. Optiquest
   4. LG

E. Exterior Corner Mounted Multi-sensor Camera (TYPE A)
   1. Axis P3717-PLE
   2. Owner Approved Equivalent

F. Interior Single-sensor Camera Ceiling Mounted (TYPE B)
   1. Axis P3245-LV
   2. Owner Approved Equivalent

G. Interior Single-sensor Camera Wall Mounted (TYPE C)
   1. Axis P3245-LV
   2. Owner Approved Equivalent

H. Interior Dual-sensor Camera Ceiling Mounted (TYPE D)
   1. Axis P3715-PLVE
   2. Owner Approved Equivalent

I. Interior Ceiling Mounted Multi-sensor Camera (TYPE E)
   1. Axis P3717-PLE
   2. Owner Approved Equivalent

J. Exterior Single-sensor Camera Wall Mounted (TYPE F)
   1. Axis P3245-LVE
   2. Owner Approved Equivalent

K. Interior Fisheye Camera Ceiling Mounted (TYPE G)
   1. Axis M3067-P
   2. Owner Approved Equivalent
L. Exterior Parapet/Roof Deck Camera Mount
   1. Axis Communications
   2. Owner Approved Equivalent

M. Wide Angle Megapixel Camera Lens
   1. Computar
   2. Theia
   3. Owner Approved Equivalent

N. Camera Power Supply
   1. Altronix
   2. Alarm-Saf
   3. LifeSafety Power
   4. Owner Approved Equivalent

O. Equipment Racks and Racks Components: (By Division 27)
   1. Chatsworth Products (CPI)
   2. Ortronics
   3. Newton Instruments
   4. Owner Approved Equivalent

P. Lockable Equipment Cabinet and Components: (By Division 27)
   1. Chatsworth Products (CPI)
   2. Ortronics
   3. Newton Instruments
   4. Owner Approved Equivalent

Q. Media Converter - Copper-to-Fiber Outdoor rated (Hardened for extreme temperatures)
   1. Axis Communications
   2. Pelco
   3. IFS / UTC Security
   4. Owner Approved Equivalent

R. PoE Network Switch
   1. Brocade
   2. Cisco
   3. Juniper
   4. Arista
   5. Owner Approved Equivalent

S. Video Wire & Cable
   1. Windy City
   2. General Cable
   3. Belden
   4. CommScope
   5. Owner Approved Equivalent

T. Uninterruptible Power Supply (UPS)
1. Eaton UPS  
   a) 5S series for workstations  
   b) 9170 for rack mounted equipment  

2. APC Smart-UPS Series  
   a) SMT series for workstations  
   b) Smart-UPS on-Line series for rack mounted equipment  

3. MinuteMan  
   a) Pro series for workstations  
   b) Enterprise Plus series for rack mounted equipment  

4. Owner Approved Equivalent  

PART 3 - EXECUTION  

3.1 CONFIGURATION  

A. Video Cameras  
   1. Provide day/night cameras in exterior locations  
   2. Lenses shall be field tested with Owner present to verify clear, crisp images and desired field of view  
      a) Substitute camera lenses as necessary to obtain required field of view at no additional cost  
      b) Provide spot filters for exterior lenses as required to reduce picture washout caused by sunlight  

B. IP PoE Cameras  
   1. The security integrator shall coordinate network and IP address requirements with Owner to identify the Media Access Control (MAC) address (Layer 2) of each provided camera, the location to be installed, and the port configuration needed for communication.  
   2. Make all necessary adjustments to camera lenses to obtain clear, crisp images and desired field of view to the Owners satisfaction.  
      a) Substitute camera lenses as necessary to obtain required field of view at no additional cost.  
      1) Adjust all cameras to produce high-definition images with no blooming, streaking or noticeable lag.  
      2) Provide and install in-line PoE injectors as required when non PoE network switches are used or when manufacturer specified power is not available to the camera.  
      3) All camera power shall comply with the specified power requirements.  

3.2 POWER REQUIREMENTS  

A. Provide uninterruptible power supplies for all active surveillance equipment  
   1. Rack mounted components, including all active network communication hardware, shall be on an Uninterruptible Power Supply <UPS> system.  
   2. Refer to Section 280000 for UPS and power requirements  
   3. Camera power supplies shall be on an Auxiliary Power Supply <APS>, system as required, with a battery backup.
a) The Auxiliary power supply shall be furnished with a power distribution panel with each camera individually fused or protected with an over-current protector.

B. Power supplies shall provide:
   1. 120 VAC input and output voltage as required
   2. UL Listed
   3. Power fail contacts to monitor the status of the input power
      a) Connect each power supply power fail alarm as a separate alarm input into AC/ID system
   4. Key lockable wall mount metal enclosure with tamper switch
   5. Independently fused outputs

3.3 INSTALLATION

A. Refer to provisions of Section 280000

B. All surveillance system devices and components shall be compatible.

C. Camera Housings and Mounts
   1. Cameras shall include housings and mounts as indicated in the Drawings.
      a) Provide the smallest available housing for each camera application.
         1) Integrated miniature dome cameras are preferred
   2. Wiring to cameras shall pass from the back-box through the mount and into the housing. Exposed wiring or conduit shall not be acceptable.
   3. Provide sun shields for camera housings in outdoor locations exposed directly to sunlight.
   4. Provide surge protection for power and copper video cables for exterior cameras at the camera and at the point of termination (security rack).
   5. Field verify the exact camera location, position, and mounting prior to installation.
   6. Roof mounted cameras shall use roof deck brackets.
   7. Provide media converters, power adapters and other accessories where camera cable run distance will exceed 280’.

D. Video Management Control System
   1. System platform software shall be ‘open architecture’ allowing for compatibility and integration with other building automated systems.
   2. The system shall allow for secure remote viewing of live and recorded video as required.

E. Provide labeling suitable to Owner for all major equipment components. Coordinate with Owner on numbering scheme to match existing. Major equipment components:
   1. IP Video monitors, IP camera Patch Panels, PoE Switches (or mid-span units), Network Video Recorders (NVR), and fiber mux units (if required).

F. Coordinate with Telecommunication subcontractor for network and patch panel provisions for security connections in the IT room. (If applicable)

G. Coordinate with Owner for all system programming and database requirements.
1. Provide all programming, setup, camera and device titling and data entry
2. Camera and device title and descriptions shall be consistent for all components

H. Install all Point-to-Point wiring with appropriate terminal connections for every wire and component termination so that all connections are mechanically and electrically secure.

I. Install field wiring in continuous lengths, without splices.

J. Verify upon job completion that all wiring and terminations are clearly labeled to identify the wire and terminal.

K. Testing of the surveillance system includes checkout of installed cameras back to the Security head end equipment to confirm proper operation of camera assemblies. Security integrator shall provide all necessary test equipment to fully demonstrate proper performance of field devices. Copies of test results shall be included in the project completion submittals given to the Owner.

END OF SECTION 28 20 00
SECTION 28 31 00 - INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY/OVERVIEW

A. This section provides specifications for the installation of Electronic Intrusion Detection (ID), and related components.

B. Related Sections

1. Section 087100 Door Hardware
2. Section 260000 Electrical (including related sub-sections)
3. Section 270000 Communications (including related sub-sections)
4. Section 280000 Electronic Safety and Security
5. Section 281000 Access Control System
6. Section 282000 Video Surveillance System
7. Section 284600 Fire Alarm and Smoke Detection

1.2 REFERENCES

A. See Section 280000 Electronic Safety and Security.

1.3 SYSTEM COORDINATION

A. The Security Integrator shall completely coordinate all relevant work of other trades/systems including, but not limited to:

1. Door Hardware
2. Fire Alarm System
3. Electrical Systems(s)
4. Telecommunications System(s)

1.4 GENERAL SYSTEM DESCRIPTION

A. General Requirements

1. Furnish all labor, materials, tools, equipment, and services for a complete security system as indicated and in accordance with provisions of the contract documents.
2. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, and devices incidental to or necessary for a sound, secure and complete installation.
3. Comply with the provisions of Division 1 for General Requirements.
   a) In the event of a conflict between the provisions of this Section and Division 1, the more stringent provisions shall apply.
4. All system devices and components included shall be compatible.

B. The project shall be equipped with new system that is maintained by the police department.

1. All work required within the project for new ID system head end shall be furnished and installed by the project security contractor.

C. The ID system will support the needs of the project in accordance with these specifications.

1. The ID system shall have the capability for future expansion to support the security needs of the completed complex.

D. The ID system shall be interfaced with the Fire Alarm system (by others) as required to comply with all building code requirements.
E. Emergency/UPS power will be utilized to power the ID system’s computer workstation (client) at the Security head end equipment location.

F. Emergency/APS power will be utilized to power the ID system’s Data Gathering Panels and control components as required throughout the facility.

1.5 INTRUSION DETECTION SYSTEM

A. A series of field installed alarm initiating devices shall be connected to the ID system so that status changes of the devices are transmitted to the security management system.
   1. Provide Data Gathering Panels <DGP>, alarm devices, and keypads to be connected to the security management system via Local Area Network (LAN).
   2. The security integrator shall coordinate network and IP address requirements with Owner to identify the Media Access Control (MAC) address (Layer 2) of each provided device, the location to be installed, and the port configuration needed for communication.

B. Glass Break Detector
   1. Contractor will need to provide compatible glass break tester for device being installed.
   2. One glass break detector per zone, do not wire in series.

C. Tamper Switches
   1. Typically closed tamper switches to monitor the secure status of all DGP’s, power supplies, terminal cabinets, power distribution units, and other Security System cabinets and enclosures.
   2. Fasten tamper switches within the cabinet to provide no access to the switch and fasteners when the cabinet is closed.
   3. Provide independent monitoring of tamper conditions for each cabinet.
      a) Include the number of tamper switches in the total alarm input figures.

D. Provide ID keypads conveniently located near areas being protected so as to allow devices to arm and disarm.

1.6 SUBMITTALS

A. Follow provisions of Section 280000 additional requirements.

B. Field Test Reports
   1. Upon completion and testing of the installed system, test reports shall be submitted in booklet form and electronic media showing all field tests performed on, and adjustments made to each/any component and all field tests performed to prove compliance with the specified performance criteria.
   2. Indicate and interpret test results in written form and verbally to owner/DBR for compliance with performance requirements at a pre-scheduled meeting.

C. Battery calculations to show the expected loads and backup duration for power supplies and UPS devices for all active ID equipment.

D. Security Contractor is responsible to prepare and submit as required to the Authority Having Jurisdiction (AHJ) any and all information to obtain an Electronic Locking Mechanisms permit.

1.7 QUALITY ASSURANCE

A. Follow provisions of Section 280000.

B. Spare Parts:
1. Provide two (2) spare components for every model and configuration of electronic components and devices used on the project as spare parts inventory.
   a) The security integrator will turn over the new and unused components and devices to the owner at project closeout.

1.8 DELIVERY, STORAGE AND HANDLING
   A. Follow provisions of Section 280000.

1.9 PROJECT/SITE CONDITIONS
   A. Follow provisions of Section 280000.

1.10 WARRANTY
   A. Follow provisions of Section 280000.
   B. All devices and components shall comply with applicable U.L. standards.

PART 2 - PRODUCTS

2.1 ACCEPTABLE INTRUSION DETECTION MANUFACTURERS
   A. ID System Platform Software
      1. Bosch
      2. Honeywell
      3. Owner Approved Equivalent
   B. Intrusion Detection Data Gathering Panels <DGP>
      1. Bosch B9512G
      2. Owner Approved Equivalent
   C. Keypads
      1. Bosch B920
      2. Owner Approved Equivalent
   D. Tamper Switches
      1. Sentrol 3010
      2. Owner Approved Equivalent
   E. Ceiling Mounted Motion Detectors
      1. Bosch DS9360
      2. Owner Approved Equivalent
   F. Wall Mounted Motion Detectors
      1. Bosch ISC-CDL1-WA12G
      2. Owner Approved Equivalent
   G. Glass Break Detectors
      1. Sentrol
      2. C&K Systems IntelliSense
      3. ID System compatible
      4. Owner Approved Equivalent
   H. Door Position Switches <DC>
      1. Concealed Magnetic Door Position Switch
         a) Sentrol 1076D
         b) Magnasphere MSS-19C/L / MSS-25C/L
2. Surface Mounted Door Position Switch <SDC>
   a) Sentrol 2707AD-L
   b) Owner Approved Equivalent

3. Overhead Door Position Switch <ODC>
   a) Sentrol 2317AH
   b) Owner Approved Equivalent

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Power Supplies

1. Power supply requirements
   a) A switch and on/off indicator within the power supply cabinet.
   b) Four hours of sealed gel battery backup to provide continuous operation during power failure.
      1) Provide batteries as required to provide specified battery backup time for a fully loaded power supply, regardless of the connected load.
   c) A battery charger to maintain the battery.
   d) Low battery and power fail contacts to monitor the status of the input power and the battery.
      1) Connect each power supply low battery and power fail alarm as a separate alarm input into DGP.
   e) Key lockable wall mount metal enclosure with tamper switch.

2. Additional DGP Power Supply Requirements
   a) The DGP power supply provides power only to DGP’s and shall not provide power for locks or any other low voltage device.

3. Additional Device Power Supply Requirements
   a) Provide device power supplies for other security system devices requiring power (e.g. card readers, local alarms, motion sensors, etc.)
   b) Provide power distribution boards with independently fused outputs.

B. Video Surveillance System Integration

1. Automatic Video Call-up
   a) All alarms shall call up all cameras in the area of alarm to the screen of the ACID alarm operator workstation to allow for operator assessment of the alarm.

2. Pre and Post Alarm Video
   a) The operator shall be able to view up to 10 seconds of video before the alarm and 30 seconds after the alarm for all cameras associated with the alarm.
   b) This feature is to be integrated with the operator alarm notification to assist in alarm assessment.
   c) This feature shall be displayed as an option on the alarm notification screen and will not require operator to make a manual video search.
3. Recording
   a) All cameras whose field of view that include images of the area affected by the alarm, shall be recorded when an alarm is detected for use in forensic analysis, including the pre and post alarm video.

4. Duress and Emergency Intercommunications Integration
   a) Calls from emergency intercoms/phones with cameras shall provide the above video call-up and the pre and post alarm video capabilities.

C. Tamper Resistant Screws
   1. Provide appropriate screw heads for each application (e.g. countersunk heads for recessed cover plate screws, flat head screws for standard junction box covers, etc.).
   2. The security integrator shall provide Torx® tamper resistant screws for:
      a) Junction boxes located above doors
      b) Junction boxes located below ceiling height and/or within reach of hatch ladders
      c) Security device cover plates
      d) Surface mounted door position switches and armored cable

3.2 ENCLOSURE INSTALLATION
A. Enclosures shall be lockable with a tamper switch and installed in a manner to be accessible with clearance to fully open enclosure door.

B. All security panels shall be wired through a dedicated power supply with battery backup.
   1. Power to the data gathering panels is to be hardwired utilizing EMT or rigid conduit in accordance with the Electrical specifications.
   2. A circuit from the Fire Alarm panel must be installed to each lock power distribution panel.

C. Enclosures shall be installed on designated wall fields in a neat and compact manner to allow for future growth.

D. Enclosures shall be sized to allow for 20% growth in each panel.

E. All panels and boards shall be installed in enclosure(s) suitable to their environment and have sufficient size and orientation to include all system components.

F. Each panel shall be labeled accordance with Owner standards.
   The label for each panel shall be posted on the exterior of the panel door.
      a) Each panel shall have a list of devices connected to it located on the inside cover.
      b) A detailed device layout drawing will be located on the inside of the panel door in an appropriate sleeve and keeper.

3.3 FURTHER REQUIREMENTS
A. Refer to provisions of Section 280000.

B. Furnish and coordinate installation of all special device back boxes and ACID field devices as shown on the security drawings and as specified in this section.

C. The exact installation locations of all equipment shall be coordinated and verified with the Contractor prior to installation.
   1. Subcontractor shall notify the Contractor if any location appears to be unsuitable.
D. Provide low voltage power supplies for electric locking devices and ACID devices and components as shown on the security drawings and specified in this Section.

E. Coordinate with the Telecommunications Subcontractor for data network connections, IP address requirements, and telephone circuits as required.

F. Prepare all systems for user operation.
   1. The security system must be complete and ready to operate prior to Owner final acceptance of the system.

G. Coordinate with the Owner for all system programming requirements.

H. Perform database programming as required to support the card reader, alarm point, surveillance system integration, and control panel configuration as required.

END OF SECTION 28 31 00
SECTION 28 31 63 - FIRE ALARM AND SMOKE DETECTION SYSTEM WITH MASS NOTIFICATION

PART 1 – GENERAL

1.1 SCOPE

A. The contractor shall furnish and install a complete microprocessor based 24VDC, electrically supervised, MULTIPLEXED, analog intelligent fire detection, voice evacuation system as specified herein and indicated on the drawings. The system shall provide evacuation alarm tone signaling using speakers and, visual notification appliances. The system shall include, but not be limited to, all control equipment, power supplies, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system. The system shall also include paging capabilities to select zones as determined by the owner and engineer.

B. The system shall operate as a non-coded, continuous ringing system, which will sound alarm devices until manually silenced, as herein specified.

C. The system shall be wired as a style B and style 4 supervised system for all circuits.

1.2 CODES AND STANDARDS

A. The system shall comply with the applicable Codes and Standards as follows:

2. National Fire Protection Association Standards:
   
   NFPA 70 NEC
   
   NFPA 72, Standard For The Installation, Maintenance And Use of Protective Signaling Systems
   NFPA 90A, Standard For The Installation Of Air Conditioning And Ventilating Systems
   ANSI 117.1 Visual Devices
   3. Local & State Building Codes
   4. Requirements of Local Authorities Having Jurisdiction
   5. Underwriters Laboratory Requirements and Listings for the use in Fire Protective Signaling Systems as follows:
   UL 864 Control Panels
   UL 268 Smoke Detectors - Systems
   UL 268A Duct Smoke Detectors
   UL 521 Heat Detectors
   UL 228 Door Holders-Closers
   UL 464 Audible Signaling Appliances
   UL 1971 Visual Signaling Appliances
   UL 38 Manual Alarm Stations
   
   6. Texas Accessibility Standard (TAS) - ADA

Notice - In the case of any discrepancy between these specifications, the project drawings, and any
applicable local codes, the installed Fire Alarm/Life Safety System shall comply with the most stringent requirement.

1.3 ACCEPTABLE MANUFACTURERS

A. All equipment, materials, accessories, devices, etc. covered by the specifications and/or noted on the contract drawings shall be new and unused and be UL listed for their intended use.

B. All references to manufacturer's or supplier’s model numbers and other pertinent information herein is intended to establish a minimum standard of quality, performance and features required.

C. Equipment of other manufacturer's or supplier's may be considered as an equal to that specified provided that completely marked and identified catalog sheets of all proposed equipment is provided to the architect/engineer for review ten (10) days prior to the date of bid for evaluation. In addition, a list of the contractor's qualifications and any exceptions to the specifications must be provided for review. Approval for any such substitution of equipment must be obtained in writing from the architect/engineer five (5) days prior to bid.

D. Acceptable manufacturer:
   1. Silent Knight

1.4 GENERAL REQUIREMENTS

A. Contractor Qualifications:

1. The equipment supplier shall be an authorized and designated representative of the Fire Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment.
2. The equipment supplier and installing contractor shall be licensed by the State Fire Marshal to sell, install, and service fire alarm systems as required by article 5.43-2 of the Texas Insurance Code.
3. The installing contractor and/or equipment supplier shall have on his staff a minimum of five (5) Registered Fire Alarm Technicians who are licensed by the State Fire Marshall's Office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the Texas Insurance Code.
4. The installing contractor or equipment supplier shall have on staff a minimum of two (2) certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place.
5. The installing contractor shall provide 24 hour, 365 days per year emergency service with qualified and state licensed service technicians.
6. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing fire alarm systems for at least ten (10) years.

1.5 SUBMITTALS

A. The installing contractor and/or equipment manufacturer shall provide complete and detailed shop drawings and include:

1. Control panel configuration including wiring and interconnection schematics.
2. Complete point to point wiring diagram showing terminal connections to all system devices.
3. Riser wiring diagram and associated zoning/addressing configurations with associated conduit sizes.
4. Complete floor plans drawings locating all devices associated with the fire alarm system.
system. Floor plans drawings shall include conduit and wiring routing complete with conduit sizing and numbers of conductors by type.
5. Factory data sheets on each piece of equipment to be used and so marked as to model, dimensions, size, voltage, and configuration.
6. Detailed system description in this specification format describing system functions and operation. All specification variation and deviation shall be clearly noted and marked.
8. Programming matrix defining all input/output functions.
9. Power supply and battery calculations.

B. All submittal data will be in bound form with contractor's name, supplier's name, project name, and state fire alarm license number adequately identified.

C. Only basic equipment devices have been shown on the contract drawings. Specific wiring between equipment/devices has not been shown. It is the contractor’s responsibility to submit for approval the COMPLETE ENGINEERED system configuration and layout showing all devices, wiring, conduit, and locations along with other required information as specified herein.

1.6 COORDINATION

A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with all trades including, but not exclusive of: electrical contractor, sprinkler contractor, HVAC/controls contractor and Elevator contractor. Adequate coordination shall be provided to ensure proper installation and interface to all peripheral items required to interact with the fire alarm and communication system to provide a complete and functional life safety system.

PART 2 – PRODUC T

2.1 SYSTEM FUNCTIONAL OPERATION

A. Alarm Detection

When an alarm condition is detected by any of the system alarm initiating devices, the following actions and indications shall occur:

1. The system common alarm LED on the main display shall flash.
2. The internal audible device shall sound. Acknowledgement or silencing the alarm condition shall silence the alarm condition and cause the flashing alarm LED to illuminate steady.
3. The back-lit LCD display shall indicate applicable information associated with the alarm condition including: device address, device type, device location, time and date of the alarm condition. Location and point messages shall be custom field programmed to the respective premises.
4. Any remote or local annunciator LED's associated with the alarm device shall be illuminated has herein specified (If indicated on drawings).
5. All automatic events programmed to the alarm point shall be executed and the associated indicating devices and/or outputs activated.
6. Activate all visual alarm devices throughout the building.
7. Sound an alert tone, followed by a custom voice message (designated by LSC)
8. De-activate HVAC systems over 2000 CFM.

B. System Trouble Detection

When a trouble condition is detected by the system’s CPU, or on any of the system initiating alarm, indicating alarm or SLC circuits, the following actions and indications shall immediately occur:

1. The system trouble LED on the main display shall flash. The internal audible trouble device shall sound. Acknowledgement of the trouble condition shall silence the audible trouble device and cause flashing trouble LED to illuminate steady.
2. The back-lit LCD display shall indicate applicable information associated with the trouble condition including: device address, device type, device location, time and date of the trouble condition. Location and point description messages shall be custom field programmed to respective the premises.
3. Any remote of local annunciator LED's associated with the trouble shall be illuminated has herein specified (If indicated on drawings).

C. Auxiliary Control

All designated "non-silencable" auxiliary control functions shall remain in operation (even upon silencing of audible alarms) until such time as the control panel is cleared and reset manually (i.e. fan control outputs, central station interface, elevator recall interface, etc.)

D. System Supervisory Detection

When a supervisory condition is detected by the control panel, the following functions shall occur:

1. The system supervisory LED on the main display shall flash. The internal audible device shall sound. Acknowledgement of the supervisory condition shall silence the audible device and cause flashing supervisory LED to illuminate steady.
2. The back-lit LCD display shall indicate applicable information associated with the supervisory condition including: device address, device type, device location, time and date of the supervisory condition. Location and point description messages shall be custom field programmed to the respective premises.
3. Any remote or local annunciator LED's associated with the supervisory condition shall be illuminated has herein specified. If indicated on drawings.

E. Addressable/Intelligent Point Description

The system shall the inherent capability to employ "Intelligent Multi-criteria" smoke detectors and addressable interface devices capable of being recognized and annunciated at the main control panel on an individual basis. All point/device location information shall be totally field programmable to exact job requirements as approved by the Architect/Engineer.

2.2 FIRE ALARM CONTROL PANEL

A. The Fire Alarm System shall be compatible with and interface with GE Mass Notification System. The panel shall be Silent Knight Honeywell 6820EVS.
B. The control panel shall be a multi-processor based networked system designed specifically for Fire Detection Alarm, one-way emergency audio communication and Mass Notification communication applications.

C. The control panel shall include all required hardware, software and site specific system programming to provide a complete and operational system. The control panel shall be designed such that interactions between any application can be configured, and modified using software provided by a single supplier. The control panel operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.

D. The control panel shall include the following capacities:

1. Support up to 2500 analog/addressable points.
2. Support network connections up to 63 other control panels and annunciators.
3. Support multiple digital dialers and modems
4. Support multiple communication ports and protocols
5. Support up to 1740 chronological events.

E. The network of control panels shall include the following features:

1. Ability to download all network applications and firmware from the configuration computer from a single location on the system.
3. Provide an operator interface control/display that shall annunciate command and control system functions.
4. Provide an internal audible signal with different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
5. Provide a discreet system control switch provided for reset, alarm silence, panel silence, drill switch, previous message switch, next message switch and details switch.
6. Provide system reports that provide detailed description of the status of system parameters for corrective action or for preventative maintenance programs. Reports shall be displayed by the operator interface or capable of being printed on a system printer.
7. Provide an authorized operator with the ability to operate or modify system functions like system time, date, passwords, holiday dates, restart the system and clear control panel event history file.
8. Provide an authorized operator to perform test functions within the installed system.

F. Alphanumeric Display and System Controls:

A.

B. Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, monitor, trouble and component status messages and control menu.

C.

1. The common control switches and with corresponding LEDs provided as minimum will be; Reset, Alarm Silence, Panel Silence, and Drill. It shall be able possible to add additional switches/LEDs as required.
2. The main control panel shall have a display that is a 24 lines by 40 character graphic LCD
3. Each point shall have a custom event message of up to 40 charters, for a total of 80 characters. In addition instructional text messages shall be supported with a maximum of 2,000 characters each.

4. Provide 8 simultaneous events to be displayed. The first seven (7) highest priority events in addition to the most recent event. The events shall be automatically placed in event types (Alarm, Supervisory, Monitor & Trouble) for easy access and it shall be possible to view the specific event type separately. Having to scroll through a mixed list of event types is not acceptable.

5. Provide an internal audible signal with different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.

6. This display shall be an EST 3-LCDXL1.

7. G. Power: All Fire Alarm Control System equipment shall operate on 120-VAC. Any special power treatment required, such as filtering or spike elimination that may be required for proper operation and protection of the Fire Alarm System, shall be provided with the system.

1. System power supply(s) shall provide multiple power limited 24 VDC output circuits as required by the panel.

2. Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functions.

3. Each system power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition.

4. All standby batteries shall be continuously monitored by the power supply. Low battery and disconnection of battery power supply conditions shall immediately annunciated as battery trouble and identify the specific power supply affected.

5. All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.

6. All AC power connections shall be to the building’s designated emergency electrical power circuit and shall meet the requirements of NFPA 72 - The AC power circuit shall be installed in conduit raceway. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside the each control panel the disconnect serves.

7. Edwards Model: 3-PPS/M (Primary Power Supply), 3-BPS/M (Booster Power Supply).
H. Annunciator (Where indicated on the drawings)

1. The system shall be designed and equipped to receive, monitor, and annunciate signals from devices and circuits installed throughout the building.

2. Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device.

3. The integral audible devices shall produce a sound output upon activation of not less than 85 dBA at 10 feet.

4. The annunciator shall contain the following system status indicators:
   a. 168 character Backlit Liquid Crystal Display
   b. System Normal Indicator
   c. System Common Alarm Indicator
   d. System Common Trouble Indicator
   e. System Common Supervisory Indicator
   f. System Ground Fault Indicator
   g. System Common Security Indicator
   h. System Disabled Point(s) Indicator
   i. System Reset Switch with Indicator
   j. System Alarm Silence Switch with Indicator
   k. System Trouble Silence Switch with Indicator
   l. System Message Queue Scroll Switches.
   m. 10-Digit Keypad to Enable/Disable System and Functions.

I. Audio and Microphone Unit

1. The system shall be capable of delivering multi-channel audio messages simultaneously over copper and/or fiber media. All audio messages and live pages shall originate at the one-way audio control unit.
   a. All audio messages and live pages shall originate at the one-way emergency audio control unit.
   b. The one-way emergency audio control unit shall store pre-recorded audio messages digitally.
   c. These messages shall automatically directed to various areas in a facility under program control.
   d. The system shall support remote panels with zoned amplifiers to receive, amplify and distribute messages through speakers over supervised circuits.

2. The one-way audio control unit shall store pre-recorded audio messages digitally. Provide expanded memory module.
   a. These messages shall be automatically directed to various areas in a facility under program control.
   b. The system shall support remote cabinets with zoned amplifiers to receive, amplify and send messages through speakers over supervised circuits.

3. Audio Amplifiers (Multi-Channel) 25Vrms
   Provide as minimum one twenty (95) watt audio amplifier per paging zone. The system software shall be capable of selecting the required audio source signal for amplification. To enhance system survivability, each audio amplifier shall automatically provide a local 3-3-3 1000 Hz temporal pattern output upon loss of the audio communications with the one-way audio control unit, during an alarm condition. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall include a dedicated, selectable 25/70 Vrms output. Provide a standby audio amplifier that will automatically sense the failure of a primary amplifier, and replace the function of the failed amplifier.

J. Control Switches and Indicators

1. Provide a one-way emergency voice communication system annunciator with the following design:
2. This standard LED annunciator shall incorporate the microphone for the one-way voice communication system, including all required zone select and manual override control switches and the following LED indicators:
3. Provide eight (8) two position switches for system by-pass functions. Actual switch function shall be determined by the owner.
4. 3-Position Switch
   a. Provide 3-position switch for each evacuation signaling zone, with "Voice," "Auto" and "Evacuate" positions identified and two LED status indicators for each audio visual evacuation signaling "zone", one red and one yellow. These LED's shall illuminate to indicate respectively: 1) Evacuation signals activated (red), 2) Trouble in audio (speaker) or visual (strobe) circuit(s) (yellow).
5. All Call Switch 3-Position
a. Provide 3-position switch for "All-Call" to activate all the evacuation signaling zones, with "Voice", "Off" and "Auto" positions identified and two LED status indicators for each audio visual evacuation signaling "zone", one red and one yellow. These LED's shall illuminate to indicate respectively: 1) Evacuation signals activated (red), 2) Trouble in audio (speaker) or visual (strobe) circuit(s) (yellow).

K. Network Communication Nodes:

1. The remote control panel(s) (network nodes) shall meet the same requirements as described in control panel section and shall contain the following: Common control switches with 168 character LCD display, as required; Integral power supply(s) with secondary stand-by power; Signaling line circuits for communications with analog/addressable devices; Audio amplification, notification appliance circuits, and auxiliary function circuits and operations, as required.

L. Network Wiring

1. The system supplied under this specification shall utilize node to node, direct wired multi-priority peer-to-peer network operations. The system shall utilize independently addressed, smoke detectors, heat detectors and input/output modules as described in this specification. The peer-to-peer network shall contain multiple nodes consisting of the command center, main controller, remote control panels, LCD/LED annunciation nodes, and workstations. Each node is an equal, active functional node of the network, which is capable of making all local decisions and generating network tasks to other nodes in the event of node failure or communications failure between a node.

2. When a network is wired in a Class wired using a Class A configuration, a single break or short on the network wiring causes the system to isolate the fault, and network communication continues uninterrupted, without any loss of function. Should multiple wiring faults occur, the network re-configures into many sub-networks and continues to respond to alarm events from every panel that can transmit and receive network messages.

M. Power Supply

1. System power supply shall provide multiple power limited 24 VDC output circuits as required by the panel. Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functions.

2. Each system power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition.

3. All standby batteries shall be continuously monitored by the power supply. Low battery and disconnection of battery power supply conditions shall immediately annunciated as battery trouble and identify the specific power supply affected.

4. All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.

5. All AC power connections shall be to the building's designated
emergency electrical power circuit and shall meet the requirements of NFPA 72 - The AC power circuit shall be installed in conduit raceway. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside the each control panel the disconnect serves.

2.3 IP CAMPUS NETWORK

N. BELOW IP MODULE IS FOR PANEL DATA TO COMMUNICATE VIA IP TO THE WORKSTATION. VERIFY PROJECT REQUIREMENTS.

A. Each mass notification control panel to LAN/WAN network interface shall be an industrial grade 10/100BASE T Ethernet® device server. The interface shall have diagnostic LEDs on the front of the unit make it easy to determine its status, and incorporate flash ROM memory facilitating upgrading the operating firmware. Power shall be supplied directly from the FACP, ensuring a reliable and monitored power source.

B.

1. Shall be Edwards EST, model MN-COM1S.
2. BELOW IP MODULE IS FOR VOICE OVER IP TO COMMUNICATE TO THE WORKSTATION. VERIFY PROJECT REQUIREMENTS.

C. Each Mass Notification control panel audio source shall be connected to the LAN/WAN network interface. Each Network audio connectivity shall consist of a supervised decoder capable of decoding MP3, WMA, G.711 and PCM data streams in either HTTP, UDP, or RTP format. Audio decoder shall operate on filtered-regulated 24 VDC power derived from the panel power supply. Power shall be supplied directly from the FACP or listed Auxiliary Power Supply, ensuring a reliable and monitored power source.

D.

1. Audio decoder shall be equipped with:
   a. A RCA jack line-level audio output.
   b. RJ45 10/100BASE T Mbit Automatic Ethernet port.
   c. RS232 DB9 male interface capable of 115,200 baud communication.
   d. Normally open relay contact rated at 500 mA @ 24 VDC.
   e. Reset button.
   f. Aluminum case.
   g. Analog audio from the decoder shall connect to the ACU/FACP audio source unit, then to a MN-PASM supervisory module that is monitored by a SIGA-RM1 supervisory
2.4 Mass Notification CONTROL UNIT

A. The mass notification control panel or remote mass notification control panel(s) shall be a multi-
processor based networked system designed specifically for detection, and one-way emergency
audio communications applications. The mass notification control panel(s) shall be listed and
approved for the application under the standard(s) as listed.

B.

C. The mass notification control panel(s) shall include all required hardware, software and site-
specific system programming to provide a complete and operational system. The control
panel(s) shall be designed such that interactions between any applications can be configured
and modified using software provided by a single supplier. The control panel operational
priority shall assure that life safety takes precedence among the activities coordinated by the
control panel.

D.

E.

F. The network of mass notification control panels shall include the following features.

1. Ability to download all network applications and firmware from the configuration computer
   on the network or at any control panel (network node) location.
2. Each control panel (network node) shall have an LCD display with common controls. The
display shall be configurable to display the status of any and all combinations of alarm,
supervisory, trouble, monitor, or group event messages.
3. Each LCD display on the system shall be capable of being programmed for control functions
   of any node or the entire network. The LCD display shall reside on the network as a node
   and continue to operate with multiple faults on the network. An LCD can be programmed
to be only operational when a node is operational in stand-alone mode, with a network fault.
4. The system program shall provide a minimum of 100 definable Service Groups to
   facilitate the testing of installed system based on the physical layout of the system. Service
groups that disable entire circuits serving multiple floors or fire zones shall not be
   considered as equal.
5. Advanced Windows based programming with Program Version Reporting to document any
   and all changes made during system start-up or system commissioning. Time and date
   stamps of all modifications made to the program must be included to allow full retention of
   all previous program version data. The operator display shall clearly identify
   unacknowledged and acknowledged alarm, supervisory, trouble, and monitor status
   messages. The system shall provide the ability to download data from the
   analog/addressable detectors to a PC while the system is on-line and operational in the
protected premises. The downloaded data may then be analyzed in a diagnostic program supplied by the system manufacturer.

6. Provide system reports that list a detailed description of the status of system parameters for corrective action or for preventive maintenance. Reports shall be displayed on the operator interface or be capable of being sent to a printer.

7. Provide an authorized operator with the ability to operate or modify system functions such as system time, date, passwords, holiday dates, restart the system and clear the control panel event history file.

8. Provide an authorized operator the ability to perform test functions within the installed system.

9. Supervision of system components, wiring, initiating devices and software shall be provided by the control panel. Failure or fault of system component or wiring shall be indicated by type and location on the LCD display. Software and processor operation shall be independently monitored for failure. The system shall provide fail-safe operation, with multiple-levels of system operation.

10. Each mass notification control panel shall be capable of:

   G. 1. Supporting up to 2500 intelligent analog/addressable points.
       2. Supporting up to ten (10) intelligent addressable loops, each loop supporting 125 detectors and 125 modules, total of 250 points per loop.
       3. Supporting network connections up to 63 other control panels and annunciators.
       4. Support up to ten network digital dialers with Contact ID or SIA format and TAP Pager protocol.
       5. Supporting multiple RS-232 communication ports and protocol.
       6. Supporting up to 1000 chronological history events.
       7. Total network response shall not exceed 3 seconds.

   H. 1. Alphanumeric Display and System Controls:

   J. Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, monitor, trouble and component status messages and control menu.

   L. 1. The common control switches and with corresponding LEDs provided as minimum will be; Reset, Alarm Silence, Panel Silence, and Drill. It shall be able possible to add additional switches/LEDs as required.
       2. The main control panel shall have a display that is a 24 lines by 40 character graphic LCD and backlit when active.
       3. Each point shall have a custom event message of up to 40 charters, for a total of 80
characters. In addition instructional text messages shall be supported with a maximum of 2,000 characters each.

4. Provide 8 simultaneous events to be displayed. The first seven (7) highest priority events in addition to the most recent event. The events shall be automatically placed in event types (Alarm, Supervisory, Monitor & Trouble) for easy access and it shall be possible to view the specific event type separately. Having to scroll through a mixed list of event types is not acceptable.

5. Provide an internal audible signal with different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.

6. This display shall be an EST 3-LCDXL1.

7. Systems not capable of such a display on the main panel faceplate shall include a CRT/Monitor display meeting the above requirements and battery stand-by.

8. 

M. Audio One-Way Voice Communications

N.

1. The voice communication system shall be capable of eight (8) channel audio, to allow the ability to have simultaneous announcements/paging. The audio channels shall be designed as such:

   a. Manual Paging
   b. Mass Notification Message (HIGHEST PRIORITY)
   c. Fire Message
   d. Alert Message
   e. Stand-by Message
   f. Elevator Message
   g. Stairwell Message
   h. Security/Weather Threat

2. The system custom digital voice message module shall provide a minimum of 100 minutes recordable time and be created using .wav file format. All messages shall be able to be created on-site without any special tools or burning of chips. Provide as a minimum one twenty (20) watt supervised audio amplifier per paging zone. The system software shall be capable of selecting the required audio source signal for amplification. To enhance system survivability, each audio amplifier shall automatically provide an internally generated local 3-3-3, 1000 Hz temporal pattern output upon loss of the audio signal from the one-way emergency audio control unit, during an alarm condition.

3. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall be a supervised, dedicated, selectable 25/70 Vrms output.

4. Provide a standby audio amplifier per node that will automatically sense the failure of any primary amplifier installed in the same panel and replace the function of the failed amplifier. Below is verbiage for Fire Strobe and Alert Strobe.

5.

O. Provide an Emergency Voice Communication System with the following design features:
P.

1. An audio control unit with Microphone for Paging.
2. Provide 3-position switch for each evacuation signaling zone and “All-Call”, with "Page FIRE", "Auto" and “Page ALERT” positions identified and two LED status indicators for each audio visual evacuation signaling "zone", one red and one yellow.
3. These LED's shall illuminate to indicate respectively:
   a. Evacuation signals activated (red),
   b. Trouble in audio (speaker) or visual (strobe) circuit(s) (yellow).
   c.

Q. Provide 2-position switch to manually activate pre-recorded voice messages, with “Message Name" positions identified and one LED status indicators, one red. Provide minimum of 12 selector switches.

R.

1. These LED's shall illuminate to indicate respectively:
   a. Message activated (red)

S. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions

T.

VERIFY PROJECT CIRCUIT WIRING REQUIREMENTS.

U. Circuits Requirements:

V.

1. Signaling Line Circuits for Network Communications:
   a. Class A, Style 7.
2. Dedicated Ethernet IP Network shall be Class B.
3. Signaling Line Circuits for Intelligent Analog Addressable Loop:
   b. No more than 100 detectors and 100 modules installed on a loop.
4. Initiating Device Circuit:
   a. Class B, Style B
5. Notification Appliance Circuits:
   a. Class B, Style Y.
   b. Maximum circuit loading to 2 amps for visuals.

6. Activation of alarm notification appliances, smoke control, elevator recall and other functions shall occur within 3 seconds after the activation of an initiating device.

2.5 Annunciator (Where indicated on the drawings)

   A. The system shall be designed and equipped to receive, monitor, and annunciate signals from devices and circuits installed throughout the building.

       1. Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device.

       2. The integral audible devices shall produce a sound output upon activation of not less than 85 dBA at 10 feet.

       3. The annunciator shall contain the following system status indicators:

           a. 168 character Backlit Liquid Crystal Display
           b. System Normal Indicator
           c. System Common Alarm Indicator
           d. System Common Trouble Indicator
           e. System Common Supervisory Indicator
           f. System Ground Fault Indicator
           g. System Common Security Indicator
           h. System Disabled Point(s) Indicator
           i. System Reset Switch with Indicator
           j. System Alarm Silence Switch with Indicator
           k. System Trouble Silence Switch with Indicator
           l. System Message Queue Scroll Switches.
2.6 INTELLIGENT FIELD DEVICES - GENERAL

A. Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Each device shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, last maintenance date, job/project number, and perform communications with the loop controller. Amount of environmental compensation left/used current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data, (Detectors Only).

B. Each device shall be capable of electronic addressing, either automatically or application program assigned, to support physical/electrical mapping and supervision by location. Setting a device’s address by physical means shall not be necessary.

2.7 INTELLIGENT DETECTORS - GENERAL

A. The System Intelligent 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. Devices not capable of combining different fire parameters using Multi-sensor technology, or that only employ digital filters shall not be acceptable.

Each detector 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 analog loop controller. Detectors not capable of making independent alarm decisions shall not be acceptable. Maximum total analog loop response time for detectors changing state shall be 1.5 seconds.

Each detector shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm communication with the analog loop controller. A red LED shall flash to display alarm status.

The detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.

Each smoke detector 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 smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings.

Each detector microprocessor shall contain an environmental compensation algorithm which identifies and sets ambient “Environmental Thresholds” approximately six times an hour. 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 24 hour long term and 4 hour short term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector
approaches 80% and 100% of 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 updated and permanently stored at the detector approximately once every hour. The intelligent analog detectors shall be suitable for mounting on any Signature Series detector mounting base.

B. FIXED TEMPERATURE/RATE OF RISE HEAT DETECTORS, SIGA-HRS

Provide intelligent combination fixed temperature/rate-of-rise heat detectors <SIGA-HRS>. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135°F and a rate-of-rise alarm point of 15°F per minute. The heat detector shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centers and be suitable for wall mount applications.

C. PHOTOELECTRIC SMOKE DETECTOR, SIGA-PS

Provide intelligent photoelectric smoke detectors SIGA-PS. The analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC or the SIGA-PRO Signature Program/Service Tool. The photo detector shall be rated for ceiling installation at a minimum of 30 ft (9.1m) centers and be suitable for wall mount applications. The photoelectric smoke detector shall be suitable for direct insertion into air ducts up to 3 ft (0.91m) high and 3 ft (0.91m) wide with air velocities up to 5,000 ft/min. (0-25.39 m/sec) without requiring specific duct detector housings or supply tubes. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photo detector shall be suitable for operation in the following environment:

- Temperature: 32°F to 122°F (0°C to 49°C)
- Humidity: 0-95% RH, non-condensing
- Elevation: no limit

D. STANDARD DETECTOR MOUNTING BASES, SIGA-SB / SIGA-SB4

Provide standard detector mounting bases SIGA-SB4 suitable for mounting on 4” octagon box. The base shall, contain no electronics, support all Signature Series detector types and have the following minimum requirements:

- Removal of the respective detector shall not affect communications with other detectors.
- 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.
The base shall be capable of supporting one (1) Signature Series SIGA-LED Remote Alarm LED Indicator. Provide remote LED alarm indicators where shown on the plans.

E. DUCT DETECTOR HOUSING, SIGA-DH

Provide smoke detector duct housing assemblies SIGA-DH to facilitate mounting an intelligent analog Photoelectric Detector SIGA-PS, along with a standard detector mounting base. Provide for variations in duct air velocity between 300 and 4000 feet per minute. Protect the measuring chamber from damage and insects. Provide an air exhaust tube and an air sampling inlet tube which extends into the duct air stream up to ten feet. Provide drilling templates and gaskets to facilitate locating and mounting the housing. Provide five one gang knockouts for mounting optional Signature Series modules. Finish the housing in baked red enamel. Provide Remote Alarm LED Indicators SIGA-LED as shown on the plans.

2.8 INTELLIGENT MODULES - GENERAL

A. It shall be possible to address each Intelligent Signature Series module without the use of DIP switches. Devices using mechanical switches for addressing shall not be acceptable. The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller. Modules requiring EPROM, PROM, ROM changes or IP switch and/or jumper changes shall not be acceptable.

B. 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 up to 24 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:

- Temperature: 32°F to 120°F (0°C to 49°C)
- Humidity: 0-93% RH, non-condensing

C. INTELLIGENT MANUAL PULL STATIONS – GENERAL

It shall be possible to address each dual action Signature Series fire alarm pull station electronically without the use of DIP switches. The manual stations shall have a minimum of 2 diagnostic LEDs mounted on their integral, factory assembled single or two stage input module. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status.

1. The station shall be capable of storing up to 24 diagnostic codes which can be retrieved for troubleshooting assistance. Input circuit wiring shall be supervised for open and ground faults. The fire alarm pull station shall be suitable for operation in the following environment:

- Temperature: 32°F to 120°F (0°C to 49°C)
- Humidity: 0-93% RH, non-condensing

D. DOUBLE ACTION MANUAL PULL STATION, SIGA-278
Provide intelligent double action, single stage fire alarm stations SIGA-278. The fire alarm station shall be of lexan construction with an internal toggle switch. Provide a key locked test feature. Finish the station in red with white “PULL IN CASE OF FIRE” lettering. The manual station shall be suitable for mounting on North American 2½” deep 1-gang boxes and 1½” deep 4” square boxes with 1-gang covers.

2.9 NOTIFICATION APPLIANCES - GENERAL

A. All appliances shall be UL Listed for Fire Protective Service. All strobe appliances or combination appliances with strobes shall be capable of providing the “Equivalent Facilitation” which is allowed under the Americans with Disabilities Act Accessibility’s Guidelines (ADA(AG)), and shall be UL 1971, and ULC S526 Listed.

B. ELECTRONIC ALARM SIGNAL

The audible/visual device shall be the EST 757-1A-T (low current) Electronic horns, to be located where indicated on the drawings. Electronic device shall not contain any vibrating electro-mechanical solenoids or contacts for reliability and performance. Electro-mechanical devices shall not be considered equal. Units shall operate at 24Vdc and be polarized supervised. Each unit shall provide a choice of eight different audible tones capable of being field selectable. The audio portion of the signal shall provide a 91 to 97 db output.

C. NOTIFICATION APPLIANCES – VISUAL (Fire – Evacuation / Mass Notification)

1. Provide wall or ceiling mounted clear lens strobes with white body and “ALERT” markings. Strobes shall provide a smooth light distribution pattern field selectable candela 15 cd, 30 cd, 75 cd, and 110 cd flash output rating, UL1971 listed with in-out screw terminals shall be provided for wiring. The strobe (15, 30, 75, 110) candela rating shall be view from the side window to verify the setting. All strobes shall be synchronization to within 10 milliseconds for an indefinite period shall not require the use of separately installed remote synch modules. The strobes shall mount to one-gang electrical box.

2. The device shall have plastic protective cover for during installation.

3. The actual candela setting on the visual shall be marked on the appliance.

4. D. NOTIFICATION APPLIANCES - 4" CONE SPEAKER

W.

1. Speakers shall have a 4" Mylar cone, paper cones shall not accept as equal. The rear of the speakers shall be completely sealed protecting the cone during and after installation. In and out screw terminals shall be provided for wiring. Speakers shall provide 1/4w, 1/2w, 1w, and 2w power taps for use with 70V systems. The actual speaker wattage & strobe candela setting shall be viewable from the device window to verify the wattage setting, without removing the device. To make any changes to the speaker wattage will only require the removal of the cover plate.

2. At the 2-watt setting, the speaker shall provide a 90 dBA sound output over a frequency
range of 400-4000 Hz. as measured in reverberation room per UL-1480.
3. Combination speaker strobes shall meet both sections of above.
4. The device shall have plastic protective cover for use during installation.
5. The actual wattage setting on the speaker shall be marked on the face of the appliance.
6. 
E. NOTIFICATION APPLIANCE – RE-ENTRANT SPEAKERS

X.
1. Provide 4” white re-entrant speakers at loud ambient locations or for outdoor weatherproof installation. Weatherproof boxes shall be provided for outdoor mounting. Speakers shall provide 2w, 4w, 8w, and 15w power taps. The re-entrant speakers shall utilize a high-efficiency compression driver. Cone type drivers are not acceptable. At the 15 watt setting, the speaker shall provide a 102 dBA sound output over a frequency range of 400-4000 Hz. when measured in reverberation room per UL-1480.
2. Combination speaker strobes shall meet both sections of above.
3. 
F. LOW PROFILE SPEAKER-STROBE

Y.
1. Provide low profile wall mount speaker/strobes at the locations shown on the drawings. The strobe shall be have a clear lens strobes with white body and “ALERT” markings. The low profile speaker/strobe shall not extend more than 1” (2.5cm) past the finished wall surface, and provide a switch selectable audible output of 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL-464.
2. Strobes shall provide synchronized flash output that shall be switch selectable for output values of 15cd, 30cd, 75cd & 110cd. Wattage and candela settings shall be visible with the cover installed. When the cover is installed, no mounting hardware shall be visible. In and out screw terminals shall be provided for all wiring. The low profile speaker/strobes shall mount in a North American 4” x 2 1/8” square electrical box, without trims or extension rings.
3. The low profile wall mount speaker/strobes.

G. REMOTE POWER SUPPLY/NAC EXPANDER PANEL

Provide auxiliary power supply/NAC extender panel with battery backup as required. Provide up to 6.5 Amps of regulated 24Vdc power which, can be directed to 4 notification appliance circuits. Each circuit shall be rated at 3 amp and power limited. Trouble contacts shall be provided for monitoring the panel. Provide a dedicated 120Vac dedicated circuit to each power supply.

2.10 MASS NOTIFICATION CONTROL UNIT

Z.
A. The mass notification control panel or remote mass notification control panel(s) shall be a multi-processor based networked system designed specifically for detection, and one-way emergency audio communications applications. The mass notification control panel(s) shall be listed and approved for the application under the standard(s) as listed.

B.

C. The mass notification control panel(s) shall include all required hardware, software and site-specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any applications can be configured and modified using software provided by a single supplier. The control panel operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.

D.

E. The network of mass notification control panels shall include the following features.

1. Ability to download all network applications and firmware from the configuration computer on the network or at any control panel (network node) location.
2. Each control panel (network node) shall have an LCD display with common controls. The display shall be configurable to display the status of any and all combinations of alarm, supervisory, trouble, monitor, or group event messages.
3. Each LCD display on the system shall be capable of being programmed for control functions of any node or the entire network. The LCD display shall reside on the network as a node and continue to operate with multiple faults on the network. An LCD can be programmed to be only operational when a node is operational in stand-alone mode, with a network fault.
4. The system program shall provide a minimum of 100 definable Service Groups to facilitate the testing of installed system based on the physical layout of the system. Service groups that disable entire circuits serving multiple floors or fire zones shall not be considered as equal.
5. Advanced Windows based programming with Program Version Reporting to document any and all changes made during system start-up or system commissioning. Time and date stamps of all modifications made to the program must be included to allow full retention of all previous program version data. The operator display shall clearly identify unacknowledged and acknowledged alarm, supervisory, trouble, and monitor status messages. The system shall provide the ability to download data from the analog/addressable detectors to a PC while the system is on-line and operational in the protected premises. The downloaded data may then be analyzed in a diagnostic program supplied by the system manufacturer.
6. Provide system reports that list a detailed description of the status of system parameters for corrective action or for preventive maintenance. Reports shall be displayed on the operator interface or be capable of being sent to a printer.
7. Provide an authorized operator with the ability to operate or modify system functions such as system time, date, passwords, holiday dates, restart the system and clear the control panel event history file.
8. Provide an authorized operator the ability to perform test functions within the installed
system.

9. Supervision of system components, wiring, initiating devices and software shall be provided by the control panel. Failure or fault of system component or wiring shall be indicated by type and location on the LCD display. Software and processor operation shall be independently monitored for failure. The system shall provide fail-safe operation, with multiple-levels of system operation

10.

F. Each mass notification control panel shall be capable of:

G.

1. Supporting up to 2500 intelligent analog/addressable points.
2. Supporting up to ten (10) intelligent addressable loops, each loop supporting 125 detectors and 125 modules, total of 250 points per loop.
3. Supporting network connections up to 63 other control panels and annunciators.
4. Support up to ten network digital dialers with Contact ID or SIA format and TAP Pager protocol.
5. Supporting multiple RS-232 communication ports and protocol.
6. Supporting up to 1000 chronological history events.
7. Total network response shall not exceed 3 seconds
8.

H. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, monitor, trouble and component status messages and control menu.

I.

1. The common control switches and with corresponding LEDs provided as minimum will be; Reset, Alarm Silence, Panel Silence, and Drill. It shall be able possible to add additional switches/LEDs as required.
2. The main control panel shall have a display that is a 24 lines by 40 character graphic LCD and backlit when active.
3. Each point shall have a custom event message of up to 40 charters, for a total of 80 characters. In addition instructional text messages shall be supported with a maximum of 2,000 characters each.
4. Provide 8 simultaneous events to be displayed. The first seven (7) highest priority events in addition to the most recent event. The events shall be automatically placed in event types (Alarm, Supervisory, Monitor & Trouble) for easy access and it shall be possible to view the specific event type separately. Having to scroll through a mixed list of event types is not acceptable.
5. Provide an internal audible signal with different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
6.

J. Audio One-Way Voice Communications
K.

1. The voice communication system shall be capable of eight (8) channel audio, to allow the ability to have simultaneous announcements/paging. The audio channels shall be designed as such:

   a. Manual Paging
   b. Mass Notification Message (HIGHEST PRIORITY)
   c. Fire Message
   d. Alert Message
   e. Stand-by Message
   f. Elevator Message
   g. Stairwell Message
   h. Security/Weather Threat

2. The system custom digital voice message module shall provide a minimum 20 watt supervised audio amplifier per paging zone. Provide as a minimum one twenty (20) watt supervised audio amplifier per paging zone. The system software shall be capable of selecting the required audio source signal for amplification. To enhance system survivability, each audio amplifier shall automatically provide an internally generated local 3-3-3, 1000 Hz temporal pattern output upon loss of the audio signal from the one-way emergency audio control unit, during an alarm condition.

3. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall be a supervised, dedicated, selectable 25/70 Vrms output.

4. Provide a standby audio amplifier per node that will automatically sense the failure of any primary amplifier installed in the same panel and replace the function of the failed amplifier.


L. Provide an Emergency Voice Communication System with the following design features:

M.

1. An audio control unit with Microphone for Paging.
2. Provide 3-position switch for each evacuation signaling zone and “All-Call”, with "Page FIRE", "Auto" and “Page ALERT” positions identified and two LED status indicators for each audio visual evacuation signaling "zone", one red and one yellow.
3. These LED's shall illuminate to indicate respectively:

   a. Evacuation signals activated (red),
   b. Trouble in audio (speaker) or visual (strobe) circuit(s) (yellow).
   c.

N. Provide 2-position switch to manually activate pre-recorded voice messages, with “Message Name" positions identified and one LED status indicators, one red. Provide minimum of 12
selector switches.

O.

1. These LED's shall illuminate to indicate respectively:
   a. Message activated (red)
   b. 

P. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions. Verify project circuit wiring requirements.

Q.

R. Circuits Requirements:

1. Signaling Line Circuits for Network Communications:
   a. Class A, Style 7.

2. Dedicated Ethernet IP Network shall be Class B.

3. Signaling Line Circuits for Intelligent Analog Addressable Loop:
   b. No more than 100 detectors and 100 modules installed on a loop.

4. Initiating Device Circuit:
   a. Class B, Style B

5. Notification Appliance Circuits:
   a. Class B, Style Y.
   b. Maximum circuit loading to 2 amps for visuals.

6. Activation of alarm notification appliances, smoke control, elevator recall and other functions shall occur within 3 seconds after the activation of an initiating device.

7.

PART 3 – EXECUTION

3.1 INSTALLATION

A. WIRING:

1. All wiring shall be in accordance with NFPA 72 and the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform
to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.

2. All wire shall be UL listed FPL for limited energy (300V) and fire alarm applications and shall be installed in conduit. Limited energy FPLP or MPP wire may be run open in air ceiling plenums provided such wire is UL listed to UL TEST 910 for such applications and is of the low smoke producing fluoro carbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.

3. All wiring for SLC signaling line circuits shall be of the twisted/shielded, low capacitance type to guard against outside RF and EMF interference and induced noise.

4. All notification appliance circuit wiring shall be run in a supervised fashion (i.e. no branch wiring or T-tap) per NFPA requirements such that any wire disarrangement will initiate the appropriate trouble signal at the main control panel per NFPA requirements.

5. Wiring splices shall be kept to a minimum with required splices to be made in designated terminal boxes or at field device junction boxes. Transposing or color code changes of wiring will not be permitted. End-of-line supervisory devices shall be installed with the last device on the respective circuit. Said device shall be appropriately marked designating it as the terminating device on the respective circuit.

6. No A.C. wiring or any other wiring shall be run in the same conduit as fire alarm wiring.

B. Open Wiring

1. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed wall, all mechanical/electrical rooms, or other areas where wiring might be exposed and subject to damage.

2. Support wire clear of knock out panels, access panels, and maintenance spaces for equipment. Wire and cable shall be run using wire management techniques supporting cable as close as possible to within one foot of the floor or roof rafters. Wire supports shall be directly fastened to the structure on a maximum of five foot centers. Wire routing shall be parallel and perpendicular to building lines. The wire and cable shall be secured with tie wraps or carrier wire. Sagging in excess of three inches will not be allowed.

C. Conduit/Raceway

1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.

2. Conduit and raceway system shall installed as specified under the general electrical section of the specifications and per NEC.

3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.

D. MINIMUM WIRE SIZES SHALL BE AS FOLLOWS

1. Initiating Zones / SLC: 18 AWG
2. Indicating Zones: 14 AWG
3. Relay Control Circuits: 18 AWG

3.2 TEST AND REPORTS
A. A state licensed factory trained technical representative of the manufacturer shall perform the final control panel connections and supervise testing of the system and it shall be subject to the approval of the responsible engineer and owner. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system.

B. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. In addition, each circuit in the system shall be fully tested for wiring supervision to insure proper wiring installation. Any items found not properly installed of non-functioning shall be replaced or repaired and re-tested. All testing shall be supervised by a licensed fire alarm superintendent.

C. The installing contractor shall provide a complete written report on the functional test of the entire system. The test and report shall verify the function of each device in the system, operation of all auxiliary control functions, and the proper operation of the main fire alarm control panel. A copy of the test report shall be provided with maintenance manuals. The test report shall be signed and dated by the licensed fire alarm superintendent responsible for supervising the final system test and checkout.

D. The installing contractor's fire alarm superintendent shall test the entire system in the presence of the local authorities having jurisdiction!

3.3 SPARE DEVICES

A. Provide 5% spare field devices including labor to install them. Devices not used shall be given to the Owner at completion of the job.

3.4 WARRANTY

A. The fire alarm system shall be free from defects in workmanship and materials, under normal and service, for a period of one year from date of acceptance or beneficial occupancy, whichever shall occur first. Any equipment shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner.

B. The equipment manufacturer shall be represented by a local service organization and the name of such shall be furnished to the Owner, Architect, and Engineer.

END OF SECTION 28 31 63
SECTION 28 46 00.21 – FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. The contractor shall design, furnish and install a complete microprocessor based 24VDC, electrically supervised, analog intelligent fire alarm system as specified herein and provide drawings. The system shall include, but not be limited to, all control equipment, power supplies, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.

B. The system shall operate as a non-coded, continuous sounding system, which will sound alarm devices until manually silenced, as herein specified.

C. The system shall be wired as a style B and style 4 supervised system for all circuits

1.2 CODES AND STANDARDS

A. The system shall comply with the applicable Codes and Standards as follows:

2. National Fire Protection Association Standards:
   NFPA 70 NEC
   NFPA 90A Air Conditioning
   UL 1971 Visual Devices
   ANSI 117.1 Visual Devices
3. Local & State Building Codes (Including all adopted amendments)
4. Texas Accessibility Standards (TAS)
5. American’s with Disabilities Act (ADA)
6. Requirements of Local Authorities having Jurisdiction
7. Underwriters Laboratory Requirements and Listings for use in Fire Protective Signaling Systems as follows:
   UL 864 Control Panels (9th Edition)
   UL 268 Smoke Detectors - Systems
   UL 268A Duct Smoke Detectors
   UL 521 Heat Detectors
   UL 228 Door Holder-Closers
   UL 464 Audible Signaling Appliances
   UL 1971 Visual Signaling Appliances
   UL 38 Manual Alarm Stations

1.3 ACCEPTABLE MANUFACTURERS

A. To establish the type, quality, and features of system required, the equipment specified is that of the Notifier Fire Systems.

B. All equipment, materials, accessories, devices, etc. covered by the specifications and/or noted on the contract drawings shall be new and unused and be U.L. listed for their intended use.

C. All references to manufacturer or supplier's model numbers and other pertinent information herein is intended to establish a minimum standard of quality, performance and features required. All equipment proposed as an EQUAL to that specified shall COMPLETELY
conform to the specifications herein.

D. Equipment of other manufacturer's or supplier's may be considered as an equal to that specified provided that completely marked and identified catalog sheets of all proposed equipment is provided to the architect/ engineer for review ten (10) days prior to the date of bid for evaluation. In addition, a list of the contractor's qualifications and any exceptions to the specifications must be provided for review. Approval for any such substitution of equipment must be obtained in writing from the architect/engineer five (5) days prior to bid.

E. Provide one of the following manufacturers:

1. Notifier Fire Systems
2. Siemens
3. Edwards System Technology (EST)
4. Silent Knight

1.4 GENERAL REQUIREMENTS

A. Contractor Qualifications:

1. The equipment supplier shall be an authorized and designated representative of the Fire Alarm Manufacturer to sell, install, and service the proposed manufacturer’s equipment.
2. The equipment supplier and installing contractor shall be licensed by the State Fire Marshall to sell, install, and service fire alarm systems as required by Article 5.43-2 of the Texas Insurance Code.
3. The installing contractor and/or equipment supplier shall have on his staff a minimum of three (3) installation superintendents who are licensed by the State Fire Marshall’s office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the Texas Insurance Code.
4. The installing contractor or equipment supplier shall have on staff a minimum of one (1) certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place.
5. The installing contractor shall provide 24 hour, 365 days per year emergency service with qualified and state licensed service technicians.
6. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing fire alarm systems for at least ten (10) years.

1.5 SUBMITTALS

A. The installing contractor and/or equipment manufacturer shall provide complete and detailed shop drawings and include:

1. Control panel configuration including wiring and interconnection schematics.
2. Complete point to point wiring diagram showing terminal connections to all system devices.
3. Riser wiring diagram and associated zoning/addressing configurations with associated conduit sizes.
4. Complete floor plan drawings locating all devices associated with the fire alarm system. Floor plan drawings shall include conduit and wiring routing complete with conduit sizing and number of conductors by type.
5. Factory data sheets on each piece of equipment to be used and so marked as to model,
dimensions, size, voltage, and configuration.

6. Detailed system description in this specification format describing system functions and operation. All specification variations and deviations shall be clearly noted and marked.


8. Programming matrix defining all input/output functions and zoning.

9. Power supply and battery calculations.

10. A letter from the manufacturer stating that the fire alarm system contractor is authorized to sell, service and install the submitted equipment.

B. Submittal shall include documentation confirming all qualifications in 1.04-A have been met. Submittals without qualification documentation shall be rejected.

C. All submittal data will be in bound form with contractor’s name, supplier’s name, project name, and state fire alarm license number adequately identified.

D. Only basic equipment devices have been shown on the contract drawings. Specific wiring between equipment/devices has not been shown. It is the contractor’s responsibility to submit for approval the COMPLETE ENGINEERED system configuration and layout showing all devices, wiring, conduit, and locations along with other required information as specified herein.

1.6 COORDINATION

A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with all trades including, but, not exclusive of: electrical contractor, sprinkler contractor, and HVAC/controls contractor and intercom system. Adequate coordination shall be provided to insure proper installation and interface to all peripheral items required to interact with the fire alarm and communication system to provide a complete and functional life safety system.

PART 2 - PRODUCTS

2.1 SYSTEM FUNCTIONAL OPERATION

A. Alarm Detection

1. When a fire alarm condition is detected by any of the system alarm initiating devices, the following functions shall occur:

   a. The system common alarm LED on the CPU Module shall flash. The internal audible trouble device shall sound. Acknowledgement or silencing the alarm condition shall silence the alarm signals and cause flashing alarm LED’s to illuminate steady.

   b. An 80 character back-lit LCD display shall indicate all applicable information associated with the alarm condition including: zone, device type, divide location, and time of alarm. Location and zoning messages shall be custom field programmed to respective premises.

   c. Any remote or local annunciator LED’s associated with the alarm zone shall be illuminated as herein specified.

   d. A three-channel digital alarm communicator shall be integrally provided and transmit trouble and alarm signals to an approved remote station (remote station connection and service provided by Owner).

   e. All automatic events programmed to the alarm point shall be executed and the
f. Activate all audible and visual alarm notification devices.
g. De-activate HVAC systems over 2,000 CFM.
h. Display system status changes on the remote annunciators.
i. Release all smoke doors, fire doors, fire coiling doors, fire smoke dampers and fire shutters.

B. System Trouble Detection
1. When a trouble condition is detected by the CPU, one of the system initiating, alarm or SLC circuits, the following functions shall immediately occur:
   a. The system trouble LED on the CPU module shall flash and the internal audible trouble device shall sound. Acknowledgement of the trouble condition shall silence the audible trouble device and cause all trouble LED's to illuminate steady.
   b. The 80-character alphanumeric LCD annunciator shall display all applicable information via the alphanumeric display associated with the respective trouble condition and its location.

C. Auxiliary Control
1. All designated "non-silenceable" auxiliary control functions shall remain in operation (even upon silencing of audible alarms) until such time as the control panel is cleared and reset manually (i.e. fan control outputs, central station interface, elevator recall interface, etc.).
2. Activation of duct smoke detectors associated fans shall shutdown their respective units immediately in addition to identifying the condition as herein specified. Duct detectors shall be programmed as a supervisory condition per NFPA 72.

D. System Supervisory Detection
1. When a supervisory condition is detected by the fire alarm control panel, the following functions shall occur:
   a. The fire alarm control panel supervisory indicator shall flash and the internal audible device shall sound. Acknowledgment of the supervisory condition shall silence the audible device and cause the supervisory indicator to illuminate steady.
   b. The 80-character liquid crystal display shall display all applicable information associated with the respective supervisory condition.
   c. Activate a supervisory contact closure to interface with the owner provided central station monitoring service.
   d. Print the status change messages on the system printer.
   e. Display the system status change on the remote annunciators.

E. Fire Drill Control
1. Provide a fire drill switch located on the Fire Alarm Control Panel. When activated, this switch will activate all horn/strobes and speakers for a fire drill. It shall not release fire shutter, shut down air handling equipment or recall elevators. If a fire alarm condition is detected, the system shall operate as defined in part 2.01A of this section.

2.2 ZONING
A. The system shall have the inherent capability to employ "Intelligent" smoke detectors and addressable interface devices capable of being recognized and annunciated at the main control panel on an individual basis. All zoning/device location information shall be totally field programmable to exact job requirements as approved by the Architect/Engineer.

2.3 FIRE ALARM CONTROL PANEL

A. The FACP shall be a NOTIFIER Model NFW-100X or approved equal and shall contain a microprocessor based Central Processing Unit (CPU) and power supply in an economical space saving single board design. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, digital dialer and other system controlled devices. Ethernet communications shall be via a I/POTs card. Panel shall be capable or supporting 198 fire alarm devices (99 detectors and 99 modules).

B. Central Processing Unit Module (CPU)

1. The CPU shall contain and execute all custom time control functions or control-by-event programs for specified events including 'Holiday' exceptions. Time control event/programs shall be automatically overridden by priority fire alarm events. All programs shall be held in non-volatile programmable EEPROM memory, and shall be lost if both system primary and secondary power failure occurs

2. System CPU shall also provide for non-alarm points for non-fire, low priority building functions. The CPU shall provide capability of multi-stage signaling, tornado warning, positive alarm sequencing as well as remote control system operation.

C. Display

1. The DIA shall provide an 80-character backlit, supertwist Liquid Crystal Display (LCD). It shall provide Light-Emitting Diodes (LED's) for AC POWER; SYSTEM ALARM; SYSTEM TROUBLE; SUPERVISORY; CPU FAIL; and ALARM SILENCED.

2. The display shall provide power to a 21-key membrane keypad with control capability to command all system functions, status readouts, manual control action, and entry of any alphanumeric or numeric information. The keypad shall include means to enter multiple five-digit passwords to prevent unauthorized manual control programming.

D. Control Switches

1. Acknowledge/Step Switch
2. Signal Silence Switch
3. Evacuate
4. Lamp Test/Reset

E. System Outputs

1. The system shall provide the following outputs:

   a. One port for supervised remote LCD annunciators (RS-485)
   b. Four notification appliance circuits (NAC) F. Loop Interface (SLC)
   c. The CPU shall communicate and provide power to all devices on its loop over a single pair of wires. The CPU shall receive digital/ANALOG information from all "intelligent" detectors and shall process this information to determine normal, alarm, trouble, and sensitivity conditions. The analog information may
F. Non-Lock Walk Test

1. The system shall include a special non-lock "walk test" mode. The walk test mode shall incorporate a one-hour time-out feature to return system to normal. Test results shall be capable of being generated and displayed on LCD annunciator or printed out on system printer.

G. Automatic Detector Test

1. The system shall include a special automatic detector test feature, which permits reading and adjustment of the sensitivity of all intelligent detectors from the main control panel. In addition, the automatic test feature shall also permit the functional testing of any "intelligent" detector or addressable interface device individually from the main control panel. An automatic detector test shall occur automatically a minimum of every two-hour period or be initiated manually from the FACP as desired. Automatic detector test sequencing shall be terminated upon receipt of a true alarm condition.

H. Special System Reports

1. The system shall have the ability to generate and print, upon command, system and point status reports. Selection of 'system' read status provides the operator with global system programming information as well as providing the operator with all individual point programming data. The system shall also provide the capability to print out a detailed 'history' report from system history file upon command.

I. Field Programming

1. The system shall be 100% field programmable without the need for external computers or, PROM programmers, and shall NOT require replacement of memory IC’s. All programs shall be stored in non-volatile EEPROM memory. Programming shall be accomplished only after entering an appropriate and pre-selected five-digit password security code. System programming mode shall NOT require the system to be taken off-line nor prohibit the system from performing its normal operations and routines. The system shall be capable of revising/changing programmed functions or system expansion at any time subsequent to initialization as described herein without factory modifications or factory programming. Field programming via the use of external computers may be considered provided programming can be accomplished on-site and the owner is permanently furnished with the required programming apparatus and software as part of this contract.
J. Event History

1. The main fire alarm panel shall have the resident ability to store a minimum of 1000 system events in chronological order of occurrence. Event history shall include all system alarms, troubles, operator actions, unverified alarms, circuit/point alterations, and component failures. Events shall be time and date stamped. Events shall be stored in non-volatile buffer memory. Access to history buffer shall be secured via five-digit password security code. Systems not employing event history memory storage shall be required to furnish a printer/recorder for recording system events.

K. Power Supply

1. The power supply shall provide all control panel and peripheral power needs with filtered power as well as rectified 24VDC power for external audio-visual devices. All power supplies shall be designated to meet UL and NFPA requirements for POWER-LIMITED operation on all external signaling lines, including initiating circuits and indicating circuits.

2. Input power shall be 120VAC 60Hz. The power supply shall provide internal supervised batteries and automatic charger. The power supply shall provide both positive and negative ground fault supervision, battery/charger fail condition, A.C. power fail indicators. The power supply shall also provide supervision of modular expansion power supplies as may be required.

2.4 FIELD DEVICES

A. Multi sensor Detector (Smoke and Heat)

1. Provide Notifier FAPT-851 intelligent multi sensor smoke detectors. The multi sensor analog detector shall use a light scattering type photoelectric smoke sensor, a unipolar ionization smoke sensor and an ambient temperature sensor to sense changes in air samples from its surroundings. The integral microprocessor shall employ time based algorithms to dynamically examine data. The Multi sensor shall be capable of adapting to ambient environmental conditions. The temperature sensor shall self-adjust to the ambient temperature of the surrounding air and input an alarm when there is a change of 65° F in ambient temperature. Systems using central intelligence for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, age and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC. Separately mounted photoelectric detectors, ionization detectors and heat detectors in the same location are not acceptable alternatives.

2. The Multi sensor smoke detector shall be rated for ceiling installation at minimum of 30 ft. (9.1m) centers and suitable for wall mount applications. The Multi sensor shall be suitable for direct insertion into air ducts up to 3 ft. (0.91m) high and 3 ft. (0.91m) wide and air velocities up to 500 ft./min. (0-2.54m/sec) without requiring specific duct detector housings or supply tubes. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The integral heat sensor shall cause an alarm when it senses a change in ambient temperature of 65° F or reaches it fixed temperature alarm set point of 135° F nominal. The Multi sensor detector shall be suitable for operation in the following environment:

a. Temperature: 32° F to 100° F (0° C to 38° C)

b. Humidity 0-93% RH, non-condensing

c. Elevation: Up to 6,000 ft. (1828m)
B. Intelligent Duct Detector

1. Notifier model DNR series duct mounted “intelligent” photoelectric smoke detectors shall be provided per applicable codes. Detectors shall operate on the same principles and exhibit the same basic characteristics as area type “intelligent” smoke sensors. The unit shall be capable of interchanging/accepting either photo-electronic or ionization type sensors. The detector shall operate in air velocities of 300 FPM to 4,000 FPM. Each detector shall interface directly to the system SLC loop without the use of zone modules.

2. The unit shall consist of a clear noryl molded plastic enclosure with integral conduit knockouts. The unit shall be provided with clear faceplate cover to provide visual viewing of detector/sensor for monitoring sensor operation and chamber condition. The duct housing shall be provided with gasket seals to insure proper seating of the housing to the associated ductwork. Each unit’s sampling tubes shall extend the width of the duct and be provided with porosity filters to reduce sensor/chamber contamination. Detectors shall be installed per NFPA 90A, and be listed with the fire alarm control panel. A remote LED shall be located on the corridor ceiling adjacent to the respective detector where detectors are not plainly visible or concealed from view.

C. Intelligent Thermal Detectors

1. Notifier Model FST-951R analog, fixed temperature and rate of rise thermal detectors shall be provided where indicated on the drawings. The detectors shall use dual electronic thermostats to measure temperature levels in the chamber and shall, on command from the control panel, send data to the panel representing the analog temperature level.

2. The detectors shall provide address-setting means on the detector heat using rotary decimal switches. No binary coding shall be required. Systems requiring separate detector programming apparatus will be unacceptable.

3. The detectors shall provide dual alarm and power/status LED’s. Status LED's shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LED's may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED.

4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base.

5. Provide weatherproof heat detectors in the Garage Areas or other non-airconditioned areas where detection is required.

D. Addressable Manual Pull Stations

1. Notifier Model NBG-12LX manual stations shall be provided where indicated on the drawings. The manual station shall provide address-setting means using rotary decimal switches. No binary coding shall be required.

2. Manual stations shall be designed for semi-flush mounting on standard electrical box. The station shall be constructed of hi-impact red molded Lexan with instructions for station operation in raised white letters. Stations shall be of the dual action type.

3. All manual pull stations shall be provided with an STI-1100 series clear plastic cover with integral horn.

E. Monitor Module
1. Notifier model FMM-101 addressable monitor modules shall be provided where required to interface to contact alarm devices. The monitor module shall be used to connect a supervised zone of conventional initiating devices to an intelligent SLC loop.

2. The monitor module shall provide address-setting means using rotary decimal switches. No binary coding shall be required.

F. Control Module

1. Notifier model FCM-1 or FRM-1 control and relay modules shall be provided where required to provide audible alarm interface and/or relay control interface. The control module shall be used to connect a supervised zone of conventional indicating devices to an intelligent loop. The zone may be wired class A or class B - field selected. The control module may be optionally wired as dry contact (form C) relay.

2. The control module shall provide address-setting means using rotary decimal switches. No binary coding shall be required. A status LED shall be provided which shall flash under normal conditions, indicating that the control module is operational and in regular communication with the control panel. The LED shall illuminate steady when the device is actuated via the fire alarm control panel.

G. Electronic Audio Visual Devices

1. Audible/Visual alarm devices shall be Notifier “L” Series electronic horn/strobe units, to be located where indicated on the drawings. Devices shall be wall or ceiling mounted as indicated on the drawings. AV devices shall be provided with the ability to provide multiple candela settings. Units shall operate at 24VDC and be polarized supervised. Each unit shall provide a choice of three different audible tones capable of being field selected. Preferred alarm signal shall be a temporal tone producing a sound pressure level of 84 dBA. The visual device shall use Xenon strobe type producing a minimum of 15 candela on a 24 VDC limited energy supervised circuit and meet the requirements of ADA and TAS. Strobe unit shall automatically flash upon operation of the horn. Horn/strobe unit shall be provided in textured white finish and be flush mounted. All visual devices shall be synchronized.

H. Electronic Alarm Horn

1. Provide Notifier “L” Series solid state electronic alarm device where indicated on the contract drawings. Units shall operate at 24 VDC and be polarized supervised. Each unit shall provide a choice of three different audible tones capable of being field selected. Preferred alarm signal shall be a temporal tone producing a sound pressure level of 84 dBA. Units shall be flush mounted and molded of high-impact white plastic.

I. Exterior Audio-Visual Devices

1. All audiovisual devices located outside or labeled weatherproof shall be weatherproof. Provide the following devices:

   b. SpectrAlert “L” Series for visual devices
   c. All devices shall be provided with a weather proof type back box.

J. High Intensity Visual Signals
1. Provide a Notifier “L” Series SpectrAlert visual signal device. High intensity visual signals shall be installed where shown on the drawings and as may be required by the Americans with Disabilities Act (Public Law 101-336) and TAS.

2. High intensity visual alarms shall be Xenon strobe type producing a minimum of 15 candela on a 24 VDC limited energy supervised circuit. Alarm devices shall be designated to be wall or ceiling mounted as indicated on the drawings. Signals shall operate in unison with audible alarm appliances. All visual devices shall be synchronized. Units shall be flush mounted and shall be provided in textured white.

K. Auxiliary AHU Relays

1. Notifier/Air Products model MR-101/C relays or approved equal shall be provided for HVAC and AHU control and interface. Relays shall be heavy duty type and rated up to 10 amps at 24 VDC, 60 HZ. Relays shall be provided with NEMA I dust cover assembly and be provided with SPDT contacts as well as (fail safe) so that if the cable is broken, disconnected etc., the AHU will automatically shut down.

L. Field Charging Power Supplies

1. Provide Notifier FCPS-24 power supplies with battery backup as required. Provide 120 volts dedicated circuit to each power supply.

M. Remote LCD Alpha-Numeric Annunciators

1. Provide where indicated on the drawings, a Notifier N-ANN-80 remote LCD alphanumeric annunciator to announce all system events and duplicate the displayed status at the main FACP. The annunciator shall be a backlit eighty-character LCD display and operate via the system RS485 and RS232 serial output terminal from main FACP. The LCD display shall automatically illuminate upon receipt of an alarm or trouble condition. The luminary source shall extinguish during normal/standy model to conserve power. The unit shall operate from FACP 24VDC power and function during system power failure while the system resides on standby batteries. The remote LCD annunciator shall include:

• Integral time-date clock
• Time-date select clock
• Time-date/contrast adjust
• Display/step switch
• System reset
• System silence
• System acknowledge
• Integral trouble buzzer

2. Annunciator shall upon command display the first system alarm, last alarm, and system alarm count. The unit shall be equipped with an integral lamp test feature. The unit shall be semi flush mounted where shown.

N. Protective Covers

1. Provide protective covers on all wall mounted fire alarm devices located in student restrooms, corridors and in the cafeteria. These protective covers shall be manufactured by Safety Technology International, Inc. (STI). These covers shall be provided on all devices including but not limited to smoke detectors, heat detectors, audible and visual devices, pull stations, etc. The mounting of a device shall be reinforced to enable the protective covers to protect the fire alarm devices.

O. Multi Criteria Fire/Carbon Monoxide (CO) Detector (FCO-951) for sleeping rooms.
1. Notifier Model FCO-951 intelligent multi criteria acclimating detector shall be provided where shown on the drawings. The intelligent multi criteria detector shall be an addressable device that is designed to monitor a minimum of photoelectric, flame, thermal and CO technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings.

2. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

3. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).

4. The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the flame, thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

5. The detectors shall provide address-setting means on the detector heat using rotary decimal switches. No binary coding shall be required. Systems requiring separate detector programming apparatus will be unacceptable.

6. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base with integral sounder.

P. Stand Alone Carbon monoxide (CO) Detector (for fossil fuel burning locations)

1. Notifier model CO1224T carbon monoxide detector with FMM-101 addressable monitor modules shall be provided where required to interface to contact alarm devices. The monitor module shall be used to connect a supervised zone of conventional initiating devices to an intelligent SLC loop.

2. The monitor module shall provide address-setting means using rotary decimal switches. No binary coding shall be required.

---

PART 3 - EXECUTION

3.1 DESIGN CRITERIA

A. The contractor shall provide drawings for Owner, Engineer and Fire Marshall’s approval.

B. Drawings shall be prepared by a state licensed alarm planning superintendent.

C. Drawings shall comply with all local, state and federal code. These include but not limited to N.E.C., U.L., NFPA, Etc.

D. Locate the fire alarm control panel in the day room unless otherwise directed by Owner.

E. Locate a remote annunciator in the radio room unless otherwise directed by Owner.

F. Additional items required above minimum codes include the following:

1. Pull Stations – All exits including exit stair wells on multi story buildings and at the FACP.
2. Smoke Detectors – Paths of egress, electrical rooms, mechanical rooms, MDF, IDF, storage rooms, top of stairs, elevator machine room, top of elevator shaft, above each fire alarm panel and remote power supplies terminal cabinets.
3. Duct type smoke detectors – all air handling units over 2000 CFM in duct work or return air paths.
5. Flow switches – Sprinkler riser.
6. Strobes – throughout the building.
7. Remote Power supplies: Locate in mechanical rooms, electrical rooms, MDF or other areas approved by Owner.
8. Smoke Detectors with low frequency sounder bases in all sleeping rooms and outside all sleeping rooms.
9. Monitor fire pump.
10. System Carbon Monoxide Detectors – Provide one in each dorm room, kitchen, and the first room of each mechanical system where gas furnaces are serving spaces. Combination CO and smoke detector may be utilized in dorm rooms. Provide CO detection in locations where gas water heaters are provided.

3.2 INSTALLATION

A. Wiring:

1. All wiring shall be in accordance with NFPA 72 and the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
2. All wire shall be U.L. Listed, limited energy (300 volt) FPLP or MPP wire and shall be run open in return air ceiling plenums. The wire shall be listed to U.L. TEST 910 for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction. Provide conduit in all inaccessible locations, inside concealed wall, all mechanical/electrical rooms, or other areas where wiring might be exposed and subject to damage.
3. Support wire clear of knock out panels, access panels, and maintenance spaces for equipment. Wire and cable shall be run using wire management techniques supporting cable as close as possible to within one foot of the floor or roof rafters. Wire supports shall be directly fastened to the structure on a maximum of five-foot centers. Wire routing shall be parallel and perpendicular to building lines. The wire and cable shall be secured with tie wraps or carrier wire. Sagging more than three inches will not be allowed nor will bending of the supporting ring structure.
4. All wiring for SLC signaling circuits shall be of the twisted low capacitance type to guard against outside RF and EMF interference and induced noise.
5. All wiring shall be run in a supervised fashion (i.e. no branch wiring or dog-legged wiring) per NFPA requirements such that any wiring disarrangement will initiate the appropriate trouble signals via the main control panel per NFPA and U.L. requirements.
6. Wiring splices shall be kept to a minimum with required splices to be made in designated terminal boxes or at field device junction boxes. Transposing or color code changes of wiring will not be permitted. End-of-line supervisory devices shall be installed with the last device on the respective circuit. Said device shall be appropriately marked designating it as the terminating device on the respective circuit.
7. No A.C. wiring or any other wiring shall be run in the same conduit as fire alarm wiring.

B. Conduit/Raceway

1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC.
3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.

C. Minimum Wire Sizes Shall Be as Follows:

1. Signaling Line Circuit: 18 AWG
2. Notification Appliance Circuit: 14 AWG
3. Relay Control Circuits: 18 AWG

D. Sprinkler Valves

1. Contractor shall connect all tamper switches and post indicator valves to the supervisory circuit. Connect all water flow switches to the alarm circuit. Coordinate exact locations of water vaults valves and flow switches with sprinkler contractor.

3.3 NOTIFICATION APPLIANCE CIRCUITS SYNCHRONIZATION

A. All visual and audible devices shall be synchronized per the current state adopted version of NFPA 72. Provide all components required.

3.4 TEST AND REPORTS

A. A state licensed factory trained technical representative of the manufacturer shall perform the final control panel connections and supervise testing of the system and it shall be subject to the approval of the responsible engineer and owner. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system.

B. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. In addition, each circuit in the system shall be fully tested for wiring supervision to insure proper wiring installation. Any items found not properly installed or non-functioning shall be replaced or repaired and re-tested. All testing shall be supervised by a licensed fire alarm superintendent.

C. The installing contractor shall provide a complete written report on the functional test of the entire system. The test and report shall verify the function of each device in the system, operation of all auxiliary control functions, and the proper operation of the main fire alarm control panel. A copy of the test report shall be provided with maintenance manuals. The test report shall be signed and dated by the licensed fire alarm superintendent responsible for supervising the final system test and checkout.

D. The installing contractor's fire alarm superintendent shall test the entire system in the presence of the local authorities having jurisdiction.

3.5 SPARE DEVICES
A. Provide 5% spare field devices including labor to install them. Devices not used shall be given to the Owner at completion of the job.

3.6 WARRANTY

A. The fire alarm system shall be free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of acceptance or beneficial occupancy, whichever shall occur first. Any equipment shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner.

3.7 GRAPHIC FLOOR PLANS

A. Provide 1/16" = 1'-0" floor plan showing all devices and zoning. Zoning shall correspond to the zone on the fire alarm control panel. The floor plans shall be framed with a glass cover and located by the fire alarm control panel. This graphic floor plan shall use the actual room numbers based on the architectural graphics package. Verify specific requirements with Owner. Provide a sample for approval.

END OF SECTION 28 46 00.21
SECTION 31 10 00 – SITE CLEARING (LA)

PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Cutting, removing from the ground, and properly disposing of trees, stumps, hedge, brush, roots, logs, weeds, rubbish, sod refuse dumps, sawdust piles, lumbering slash, and other materials within the limits of the right-of-way or other designated areas that interfere with the work or are considered objectionable.

B. Selective clearing, preserving existing vegetation, scalping, and the preservation of objects designated to remain Removal of trees, shrubs, and other plant life.

C. Topsoil excavation.

1.2. RELATED SECTIONS

A. Document: Geotechnical Report

B. Section 31 1317 - Tree Protection

C. City of Austin Standard Specifications- Section 132s-Embankment

1.3 DEFINITIONS

A. Clearing. The cutting and removal of all trees, brush, and other objectionable growth, and the removal and disposal of logs, rubbish piles, refuse dumps, sawdust piles, lumbering slash, and other objectionable matter from the surface of the ground in the areas shown on the plans or designated by the Engineer.

B. Grubbing. The grubbing and removal of all stumps, roots, and other objectionable matter, lying wholly or in part below the surface of the ground.

C. Selective Clearing. The trimming of selected trees and shrubs, the removal from the ground and disposal of logs, root pods, brush, refuse dumps, and other undesirable debris, and the cutting, removal, and disposal of all undergrowth, stumps, and standing trees, except those trees and shrubs designated to be preserved. The selective clearing areas will be shown on the plans.

D. Preserved Vegetation. Areas of the right-of-way containing trees and brush and designated on the plans as Preserved Vegetation areas shall not be disturbed except as described below.

E. Scalping. Areas not classified as clearing and grubbing and that are within construction limits shall be scalped, if appropriate. Scalping shall include the removal and disposal of material such as saplings less than 4” in diameter measured 12” above the ground, logs, brush, roots, grass, residue of agricultural crops, refuse dumps, and decayed matter.

1.4 REGULATORY REQUIREMENTS

A. No storage of petroleum, other chemicals, waste materials, trash, etc., shall be allowed within 100 feet of a wetland.
B. Coordinate clearing Work with utility companies.

PART 2 - EXECUTION

2.1. PREPARATION

A. The construction limits on the plans designate the clearing limits.

B. Trees defined at risk by Section 32 9300, and trees designated to remain, shall be delineated prior to construction activities by a method acceptable to the owner’s representative.

2.2. PROTECTION

A. Protect trees, plant growth, and features designated to remain, as final landscaping.

B. Protect bench marks from damage or displacement. Any bench marks damaged by contractor’s operations shall be replaced by a Registered Land Surveyor in state of Texas.

2.3. CLEARING AND REMOVAL

A. Clear areas established within the construction limits and execution of work. The contractor shall exercise caution to not damage at risk trees or trees designated to remain.

B. Trees, brush, stumps, and other deleterious matter, within the construction limits, and necessary for removal during construction shall be wasted off site.

C. Should field conditions exist which would warrant damage of a tree at risk, or a tree designated to remain, the contractor shall cease activity in that area and immediately contact the owner’s representative for permission to proceed.

D. Holes remaining after removal of trees, stumps, etc., shall be backfilled with material approved by the Engineer and compacted as directed except in areas to be excavated.

E. The Contractor shall complete the operation by blading, bulldozing, or other approved methods, so that the project shall be free of holes, ditches, or other abrupt changes in elevations that resulted from the clearing and grubbing operations.

END OF SECTION 31 10 00
SECTION 31 13 17 - TREE PROTECTION (LA)

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Tree and brush preservation during demolition and construction.

1.2 RELATED SECTIONS

A. Section 31 1000 Site Clearing (LA)

B. City of Austin Standard Specifications - Section 132s-Embankment

1.3 DEFINITIONS

A. Preservation Zone: Area of the project site to remain in existing, natural condition throughout the construction process and project development while preserving existing vegetation and natural features.

PART 2 - EXECUTION

2.1 IDENTIFICATION

A. Verify delineation of preservation zone with owner prior to clearing of site.

2.2 PRESERVATION ZONE

A. General Preservation Zone - The preservation zone will be delineated by range survey flagging strung at a height of four feet along the Limits of Construction as defined on the plans. Flagging shall be secured by wrapping around tree trunks at the edge of the preservation zone at intervals of ten feet. Flagging will remain in place until all construction equipment is removed from the site.

B. Specimen Trees - The preservation zone for specimen trees will be delineated by tree preservation fencing.

C. All equipment, vehicles, and materials are to be located outside of the preservation zone at all times. Parking or driving of equipment, machinery or vehicles of any type is prohibited within the preservation zone.
D. No grading, trenching, storage of construction materials, stockpiling of excavation of fill soil, gravel, etc. or release of equipment washout water will occur within the preservation zone.

2.3 TREE REMOVAL

A. Remove trees within the construction limits in a manner that will not cause damage to protected trees within the preservation zone.

1) Do not allow trees to be removed to fall into protected trees canopies, or onto tree trunks during removal operations.

2) Do not allow trees to be removed to penetrate edge of preservation zone during removal operations.

2.4 TREE PRUNING

A. All tree pruning operations during the construction process will be performed under the direction of an arborist approved by the project landscape architect. Arborists will have a minimum of three years of tree pruning and preservation experience.

B. Report any damage to trees due to demolition or construction that are located within the preservation zone to the consulting arborists within 6 hours of occurrence.

2.5 PENALTIES

A. Trees within the preservation area that are damaged to the extent that replacement is required must be replaced with a single tree or multiple trees that equal the caliper inch of the damaged tree at the cost of the contractor.

1) Magnitude of damage and tree replacement species must be approved by the project landscape architect.
SECTION 312300 – EXCAVATION AND FILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to Work of this section.

1.2 STANDARDS

A. The following Standards are listed in this specification:

1. ASTM C 31.
2. ASTM C 33.
3. ASTM C 150.
4. ASTM D 448.
5. ASTM D 698.
6. ASTM D 1557.
7. ASTM D 1621.
8. ASTM D 2487.
9. ASTM D 4253.
10. ASTM D 4254.
11. ASTM D 4491.
12. ASTM D 4533.
13. ASTM D 4632.
14. ASTM D 4716.
15. ASTM D 4751.
16. ASTM D 4759.
17. ASTM D 4833.

1.3 DESCRIPTION OF WORK

A. Earthwork: The extent of earthwork is indicated on the drawings. The work, in general, includes the following items:

1. Excavation and backfill for building structure and foundation.
2. Preparation of subgrade for building slabs, and walks adjacent to buildings.
3. Excavation and backfill in conjunction with underground mechanical and electrical utilities under slabs on grade, and mechanical and electrical appurtenances that are buried under the building slab.
4. Rough and finish grading adjacent to the building.
5. Furnishing Unit Prices for additional earthwork.

B. Excavation Definition: "Excavation" consists of removal of all material encountered to required subgrade elevations indicated and subsequent disposal of all materials removed.
1.4 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with all applicable requirements of governing authorities having jurisdiction.

B. Testing and Inspection Services:
   1. Owner's Testing Laboratory: The Owner will engage a soil testing and inspection service for quality control testing during earthwork operations. Reference Section entitled "Testing Laboratory Services".
   2. Contractor's Testing Laboratory: The Contractor shall engage at his own expense a testing laboratory acceptable to the Architect/Engineer to perform quality control testing of all proposed soil materials. Reference Section entitled "Testing Laboratory Services".

C. Depth of Bearing Strata: It is to be understood that site soil conditions are variable across the site. Footing design dimensions and bearing elevations shown are minimums. The design of the footings is based on the assumed strata bearing capacity at the elevation shown on the drawings and as indicated in the General Notes. If the indicated depth of footing excavation is reached without developing the required strata bearing capacity, the Owner's Geotechnical Engineer on site will immediately advise the Contractor on the required bearing elevation for each individual footing or mat. Revisions will be paid for in accordance with the Contract condition relative to changes in the Work.

D. Survey Work, Grades, and Elevations:
   1. Grades and Elevations: Finished grades indicated by spot elevation and normal contour line elevations denote finished top surface elevations. Report conflicts, errors and inconsistencies in grades and elevations to Architect/Engineer for resolution. Do not proceed with the work in questionable areas until conflicts are resolved by the Architect/Engineer.
   2. Survey Work: Lay out work to the lines and levels required before excavation. Record actual measurements of each footing and mat plan centerline location, bottom elevation, deviation from specified tolerances, and all other pertinent data as required.

1.5 SUBMITTALS

A. Laboratory Test Reports: Submit the following reports directly to the Architect/Engineer from the testing services, with copy to Contractor:
   1. Test reports on borrow and fill material including optimum moisture-maximum density curve for each type of soil.
   2. Verification reports of each footing subgrade.
   3. Field density test reports.
   4. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.
   5. All other test reports as required by "Testing Laboratory Services", and other specification sections.
   6. Product Data.
1.6 JOB CONDITIONS

A. Site Information: Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for convenience of Contractor. Additional test borings and other exploratory operations may be made by the Contractor at no cost to the Owner.

B. Removal of Items Remaining from Demolition: Include as part of earthwork the breaking up and removal of all concrete slabs, pavements, footings, foundations, cisterns, septic tanks, abandoned underground utility lines and all other obstructions remaining from previous demolition operations that may have occurred.

C. Existing Utilities:
   1. The drawings indicate the locations of known active and inactive above grade and below grade utilities. Locate all existing underground utilities in areas of work before proceeding. Provide adequate support and protection during earthwork operations of utilities that are to remain in place. Demolish and completely remove from the site existing utilities indicated to be removed. Coordinate with utility companies for proper shut-off of services for active lines.
   2. If any active utility not indicated in drawings is encountered, notify Architect/Engineer and protect from damage until instructions for proper disposition of the utility are given by the Architect/Engineer. Perform the requested work in compliance with rules and regulations of authority having jurisdiction.
   3. Repair active utilities scheduled to remain that are damaged by earthwork operations to the satisfaction of the utility owner.
   4. If any inactive utility not indicated on the drawings is encountered, remove, plug, or cap as directed by the Architect/Engineer. Obtain any necessary data relative to proposed abandonment of existing utility service from authority having jurisdiction.
   5. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by Architect/Engineer and then only after acceptable temporary utility services have been provided.
      a. Provide minimum of 48-hour notice to Architect/Engineer, and receive written notice to proceed before interrupting any utility.

D. Use of Explosives:
   1. The use of explosives is not permitted.

E. Protection of Persons and Property:
   1. Barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights as recommended by authorities having jurisdiction.
   2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.
   3. Perform excavation within drip-line of large trees to remain by hand, and protect the root system from damage or dryout to the greatest extent possible. Maintain moist condition.
for root system and cover exposed roots with burlap. Paint root cuts of 1” diameter and larger with emulsified asphalt tree paint.

4. Accidental or Careless Damage to Work Intended to Remain in Place: Restore to a condition as good or better than existed before work was commenced as approved by the Architect/Engineer and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 DEFINITION OF SOIL MATERIALS

A. Satisfactory Soil Materials: Satisfactory soil materials are defined as those complying with ASTM D 2487 soil classification groups GW, GP, GM, SM, SW, and SP. Some CL materials subject to the requirements for "Select Fill" may be acceptable.

B. Unsatisfactory Soil Materials: Unsatisfactory soil materials are defined as those complying with ASTM D 2487 soil classification groups GC, ML, MH, CH, OL, OH, and PT. Groups SC and CL are also unsatisfactory unless conforming to requirements specified below.

C. Fill and Backfill:

1. Definition: "Fill" is soil material that is used to raise existing grades such as under foundation slabs or above footings, or to replace unsuitable material. Backfill" is soil material that is used to fill an excavation, to fill against the structure, or to fill behind foundation walls.

2. Select Fill: "Select fill" material shall be used as noted on the drawings as fill and/or backfill and shall conform to one of the following:
   a. Sandy clay or clayey sand having a plasticity index between 7 and 15 and a liquid limit not exceeding 40. Material shall be free of debris, roots, vegetation, organic matter and all other deleterious substances and free of rock or gravel greater than 2” in any dimension.
   b. Satisfactory Soil Material as defined above free of clay, rock, or gravel larger than 2” in any dimension and free of debris, roots, vegetation, waste and all other deleterious materials.

3. Drainage Fill: "Drainage fill" shall be used as noted on the drawings as fill material that is used around a drainage pipe in a wall drainage system or under a foundation slab as part of an underfloor drainage system and shall conform to the following:
   a. Uniformly graded mixture of natural or crushed gravel, crushed stone, and natural sand, conforming to the coarse aggregate requirements of ASTM C 33, size 67 with 100% passing a 1” sieve and 0% to 5% passing a No. 8 sieve.
   b. Washed evenly graded mixture of crushed stone or crushed or uncrushed gravel, ASTM C 33; coarse-aggregate grading Size 56; with 100% passing a 1 1/2” sieve and not more than 5% passing a No. 4 sieve.

4. Drainage Backfill: "Drainage backfill" shall be used as noted on the drawings as backfill material that is used behind a foundation wall as part of a wall drainage system Drainage backfill must be compatible with any drainage fill material to which it comes in contact as part of the complete wall drainage system. Drainage backfill shall conform to the following:
a. Washed evenly graded mixture of crushed stone or crushed or uncrushed gravel, ASTM D 448; coarse-aggregate grading Size 57; with 100% passing a 1 1/2” sieve and not more than 5% passing a No. 8 sieve.

5. Impervious Fill: "Impervious Fill" shall be used as noted on the drawings as backfill material that is used as a cap to seal off surface water from penetrating into backfill below. The material shall be lean clay with a Liquid Limit of between 35 and 50, with a Plasticity Index greater than 25, and capable of compacting to a dense composite. The material shall have at least 70 percent by weight passing the No. 200 sieve and no more than 15 percent by weight retained in the No. 4 sieve.

6. Granular Base under slab-on-grade: "Granular Base" material shall be used as noted on the drawings as fill material between the moisture retarder and the slab and shall be a clean, well-graded, granular mixture of crushed stone, crushed, recycled concrete, or crushed or uncrushed gravel that is trimmable, compactable, and drains well.
   a. Subject to compliance with requirements, the following materials are acceptable:
      1) Crushed, recycled concrete with 100% passing the 1 1/2 inch sieve, 45% to 60% passing the 3/8” sieve, 25% to 40% passing the #4 sieve, 20% to 35% passing the #8 sieve, 10% to 30% passing the #100 sieve, and 0% to 5% passing the #200 sieve.

7. Leveling Sub-base under Moisture Retarder: "Leveling Sub-Base" shall be used as noted on the drawings as a thin smoothing layer over the sub-grade and directly below the moisture retarder. The material shall be a clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, size 10, with 100 percent passing a No. 4 sieve and 10 to 30 percent passing a No. 100 sieve; meeting deleterious substance limits of ASTM C 33 for fine aggregates.

8. Cement Stabilized Sand Backfill: "Cement Stabilized Sand" shall be used as noted on the drawings and in these specifications as backfill material and shall be a well mixed composite of the following materials:
   a. Granular soil material conforming to one of the following:
      1) Uniformly graded mixture of natural or crushed gravel, crushed stone, and natural sand, conforming to the fine aggregate (concrete sand) requirements of ASTM C 33, with 100% passing a 3/8” sieve and 2% to 10% passing a No. 100 sieve.
      2) Concrete sand, 3/8” to No. 100, conforming to ASTM C 33.
      3) A washed free draining river sand graded so that 100% will pass a 3/8” sieve and less than 3% shall pass a No. 200 sieve.
   b. Potable Water added in such proportion to make the mixture workable and fully hydrate the cement.
   c. Cement, Type I, ASTM C 150 added in such proportion that the cement to dry sand ratio by weight shall be a minimum of 7%.
      1) The cement stabilized sand shall produce a minimum unconfined compressive strength of 100 PSI in 48 hours and 400 PSI in 7 days where compacted to 95% density according to ASTM D 698 without additional moisture control, cured in accordance with ASTM C 31 Item 9, and tested in accordance with ASTM C 31.

9. Use of On-site Materials: On-site materials may be used for fill and backfill only for building bad preparation at the Annex building and only when approved by the Owner's Testing Laboratory. On site materials are not satisfactory for use under the Headquarter Building or War Memorial and shall be hauled off and disposed of in a safe manner.
D. Approval: All soil materials used for the project shall be approved by the Owner's Testing Laboratory prior to hauling or placement. Soil materials used for fill and backfill shall be retested and reapproved each time the source or character of the material changes.

E. Filter Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile: made from polyolefins, polyesters, or polyamides: and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 100 lbf; ASTM D 4632
2. Tear Strength: 40 lbf; ASTM D 4533
3. Puncture Resistance: 50 lbf; ASTM D 4833
4. Water Flow Rate; 90 gpm per sq. ft.; ASTM D 4491
5. Apparent Opening Size; No. 50; ASTM D 4751

F. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 200 lbf; ASTM D 4632
2. Tear Strength: 75 lbf; ASTM D 4533
3. Puncture Resistance: 90 lbf; ASTM D 4833
4. Water Flow Rate; 4 gpm per sq. ft.; ASTM D 4491
5. Apparent Opening Size; No. 30; ASTM D 4751

G. Geocomposite Drainage System: A manufactured system consisting of a geotextile filter fabric specified above that is fusion bonded to a high-impact plastic cuspated core and with the following minimum properties.

1. Moderate Flow Rate, @3600 psf and hydraulic gradient = 1.0, ASTM D 4716: 5 gpm/ft. width., Compressive Strength, ASTM D 1621: 15,000 psf.
   a. Subject to compliance with requirements, provide one of the following:
      1) TC MiraDRI, Inc.; MiraDRAIN MD-2000.
      2) Greenstreak; Sheet Drain HS.
      3) JDR Enterprises, Inc.; J-DRain 300.
      4) Solutia, Inc.; Hydroway 100.
      5) Akzo Nobel Geosynthetics Company; Enkadrain 9010.

H. Slotted Collector Pipe: Provide Schedule 80 PVC pipe with 0.10 inch slots comprising a minimum of 8% of the total surface area of the pipe but no more than 10%.

PART 3 - EXECUTION

3.1 CLEARING AND GRUBBING

A. Remove all existing slabs, pavements, trash, rubbish, debris, trees, roots, stumps, underbrush, grass, shrubs, plants and other vegetation from within the mass excavation limits.
3.2 PREPARATION

A. Survey Work:
   1. Set required lines and levels as required to accurately perform the excavation work.
   2. Maintain all bench marks and other reference points.

B. Protection of Existing Work:
   1. Protect bench marks and existing structures, utilities, roads, sidewalks, paving, curbs and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations. In areas where excavations must be carried to such depths that surcharge from streets, sidewalks, or earth pressure create hazardous conditions, provide sheet piling, shoring and bracing, or combinations thereof, as required to protect excavations. Remove shoring and bracing before backfilling is completed, but not before permanent supporting structure is in place.
   2. Protect excavations by laying back sides on a maximum 1:1 slope or by other methods as required to prevent cave-ins and loose dirt from falling into excavations.
   3. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
   4. Notify Architect/Engineer of any unexpected subsurface conditions. Discontinue work in area until Architect/Engineer provides notification to resume work.

3.3 EXCAVATION

A. Unclassified Excavation: The excavation for this project is unclassified. The Contractor is required to excavate to subgrade elevations specified, regardless of the character of materials or obstructions encountered. No additional costs will be paid by the Owner for any underground obstructions encountered.

B. Unauthorized Excavation:
   1. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect/Engineer. Unauthorized excavation, as well as remedial work directed by Architect/Engineer, shall be at Contractor's expense.
   2. Under footings, foundation bases, or foundation walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill or cement stabilized sand may be used to bring elevation to proper position, when acceptable to Architect/Engineer and approved by the Geotechnical Engineer.
   3. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Architect/Engineer.

C. Approval of Subgrade:
   1. When excavation has reached required subgrade elevations, notify Owner's Geotechnical Engineer who will make an inspection of conditions.
2. Proofroll exposed subgrade below building with appropriate compaction equipment. Conduct proofrolling operations only in the presence of the Owner's Geotechnical Engineer. Undercut areas which "pump" or "rut" during operations to firm natural soil, and backfill and compact as specified.

3. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material with cement stabilized sand, lean concrete, or select fill as directed by Owner's Geotechnical Engineer.

4. Removal of unsuitable material and its replacement as directed will be paid on basis of contract conditions relative to changes in the work.

5. Reconstruct subgrades damaged by freezing temperature, frost, rain, accumulated water, or construction activities as directed by the Owner’s Geotechnical Engineer.

D. Stability of Excavations:

1. Slope sides of excavations to comply with local codes and ordinances having jurisdiction and in accordance with the requirements noted in the Geotechnical Report. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

2. Maintain sides and slopes of excavations in safe condition until completion of backfilling. Protect slopes from erosion by covering the slope with material such as polyethylene sheet.

E. Shoring and Bracing:

1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.

2. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

F. Dewatering:

1. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

2. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

3. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. Do not discharge drainage water lines into municipal sewers without municipal approval. Prevent water running onto adjacent properties and public thoroughfares. Direct surface drainage away from excavated areas.

G. Material Storage:
1. Where required by schedule or site limitations, stockpile satisfactory soil materials and/or select fill where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.

2. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.

3. Dispose of excess soil material and waste materials as herein specified.

H. Excavation for Structures:

1. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10'. Excavations for footings and mats may be neat excavated where possible with sides and top edges free of loose or wet materials. Where neat excavation is not possible, excavate by open cut and allow sufficient distance from the edge of footings and foundations to permit placing and removing concrete formwork, installing services, other construction, and for inspection.

2. In excavating for footings and foundation, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Where unsatisfactory bearing surfaces are encountered, the area shall be undercut as required and backfilled with cement stabilized sand or lean concrete as directed by the Geotechnical Engineer. Trim bottoms to required lines and grades to leave solid, clean, level and flat base to receive other work.

3. Protect soils exposed at the base of completed foundation excavations against disturbance from construction activities and changes in moisture content. Excavations shall not be left overnight unless it is protected with a minimum 2” thick seal slab of lean concrete. Where the bottom of the excavation will be exposed to movement of crawler type heavy equipment, the contractor may leave about one foot of undisturbed soil above indicated bottom of footing elevations until just prior to final excavation.

I. Excavation and Backfilling for Trenches:

1. Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Provide 6” to 9” clearance on both sides of pipe or conduit.

2. Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to keep the top of pipe or conduit below the frost line.

3. Where rock is encountered, carry excavation 6” below required elevation and backfill with a 6” layer of crushed stone or gravel prior to installation of pipe.

4. For pipes or conduit 5” or less in nominal size and for flat-bottomed multiple-duct conduit units, do not excavate beyond indicated depths. Hand excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.

5. For pipes or conduit 6” or larger in nominal size, tanks and other mechanical/electrical work indicated to receive subbase, excavate to subbase depth indicated, or, if not otherwise indicated, to 6” below bottom of work to be supported.

6. Except as otherwise indicated, excavate for exterior waterbearing piping (water, steam, condensate, drainage) so top of piping is not less than 3’-6” below finished grade.

7. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.
8. Backfill trenches with concrete where trench excavations are close to column or wall footings such that the bottom of the excavation is below the zone of influence of such footings, or which pass under wall footings. The zone of influence of a footing is defined by 45 degree planes extending downward from the bottom edges of the footing. Place concrete to level of bottom of adjacent footing. In other locations, backfill trenches with select fill.

9. Do not backfill trenches until tests and inspections have been made and backfilling authorized by Geotechnical Engineer or other authorized Owner's representative. Use care in backfilling to avoid damage or displacement of pipe systems.

10. For piping or conduit less than 2'-6" below surface of roadways, provide 4" thick concrete base slab support. After installation and testing of piping or conduit, provide minimum 4" thick encasement (sides and top) of concrete prior to backfilling or placement of roadway subbase.

J. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.

3.4 PLACING FILL AND BACKFILL

A. Location: Place satisfactory and approved soil material in layers to required subgrade elevations for each area classification listed below:

1. Excavations: In excavations use select fill or approved excavated material. Place in layers to required subgrade elevations.
2. Building Slabs: Under building slabs use select fill as shown on the drawings. Place fill between the top of footings and mats and the building slab or the bottom of the drainage course.
3. Around Footings: Backfill around the formed edges of footings with lean concrete or cement-stabilized sand.
4. Behind Foundation Walls: Behind foundation walls, use drainage fill around the wall drain and drainage backfill over the drainage fill and wall drain up to within two feet of grade. Use impervious fill material at the top 24" of the wall backfill.
5. Under Walks: Use minimum 6" deep course of base or subbase material, or approved excavated material.
6. Backfill Adjacent to Structures: Backfill against the structure with select fill up to within two feet of grade. Use impervious fill material at the top 24" of backfill adjacent to structures.
7. Under Steps: Use minimum 6" course of subbase or base material.
8. Under Piping and Conduit: Under piping and conduit use subbase or base material, shaped to fit bottom of trench.

B. Prior to Backfill Placement: Backfill excavations as promptly as work permits but not until completion of each of the following:

1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Inspection, testing, approval, and recording locations of underground utilities.
4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.

5. Removal of trash and debris.

C. Ground Surface Preparation:

1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

2. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

D. Grading:

1. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

2. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes to the following tolerances:
   a. Lawn or Unpaved Areas: Plus or minus 1 inch.
   b. Walks: Plus or minus 1 inch.

3. Grading Surface of Fill Under Building Slabs: Provide final grades within a tolerance of 1/2" when tested with a 10' straightedge.

4. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

5. Allowance for Compaction and Settlement: Allow for natural compaction and settlement during grading operations. Where excessive settlement occurs, scarify settled areas, fill and compact to required subgrade levels.

3.5 COMPACTION

A. General: Control all soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture density relationship (cohesive soils) determined in accordance with ASTM D 698; and not less than the following percentages of relative density, determined in accordance with ASTM D 4253 and 4254, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless
soils. Cohesive soils are defined as those that have more than 50% of the soil material by weight passing the #200 sieve.

1. At Annex Building Slabs and Steps, and Pavements: Scarify the top 6" of subgrade. Recompact the top six inches and compact each lift of fill material at the optimum moisture content (± 2%) to 95% maximum density for cohesive material or 85% relative density for cohesionless material. Place and compact the ½" layer of the leveling sub-base at the optimum moisture content (± 2%) to 85% relative density before placing the moisture retarder. After installing the moisture retarder, place and compact the granular base material at the optimum moisture content (± 2%) to 85% relative density.

2. Building Slabs and Steps: Remove existing subgrade material to the depth specified in the documents and replace with fill material up to the planned subgrade level. Compact each lift at the optimum moisture content (± 2%) to 95% maximum density or 85% relative density. Place and compact the ½" layer of the leveling sub-base at the optimum moisture content (± 2%) to 85% relative density before placing the moisture retarder. After installing the moisture retarder, place and compact the granular base material at the optimum moisture content (± 2%) to 85% relative density.

3. Behind Foundation Walls: Compaction requirements within five feet of the wall shall be 75% relative density. Compaction requirements outside the five-foot band shall be 85% of relative density. The moisture content shall be at optimum moisture (± 2%). The top two feet of impervious fill shall be compacted at optimum moisture content to 90% or 95% of maximum density depending on the proximity to the wall.

4. Lawn or Unpaved Areas: Scarify and re-compact top 6" of subgrade and each layer of backfill or fill material at the optimum moisture content (± 2%) to 90% maximum density for cohesive soils and 85% relative density for cohesionless soils.

5. Walkways: Scarify and re-compact top 6" of subgrade and each layer of backfill or fill material at the optimum moisture content (± 2%) to 90% maximum density for cohesive material and 85% relative density for cohesionless material.

C. Moisture Control:

1. 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, to prevent free water appearing on surface during or subsequent to compaction operations.

2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

3. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3.6 BUILDING SLAB DRAINAGE COURSE

A. General: Drainage course consists of placement of drainage fill material, in layers of indicated thickness, over subgrade surface to support concrete building slabs.

B. Placing:

1. Place drainage fill material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Compact drainage course to not less
than 95 percent of relative density as determined by ASTM D 4254. Maintain optimum moisture content (± 2%) for compacting material during placement operations.

2. When a compacted drainage course is shown to be 6" thick or less, place material in a single layer. When shown to be more than 6" thick, place material in equal layers, except no single layer more than 6" or less than 3" in thickness when compacted.

3.7 FIELD QUALITY CONTROL

A. Refer to Section entitled “Testing Laboratory Services” for required quality control testing during construction.

3.8 MAINTENANCE

A. Protection of Graded Areas:
   1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
   2. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

C. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.9 DISPOSAL OF EXCESS WASTE MATERIALS

A. Removal to Designated Areas on Owner's Property: Transport acceptable excess excavated material to designated soil storage areas on Owner's property. Stockpile soil or spread as directed by Architect/Engineer.
   1. Transport waste material, including unacceptable excavated material, trash and debris to designated soil areas on Owner's property and dispose of as directed. Remove excess excavated material, trash, debris and waste materials and dispose of it off Owner's property.

3.10 UNIT PRICES

A. Basis of Bids: Include excavation work and other earthwork necessary to produce the work required.

B. Changes in the Work: Payment for changes in earthwork will be made on the actual net volume change of foundation in place and accepted based on design dimensions shown. No additional compensation will be made for excavation, concrete fill, reinforcing, or other costs due to unauthorized over-excavating in any dimension.
C. Unit Prices: Quote Unit Prices which include full compensation for labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casing as required, dewatering, and other necessary items for complete installation. Provide Unit Prices for the following items, as set forth in the Contract conditions, which will apply in the event additions to or deductions from the Work are required and authorized by a written order from the Architect and approved by the Owner to the Contractor. Refer to Section 03 30 00 for concrete, reinforcing steel, and dowel Unit Price requirements.

1. Soil excavation, per cu. yd.
2. Rock excavation, per cu. yd.
3. Select fill material, placement, and compaction, per cu. yd.
4. Cement stabilized sand and/lean concrete material and placement, per cu. yd.

END OF SECTION 312300
SECTION 31 23 00.11 LANDSCAPE GRADING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Final grade topsoil for finish landscaping.

1.2 RELATED SECTIONS

A. Section 32 9223 - Sod

B. Section 32 9300 - Trees, Plants and Ground Cover: Topsoil fill for trees, plants and ground cover.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Existing Topsoil:

1. Existing topsoil removed/excavated from site and stockpiled.

B. Supplemental Topsoil:

1. Sandy loam from source approved by Owner; 100 percent passing through 1-inch screen.
   a. Sand (2,000 mm to 0.50 mm): 40 to 50 percent.
      Silt (0.050 mm to 0.005 mm): 30 to 40 percent.
      Clay (0.005 mm and smaller): 10 to 30 percent.

2. Free of subsoil, brush, stumps, roots, organic litter, objectionable weeds, clods, shale, stones 1-inch minimum dimension or larger, or other material harmful to grading, planting, plant growth, or maintenance operations.

3. Presence of vegetative parts of Bermuda grass, Johnson grass, nut grass (Cyperus rotundus), and other hard to eradicate weeds or grass will be cause for rejection of topsoil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify building and trench backfilling have been inspected.

3.2 SUBSTRATE PREPARATION
A. Apply herbicide, per manufacturer's specifications, to all areas of the project site shown to receive new seeding, sodding, landscape improvements, or mulching.

B. Eliminate uneven areas and low spots.

C. Remove debris, roots, branches, stones, in excess of 2 inches in size. In ball field areas, if remove debris, roots, branches, stones in excess of ¾ inches in size. Remove subsoil contaminated with petroleum products.

D. Scarify surface to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.3 PLACING TOPSOIL

A. Place topsoil in 4” lifts maximum in areas where new landscape planting is required. The finished settled depth of topsoil is be 2”, 4 inches in ball field areas. Place topsoil during dry weather. In ball field areas, see specification section “02924 Ball Field Top Soil.”

B. Place topsoil as required in new parking areas and adjacent to building areas to provide adequate soil for new planting and insure proper drainage. Provide a minimum 6-inch layer of topsoil over all new landscape areas.

C. If the Contractor uses both existing topsoil and supplemental topsoil, the contractor shall ensure each individual field is constructed using either the existing topsoil or supplemental soil, and not a combination of both existing and supplemental topsoil.

C. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of sub grade.

D. Remove roots, weeds, rocks, and foreign material while spreading.

E. Manually spread topsoil close to existing plant life, to prevent damage.

F. Roll placed topsoil.

G. Dispose of surplus subsoil and topsoil as directed by Owner.

H. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.4 TOLERANCES

A. Top of Topsoil: Plus or minus 1 inches.

3.5 PROTECTION

A. Protect landscaping and other features remaining as final work.

B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

END OF SECTION 31 23 00
SECTION 316324 – DRILLED AND UNDERREAMED FOOTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

B. Information concerning a sub-surface soil investigation by the Owner’s Geotechnical Engineer is available and will be furnished by the Owner upon request. The contractor may use the data included therein for his general information only. The Architect/Engineer is not responsible for the accuracy or applicability of the data therein.

1.2 DEFINITIONS

A. Casing: Steel cylinder used to resist earth and water pressures, to serve as concrete form, and to protect personnel.

B. Dry Method: A method of pier installation in which concrete is placed in the dry. Casing may or may not be used to maintain sidewall stability.

C. Owner’s Representative: The Architect, Structural Engineer, or Geotechnical Engineer authorized to act on behalf of the Owner.

D. Owner’s Representative- Geotechnical Engineer: The Geotechnical Engineer specifically authorized to carry out the responsibilities defined in this specification.

E. Probe hole: A 1.6 to 2.5 inch diameter hole usually drilled by air percussion methods to a required depth below the pier bottom. The Geotechnical Engineer feels the probe hole by lowering and raising a hooked rod. The size and amount of seams found enables the determination of the soundness of the subsurface formation.

F. Tremie method: Procedure for placing concrete under water or slurry using a watertight steel pipe or tube to place concrete without washing out cement fines.

1.3 STANDARDS

A. The following Standards are listed in this specification:

1. ASTM A 36.
2. ASTM A 283.
3. ASTM A 929.
4. ASTM C 33.
5. ASTM C 94.
6. ASTM C 150.
7. ASTM D 1143.
1.4 SCOPE OF WORK

A. The Drilling Contractor shall furnish all labor, materials, services, equipment (including temporary casings where required), and shall install all piers at the locations and depths shown on the drawings or as otherwise directed by the Owner’s Geotechnical Engineer. Installation methods compatible with the design may be used if acceptable to the Owner’s Geotechnical Engineer. Methods that are not compatible with the design shall be excluded from consideration.

B. The Drilling Contractor shall furnish and place all reinforcing steel, dowels, and anchor bolts that are shown on the drawings to be embedded in the pier.

C. The General Contractor shall provide all necessary excavation, sheeting and bracing or other adequate maintenance of excavation banks, suitable runways and ramps as necessary for access of pier drilling, control of ground and surface water as necessary to keep the work area sufficiently dry, suitable access roads for movement of equipment and materials to and from pier locations, field layout required for pier work including setting and maintaining a location stake for each pier and giving cut-off grades on all piers, removal and replacement of all overhead and underground obstructions as required, and coordination of all concrete ordering and delivery.

1.5 QUALIFICATIONS

A. Drilled piers shall be installed by a specialty Drilling Contractor with suitable equipment, competent personnel, and a reputation of satisfactorily performing the work. The Contractor shall have a minimum of 5 years successful experience and a minimum of 5 successful installations on projects of a similar size and scope to this project and of using similar installation methods as may be anticipated for this project. Evidence of compliance with this section shall be submitted to the Architect/Engineer prior to entering into a contract for the work.

1.6 QUALITY ASSURANCE

A. The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

B. The Contractor shall comply with all local, state, and federal statutes, including OSHA, for drilling and excavating.

C. Codes and Standards: The Drilling Contractor shall comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. ACI 301, “Specifications for Structural Concrete for Buildings.”
3. ACI 318, “Building Code Requirements for Reinforced Concrete.”
In addition, all applicable building code and local regulations shall be followed. In case of conflict, the strictest interpretation shall govern.

D. Survey Work:

1. The General Contractor shall employ a qualified and licensed professional engineer/land surveyor to perform all surveys, layouts and measurements for drilled pier work including the layout of anchor rods and/or reinforcing steel dowels embedded in drilled piers. The surveyor shall conduct the layout work for each drilled pier to the lines and levels required prior to beginning excavation and shall make actual in-place measurements of each drilled pier plan location, shaft diameter, bottom and top elevations and deviations from specified tolerances.

2. The surveyor shall record and submit all information pertinent to each drilled pier and cooperate with other testing and inspection personnel to provide data for all required reports.

E. Testing Laboratory Requirements: The Drilling Contractor shall cooperate with all testing and inspection personnel employed to perform field quality control tests and inspections. See Testing Laboratory section of the specifications for required tests and inspections to be performed by the Testing Laboratory and Geotechnical Engineer.

1. Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents.

1.7 JOB CONDITIONS

A. Site Information:

1. Data on indicated subsurface conditions are not intended as representations or warranties of continuity of such conditions. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by the Contractor. The data are made available for convenience of the Contractor.

2. The Contractor may make additional test borings and other exploratory operations at no additional cost to the Owner.

3. The Contractor shall inspect the site prior to drilling operations and shall determine any constraints to the work presented by the existing surface conditions and report them to the Owner’s Representative.

B. Protection of Existing Structures: Locate all existing underground structures and utilities that are to remain in service during construction. Protect above-ground structures, underground utilities and other construction from damage caused by drilling operations. Report any conflicts between drilling work and underground utilities and structures to the Owner’s Representative and do not proceed with the work until the conflict is resolved.

1.8 PREINSTALLATION CONFERENCE

A. At least 7 days prior to beginning pier installation, the Contractor shall conduct a meeting to review the proposed excavation, inspection, and concrete and reinforcement placement methods and procedures to produce pier construction of the required quality. Also review requirements
for submittals, status of coordinating work and availability of materials. Establish work progress schedule and procedures for bearing surface inspection, materials testing, and certifications. The Contractor shall send a pre-installation conference agenda to all attendees 7 days prior to the scheduled date of the conference.

B. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:

1. Contractor's Superintendent.
2. Laboratory responsible for field material testing.
3. Drilling Subcontractor.
4. Ready-Mix Concrete Producer.
5. Geotechnical Engineer.
6. Owner's and Architect's/Engineer's Representative.

C. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by him to all parties concerned within 5 days of the meeting. One copy of the minutes shall be transmitted to the following for information purposes:

1. Owner's Representative.
3. Engineer-of-Record.

D. The Engineer shall be present at the conference. The Contractor shall notify the Engineer at least 7 days prior to the scheduled date of the conference.

1.9 SUBMITTALS

A. Concrete Mix Design: Submit concrete mix designs suitable for method of concrete placement for Engineer and Owner's Testing Laboratory approval prior to pier installation.

B. Drilling Records: The Drilling Contractor and the Owner's Geotechnical Engineer or other authorized inspector shall each submit copies of the drilling record for each pier to the Architect/Engineer immediately after drilling. The reports shall indicate the name of the job, name of Drilling Contractor, and name of drilling superintendent. For each pier installed, the report shall indicate the following information:

1. Pier number and location.
2. Pier shaft diameter.
3. Pier underream diameter.
4. Bottom elevation.
5. Top elevation.
6. Pier length.
9. Reinforcing steel size and depth actually placed.
10. Drilling start and finish time.
11. Concreting start and finish time.
12. Variation from specified tolerances including surveyed location and plumbness.
13. Construction method (dry method, or casing method).
14. Groundwater conditions (rate of water infiltration and depth of water in hole prior to concreting for dry piers; water elevation in hole for wet piers).
15. Elevation of top and bottom of any casing left in place.
16. Description of temporary or permanent casing (including purpose, diameter, wall thickness and length).
17. Description and elevation of any obstructions encountered and whether removal was obtained.
18. Description of pier bottom including amount and extent of loose material.
20. Any difficulties encountered in drilling or concreting operations.
21. Any deviations from specifications.

Reports prepared by the Owner's Geotechnical Engineer or authorized inspector shall be compiled and signed by a licensed professional engineer in the state where the project is located. Reports prepared by the Drilling Contractor shall be compiled and signed by the drilling superintendent.

C. Shop Drawings:
   1. Reinforcing Steel: Submit shop drawings for all drilled pier and pier cap reinforcing steel.
   2. Installation Method: Submit detailed procedures of the installation method, including (where applicable) type and number of drilling rigs and equipment, casing size and length, casing removal method, drilling fluid type, dewatering method, concrete placement, and reinforcing steel securing and placement.

D. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items.

E. Qualification Data:
   1. Submit qualification data for firms and persons specified in the article entitled “Qualifications” to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
   2. Submit Welding Procedure Specifications (WPS) in accordance with ANSI/AWS D1.1 for all welded joints in steel casing. Submit test reports showing successful passage of qualification tests for all non-prequalified WPSs.
   3. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests as specified. If recertification of welders is required, retesting will be at Contractor's responsibility.

F. Alternates: The Drilling Contractor shall submit his bid based on the specifications as written without exceptions. He may submit bids for alternates to the specifications or modifications to the design, load test program, or installation specifications for consideration by the Owner's Representative and the Owner.

G. Post Construction Survey: After completion of pier placement, the Contractor shall provide the Owner’s Representative with an as-built survey showing the actual locations of the piers at the top elevations. This survey shall show the plumbness of vertical piers, and all abandoned piers and their replacements. No construction of superstructures shall commence until this survey has...
been reviewed and accepted by the Owner’s Representative. In order to facilitate the progress of the Work, the Contractor shall submit partial pier surveys for approval as the Work proceeds.

PART 2 - PRODUCTS

2.1 CONCRETE

A. Concrete shall be as specified in the "Cast-in-Place Concrete" section of the specifications, in the general notes, and on the drawings, with the additional requirements specified below:

B. Maximum Aggregate Size: Provide maximum aggregate size of three quarters of minimum clear spacing between individual reinforcing bars or bundles of bars, with 1 1/2" maximum.

C. Water Reducing Admixtures: Where required by mix design, use water-reducing admixtures in strict compliance with manufacturers’ directions. Admixtures to increase cement dispersion, or provide increased workability for low-slump concrete may be used at contractor's option. Use admixtures in the amounts as recommended by manufacturer for climatic conditions prevailing at time of placing concrete. Adjust quantities of admixtures as required to maintain quality control.

D. Slump Limits: Proportion concrete to have a slump that is suitable for the placement process used. The mix must maintain flowability throughout the concrete placement time and during extraction of any temporary casing.

2.2 REINFORCING STEEL

A. See "Concrete Reinforcing Steel" section of the specifications.

B. Reinforcing Support and Positioning Devices: Devices made of non-corrosive material that support and align reinforcing steel within the shaft and that provide the appropriate side and bottom cover to the reinforcing steel. Acceptable manufacturers include:

1. Piersearch.
2. Aztec, a Dayton-Superior Company.
3. Foundation Technologies, Inc.

2.3 STEEL CASING

A. Steel casing shall conform to ASTM A 283, Grade C or ASTM A 36.

2.4 GROUT

A. Grout used for filling annular void outside permanent casings shall be sand cement grout consisting of Portland cement (ASTM C 150 Type I or III), sand (ASTM C 33), and water. Proportions by weight shall be one part cement, 2 1/4 to 2 1/2 parts sand, and the minimum amount of water required to obtain a workable mix but not exceeding a water-cement ratio of.
1.0. The grout mix shall be suitable for the method of installation, whether by gravity feed or by pumping under pressure.

2.5 CONCRETE MIXING

A. Ready Mix Concrete: Comply with the requirements of ASTM C 94.

B. Hot Weather Concreting: The maximum acceptable concrete temperature at the truck discharge point shall be 95°F. Refer to Hot Weather Concreting Practices specified in "Cast-in-Place Concrete" section of the specifications for required hot weather concreting practices.

C. Cold Weather Concreting Practices: Refer to the "Cast-in-Place Concrete" section of the specifications for cold weather concreting practices and the conditions under which they are to be followed.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Requirements:

1. Excavate holes for drilled piers to dimensions and required bearing strata or elevations as shown on the drawings unless directed otherwise in the field by the Owner's Geotechnical Engineer.
2. Maintain sidewall stability during drilling. If sidewall instability is encountered that the Owner's Representative considers excessive, the Contractor shall use alternate drilling methods such as temporary casing.
3. Excavate holes for closely spaced piers and those occurring in fragile or sand stratas only after adjacent holes are filled with concrete and allowed to set a minimum of 6 hours or longer as required for concrete to harden unless temporary casing to maintain sidewall stability is used.
4. Drilled pier design dimensions and depths shown on the drawings shall be considered minimums and are based on bearing and/or friction in assumed strata. If bearing stratum is not capable of maintaining the assumed capacity, the foundation system shall be revised as directed by the Owner's Geotechnical Engineer and Owner's Representative. Revisions will be paid for in accordance with contract conditions relative to changes in the work. Refer to drawings for design bearing pressures, skin friction values, or pier load capacity.
5. Remove loose material and excess free water from the bottom of the shaft. Refer to the “Dewatering” section of the specifications. The bearing surface should be essentially flat within a tolerance of 1 vertical to 12 horizontal or with one step having a vertical height less than one-quarter of the diameter of the bearing area.
6. Where directed by the Geotechnical Engineer, provide a 1.6 inch to 2.5 inch diameter probe hole to a minimum depth below the bottom of the pier equal to the diameter of the bearing area.

B. Equipment:
1. Provide adequate equipment so work is expedited to the fullest extent possible. Use equipment fully capable of excavating shafts to depths, diameters, and sizes indicated, and within the specified tolerances. Maintain equipment in satisfactory operating condition and provide sufficient quantity of equipment to maintain the projected schedule of the Work.

2. Using bits or augers with a power-driven rotary-type rig, a shaft of a diameter specified on the drawings shall be excavated from the ground surface to a depth as specified on the drawings or as ordered by the Owner's Geotechnical Engineer.

C. Obstructions:

1. If rocks, boulders, or other unforeseen obstructions are encountered which cannot be removed by standard drilled pier excavation methods, and if such obstructions are not indicated by available sub-surface data, removal of such obstructions will be paid for in accordance with the terms of the Contract relative to changes in the Work.

2. Remove such obstructions by hand labor using air-powered tools or by other safe methods recognized in the construction industry. Standard drilled pier excavation methods include the use of core barrels with pier drilling equipment.

3. The work of this Section includes demolition and removal of rock, boulders, concrete, masonry, and other subsurface obstructions that are indicated by the Contract Documents, or by the available subsurface exploration data, and such work will not be considered a change in the Work.

D. Overexcavation: No payment will be made for extra length or greater diameter of drilled piers when they are installed to a greater depth or are larger than required unless authorized by the Owner's Geotechnical Engineer. Overexcavated drilled piers will be measured and paid for in accordance with the original or authorized design depth and diameter.

E. Excavated Material:

1. Deposit and spread excavated material on site observing proper placement and compaction requirements.

3.2 REQUIREMENTS FOR UNDERREAMS

A. Bell Configuration: The sides of the underream shall slope not less than 45° with the horizontal. The bell roof slope shall be a straight line or curve upward. The thickness of the bottom edge shall be at least six inches.

B. Underream to Shaft Diameter: The diameter of the underream shall not exceed three times the diameter of the shaft.

3.3 DEWATERING

A. Provide and maintain pumping equipment to keep excavations free of water before placing concrete. An excavation is considered dry if the water rises at a rate of less than 1/4 inch per minute and the height of water at the bottom of the pier does not exceed two inches at the time of concrete placement.
B. Dewater in a manner that will not create subsidence or ground loss that might adversely affect the Work or existing adjacent structures. Should the dewatering system employed involve pumping inside the pier, extreme caution shall be used to prevent an unbalanced water head from causing a "blowout", bottom heave, or "quick" condition that could disturb the proposed bearing stratum or surrounding soil strata.

C. The dewatering method shall be submitted for review and approval of the Owner's Geotechnical Engineer.

D. Conduct water to general site run-off ditches and disposal areas with discharge lines. Provide ditching as required to conduct water to site drainage facilities.

E. If excessive water and/or sidewall instability is encountered and drilling operations must be halted, consult with Geotechnical Engineer and Owner’s Representative before using alternate methods of construction.

3.4 TEMPORARY STEEL CASINGS

A. Requirements:

1. Provide temporary casing at locations where the soil will not stand without support or where sloughing of the sides of shafts may seriously delay or endanger the satisfactory completion of excavation and placement of concrete. Also provide temporary casing at locations as directed by the Geotechnical Engineer to seal off the inflow of water into the excavation. Refer to the geotechnical report for conditions where casing may be required.

2. The Contractor shall have immediately available for use on the job an ample supply of casing for each size that will be required for use in the shafts and shall provide additional amounts, as required, to ensure the orderly progress of the job.

3. Such casing may be in short pieces but with jointing devices of sufficient strength that assembled sections of casing may be pulled complete as concrete is placed, or immediately thereafter. Provide casing of sufficient strength to withstand handling stresses, concrete pressure, and surrounding earth and/or fluid pressures. Make diameter of excavation in relation to diameter of casing such as to create a minimum of void space outside of casing. Provide casing with a minimum outside diameter equal to normal outside diameter of drilled foundations.

B. Delivery, Handling, and Storage of Casing

1. Deliver casing to site in undamaged condition.

2. Handle and protect casing to maintain diameter within plus or minus two percent.

C. Casing Withdrawal: Unless otherwise approved by the Owner’s Representative, all temporary casing shall be removed from shafts as concrete is placed or immediately thereafter, and in such a manner as to prevent sloughing material from dropping to the bottoms of shafts or falling on top of freshly placed concrete. Casings shall be pulled in a single continuous smooth operation without sudden jerks or impact. Maintain head of concrete above the bottom of the casing that exceeds the soil and water pressure at all times during casing withdrawal. Do not vibrate concrete internally before the casing is withdrawn. A vibratory casing extractor may be used.
Do not withdraw casing after the concrete has attained initial set. The casing withdrawal and concreting operations shall be observed by the Geotechnical Engineer.

3.5 REINFORCING STEEL PLACEMENT

A. Before placing, clean reinforcing steel and dowels of loose rust, scale, dirt, grease and other material that could reduce or destroy bond.

B. Fabricate and erect reinforcing cages in shafts as one continuous unit using inner ring reinforcing guide. Place reinforcement accurately and symmetrically about axis of hole and hold securely in position during concrete placement. The Contractor shall verify depths of drilled piers prior to cutting and tying reinforcing steel cages. Reinforcing steel shall be delivered to the site in standard 60-foot lengths and cut as required. Splice no more than 33% of the bars at any one location, alternating spliced and unspliced bars in a symmetrical pattern. Splices shall be 30 bar diameter compression splices for bars #11 and smaller and mechanical end bearing compression splices for #14 and #18 bars unless noted otherwise on the drawings. See drawings for additional splice information. The Contractor shall be responsible for adding additional reinforcing steel ties or spirals as required to ensure stability of cage and maintenance of shape and configuration as required for proper lifting, handling, and placement.

C. Provide cover to reinforcing steel of not less than 3 inches where exposed to soil and not less than 4 inches in temporarily cased piers. Provide spacer devices to maintain side and bottom cover. Devices shall be installed in accordance with manufacturer’s instructions.

D. Permissible reinforcing steel upward vertical movement during casing withdrawal shall be no greater than 6 inches. Downward movement should not exceed 6 inches for every 20 feet of shaft length.

E. Use templates to set anchor bolts, leveling plates and other accessories furnished under work of other sections. A qualified and licensed Engineer/Land Surveyor shall determine the plan location and elevation of such devices. Provide spacers (capable of sliding on any temporary casings required), blocking and holding devices to maintain required position during concrete placement.

F. The General Contractor shall protect exposed ends of dowels and anchor bolts from mechanical damage and exposure to weather by wrapping and taping with polyethylene or other suitable material.

3.6 CONCRETE PLACEMENT

A. General:

1. Fill drilled piers with concrete immediately after inspection and approval by the Geotechnical Engineer or other authorized inspector. Use protection sheets (cut out to receive concrete) over excavation openings, extending at least 12” beyond edge. Complete the excavation and concrete placement in uncased excavations before the end of the workday unless the Architect/Engineer and Geotechnical Engineer grants permission to do otherwise in writing.
2. Place concrete continuously and in a smooth flow without segregating the mixed materials.
3. Place concrete by means of bottom discharge bucket, flexible drop chute, elephant trunk hopper, concrete pump, or tremie. Free fall of concrete may be used if provided for in concrete mix design and provided it is directed through a hopper or chute such that fall is down center of shaft without hitting sides or reinforcing steel. Free fall of concrete is not permitted for depths greater than the smaller of 20 times the shaft diameter or 60 feet.
4. Place concrete in-the-dry if at all possible. If water occurs, and it is impracticable to dewater drilled pier excavation, and reasonable attempts to seal off water flow have failed, allow water level to attain its normal level and place concrete by tremie method or by concrete pumping. Other methods of depositing concrete underwater may only be used if approved by Architect/Engineer.
5. Stop concrete placement at cut-off elevation shown, screed level, and apply a scoured, rough finish. Where cut-off elevation is above ground elevation, form top section above grade and extend shaft to required elevation.
6. Provide mechanical vibration for consolidation of at least top 5' of each shaft but only after any temporary casing is pulled or when casing is permanent.
7. Interrupted placing operations of over one hour duration will require a cold joint installation as follows. Leave resulting shaft surface approximately level. At resumption of concrete placing, clean off surface laitance, roughen as required, and slush with a 1-to-1 cement grout or commercial bonding agent before remainder of concrete is placed. Intentional cold joints will not be permitted.
8. Concrete shall not be placed in adjacent drilled piers located within three center-to-center shaft diameters of each other until concrete has cured a minimum of 6 hours.
9. Aluminum pipe or equipment shall not be used for placing concrete.

B. Tremie Method:

1. The drilled shafts shall be filled with concrete by the use of a tremie or concrete pump, sealed at the bottom, extending from above the ground surface to the bottom of the drilled shaft. Inspection of the empty tremie on the bottom may be requested of the Contractor by the Owner's authorized inspector. With the sealed tremie on the bottom of the shaft, the tube shall be filled to the top extending above the ground. The filled tremie shall be picked up approximately one (1) foot off the bottom of the shaft to allow the weight of the concrete to displace the seal at the bottom of the tremie. At no time is the tremie to be pulled to such a height as to clear the surface of the concrete already placed in the shaft. All concrete shall be poured through the now open tremie with care taken to maintain a sufficient head of concrete to completely displace all water and suspended cuttings of material and to provide sufficient pressure so as to prevent reduction in pile diameter by earth pressure on the fresh concrete. The concrete in each pile shall be carried above cut-off elevation and then dipped out while fresh to cut-off elevation.
2. All concrete shall be deposited through the tremie or pump line so as to provide a continuous flow, without aggregate segregation, from bottom to top of pile. The production and delivery of the ready-mixed concrete shall be such that not more than 45 minutes shall elapse between the depositing of successive batches of concrete to ensure a monolithic unit of concrete. No deviation from this method will be acceptable.
3. Should the surface of the concrete in the shaft be breached by the tremie or pump line, the tube shall immediately be withdrawn from the hole, re-sealed and re-lowered below the surface of the concrete, and pouring operations re-started. Should the Owner's authorized inspector deem it necessary, the Contractor shall instead retrieve the reinforcing steel...
cage, redrill the shaft to reopen the hole, and begin the concreting operations from the bottom of the pier shaft.

4. If the Owner's authorized inspector has reason to suspect that the concrete was breached by the tremie or pump line or that the pier, for any other reason, may contain extraneous material or otherwise fail the specifications, he may order the pier cored for inspection and/or testing. If the core recovery and/or test results indicate non-compliance with the specifications, the Contractor shall bear the expense of the investigation and/or testing and shall also, at no cost to the Owner, install proper additional construction as required by the Architect/Engineer. Should the investigation and/or testing indicate compliance with the specifications the Owner shall bear the cost of such investigation and/or testing.

C. Hot and Cold Weather Placement: Refer to Part II.

3.7 CONSTRUCTION TOLERANCES

A. Plan Location: The tolerance on plan location for the top of the drilled pier shall not be more than 1/24 of the pier diameter or 3” in any direction, whichever is less. If the as-installed shaft is larger than required, the center of the shaft may be taken as the center of a shaft having the required area that lies wholly within the as-installed shaft.

B. Plumbness: Permissible tolerance for plumbness shall be 1.5% of the length. The centers of the top and bottom may be taken as the center of the required area that lies wholly within the as-installed area.

C. Bottom Area: The bottom of the pier shall be essentially horizontal within a tolerance of 1 vertical to 12 horizontal with the area of the bottom bearing not less than 98% of that specified on the drawings.

D. Top Area: The Contractor shall remove excess concrete at the top of the pier beyond the limits of the pier diameter. The pier top diameter shall be the same diameter as the shaft below. Piers extending above the ground surface shall be formed.

E. Concrete Cut-Off Elevation: Concrete cut-off elevation at the pier top shall be plus one inch to minus three inches.

F. Battered Piers: Battered piers shall be installed within 5% of the length from the specified inclination.

G. Anchorage Embedment Tolerance: Vertical and horizontal deviation from design location for individual anchorage components embedded in the pier shall not exceed ± 0.5 inches.

H. If any of the above tolerances are exceeded, the Architect/Engineer shall immediately be notified to evaluate the eccentricity in the pier and recommend corrective measures. The cost of re-engineering and corrective construction shall be borne by the Contractor.

3.8 INSPECTIONS AND TESTS FOR DRILLED PIER EXCAVATIONS

A. Verification of Design: Bottom elevations, bearing and/or skin friction capacities and lengths of drilled piers as shown on the drawings are estimated from available subsurface data. Actual
elevations, pier lengths, and bearing and/or skin friction capacities will be determined by the Geotechnical Engineer from conditions found in the excavations.

B. Notification of Architect/Engineer: If field conditions differ from the data and design recommendations outlined in the Geotechnical Report, the Geotechnical Engineer shall notify the Architect/Engineer immediately.

C. Additional Tests: Additional tests may be required by the Geotechnical Engineer to determine new design criteria. Such tests shall be made as quickly as possible so as not to delay the concreting operations any longer than absolutely required.

D. Inspection Requirements: Each drilled pier shall be inspected by the authorized inspector and approved prior to placement of concrete.

E. Cooperation with Testing and Inspection Personnel: The Contractor shall provide facilities as required to assist in the inspection and testing of the excavations, and cooperate with the inspecting and testing personnel to expedite the work.

F. Notification of Inspector: The Contractor shall notify the authorized inspector at least six hours prior to the time the excavation will be ready for inspection.

G. Personnel Safety: The Contractor shall provide gas testing equipment, protective cage, or temporary casing of proper diameter, length, and thickness, and all other safety equipment required by law for inspection and testing of drilled piers and to protect workmen and inspectors during hand belling or other operations necessitating entry into shaft.

3.9 APPROVAL BY THE GEOTECHNICAL ENGINEER

A. Approval by the Owner's Geotechnical Engineer is required on all pier installation criteria and his decision and judgment on pier length, rejection of piers, additional piers required, and all other pier installation and capacity questions shall be final.

3.10 CONTRACT BASIS

A. Basis of Bids: Bids shall be based on number of drilled piers, design length from top elevation to bottom of shaft (extended through the bell, if applicable), and diameter of shaft and bell, as shown on drawings. The bid price shall include cost for temporary casing of excavation that may be required.

B. Basis for Payment: Payment for drilled piers will be made on actual net volume of drilled piers in place and accepted. The actual length and shaft diameter, and bell diameter (if applicable) may vary to coincide with elevation where satisfactory bearing stratum is encountered, and with actual bearing value of bearing strata determined by testing services, and with stability and characteristics of soil strata. Adjustments will be made on net variation of total quantities, based on design dimensions for shafts and bells.

1. There will be no additional compensation for excavation, concrete fill, reinforcing, casings, or other costs due to unauthorized overexcavating shafts. Overexcavated piers
will be measured and paid for in accordance with required design or authorized depth. No payment will be made for rejected drilled piers.

2. Prices quoted shall include full compensation for labor, temporary casing, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete, and other items for complete installation.

C. Unit Prices: Unit prices for the following items, as set forth in contract conditions, will apply in event additions to or deductions from work are required and authorized by written order from Architect/Engineer to Contractor.

1. Soil excavation (including temporary casing if required): per cu. yd.
2. Rock excavation: per cu. yd.
3. Reinforcing steel and dowels, installed: per lb.
4. Concrete: per cu. yd.

END OF SECTION 316324
SECTION 32 14 13 - CONCRETE PAVERS

PART 1 - GENERAL

1.01 SUMMARY
   A. Section Includes
      1. Concrete pavers and joint sand.
      2. Bitumen setting bed.
      3. Asphalt tack coat

1.02 REFERENCES
   A. American Society for Testing and Materials (ASTM)
      1. C 33, Specification for Concrete Aggregates.
      3. C 140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
      9. C 1645, Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.

   B. Interlocking Concrete Pavement Institute (ICPI):
      1. ICPI Tech Spec Technical Bulletins

1.04 SUBMITTALS
   A. In accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
   B. Manufacturer’s drawings and details: Indicate perimeter conditions, relationship to adjoining materials and assemblies, expansion and control joints, concrete paver layout, patterns, color arrangement, installation and setting details.
   C. Neoprene modified asphalt adhesive product catalog sheets with specifications.
   D. Bituminous setting bed: asphalt cement mix design to be used in the bituminous setting bed conforming to ASTM D 3381.
   E. Sieve analysis per C 136 for sand mixed with bitumen and sand for joints between concrete pavers.
   F. Concrete pavers:
      1. Four representative full-size samples of each paver type, thickness, color, finish that indicate the range of color variation and texture expected in the finished installation as shown per plan. Color(s) to be selected by Owner from manufacturer’s available colors.
      2. Accepted samples become the standard of acceptance for the work.
      3. Test results from an independent testing laboratory for compliance of concrete pavers with ASTM C 936.
      4. Manufacturer’s catalog product data, installation instructions, and material
safety data sheets for the safe handling of the specified materials and products.

G. Paver Installation Subcontractor:
1. A copy of Subcontractor’s current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.
2. Job references from projects of a similar size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.

1.04 QUALITY ASSURANCE
A. Paving Subcontractor Qualifications:
1. Utilize an installer having successfully completed concrete paver installation similar in design, material, and extent indicated on this project.
2. Utilize an installer holding a current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.
B. Regulatory Requirements and Approvals: [Specify applicable licensing, bonding or other requirements of regulatory agencies.]
C. Mock-Ups:
1. Install a 7 ft x 7 ft (2 x 2 m) paver area.
2. Use this area to determine surcharge of the bitumen-sand layer and adhesive, joint sizes, lines, laying pattern(s), color(s) and texture of the job.
3. This area will be used as the standard by which the work will be judged.
4. Subject to acceptance by owner, mock-up may be retained as part of finished work.
5. If mock-up is not retained, remove and properly dispose of mock-up.

1.05 DELIVERY, STORAGE & HANDLING
A. General: Comply with Division 1 Product Requirement Section.
B. 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 packaging with identification labels intact.
1. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
2. Deliver concrete pavers to the site in steel banded, plastic banded or plastic wrapped packaging capable of transfer by forklift or clamp lift.
3. Unload pavers at job site in such a manner that no damage occurs to the product.
D. Storage and Protection: Store materials protected such that they are kept free from mud, dirt, and other foreign materials. Store concrete paver cleaners and sealers per manufacturer’s instructions.
1. Cover joint sand with waterproof covering if needed to prevent exposure to rainfall or removal by wind. Secure the covering in place.

1.06 PROJECT/SITE CONDITIONS
A. Environmental Requirements:
1. Do not install bitumen setting bed or pavers during heavy rain or snowfall.
2. Do not install bitumen setting bed and pavers over frozen base materials.
3. Do not install frozen bitumen setting bed materials.
4. Do not install concrete pavers on frozen bitumen setting bed materials.

1.07 MAINTENANCE
A. Extra Materials: Provide [Specify area.] [Specify percentage.] additional material for use by owner for maintenance and repair.
B. Pavers shall be from the same production run as installed materials.

PART 2 PRODUCTS

2.01 INTERLOCKING CONCRETE PAVERS
A. Manufacturer: Specify Keystone Hardscapes (800-747-8971
https://www.keystonehardscapes.com/contact) or approved equal.
1. Contact: Dave Hasness, PE
Region Engineer
Keystone Hardscapes
512-787-1247
dhasness@keystonehardscapes.com

B. Interlocking Concrete Paver Units, including the following:
1. Paver Type: [Specify name of product group, family, series, etc.].
   a. Size and color per plan
   c. Size: 60mm thick.
   d. Average Compressive Strength (ASTM C 140): 8000 psi (55 MPa) with no individual unit under 7200 psi (50 MPa).
   e. Average Water Absorption (ASTM C 140): 5% with no unit greater than 7%.
   f. Freeze/Thaw Resistance (ASTM C 1645): 28 freeze-thaw cycles with no greater loss than 225 g/m² of paver surface area or no greater loss than 500 g/m² of paver surface area after 49 freeze-thaw cycles. Freeze-thaw testing requirements shall be waived for applications not exposed to freezing conditions.

2.02 PRODUCT SUBSTITUTIONS
Product substitutions shall be submitted and approved in writing per bid instructions.

2.03 BITUMEN SETTING BED MATERIALS
A. Primer for base: Anionic asphalt emulsion SS-1h, per ASTM D 977.
B. Sand for asphalt bed
   1. Clean, non-plastic, free from deleterious or foreign matter, symmetrically shaped, natural or manufactured from crushed rock.
   2. Do not use limestone screenings, stone dust, or sand in the bedding material that does not conform to the grading requirements.
   3. Graded according to ASTM C 136.
   4. Bedding Sand Material Requirements: Conform to the grading requirements of ASTM C 33 with modifications as shown in Table 1.
Table 1
Grading Requirements for Bedding Sand
ASTM C 33

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4 (4.75 mm)</td>
<td>100</td>
</tr>
<tr>
<td>No. 8 (2.36 mm)</td>
<td>85 to 100</td>
</tr>
<tr>
<td>No. 16 (1.18 mm)</td>
<td>50 to 85</td>
</tr>
<tr>
<td>No. 30 (0.600 mm)</td>
<td>25 to 60</td>
</tr>
<tr>
<td>No. 50 (0.300 mm)</td>
<td>10 to 30</td>
</tr>
<tr>
<td>No. 100 (0.150 mm)</td>
<td>2 to 10</td>
</tr>
<tr>
<td>No. 200 (0.075 mm)</td>
<td>0 to 5</td>
</tr>
</tbody>
</table>

C. Asphalt cement: Meet ASTM D3381, viscosity grade AC-20; heated to 300°F (150°C), 7% asphalt mixed with 93% sand in batches 145 lbs. (66 kg) asphalt to 1,855 lbs. (840 kg) sand. Exact proportions to be determined by the Contractor.

D. Neoprene modified asphalt adhesive: Karnak 237 2% AF Neo-asphalt.

2.04 JOINT MATERIALS
A. Joint sand: grading for conforming to ASTM C 144.
B. Sealant and backer materials: see Section 07920 – Joint Sealants.

PART 3 – EXECUTION

3.01 EXAMINATION
A. Acceptance of Site Verification of Conditions:
   1. General Contractor shall inspect, accept and certify in writing to the paver installation subcontractor that site conditions meet specifications for the following items prior to installation of interlocking concrete pavers:
      a. Verify that concrete base materials, thickness, surface tolerances and elevations conform to specified requirements.
      b. Verify location of [2 in. (50 mm) diameter] weep holes [at 20 ft (7 m)] centers [at lowest elevations] against curbs, walls, or other permanent structures [as indicated on the drawings]. Verify holes filled with washed pea gravel. Provide temporary plugs for holes to prevent ingress of sand-asphalt setting bed or neoprene adhesive during construction. Remove plugs when paving adjacent to drain holes.
      c. Verify that concrete surfaces to receive the bitumen bedding material are free of dust, oil, grease, paint, wax, curing compounds, primer, sealers, form release agents, from cracks over 3/16 in. (5 mm) in width, or any deleterious substances and debris which may prevent or reduce bonding.
      d. Conduct moisture tests to verify that concrete surfaces are cured, free from hydrostatic pressure and having a moisture content of less than 5%.
      e. Verify location, type, and elevations of edge restraints, [concrete collars around] utility structures, and drainage inlets.
      f. Do not proceed with installation of bedding sand and interlocking concrete pavers.
pavers until base conditions are corrected by the General Contractor or designated subcontractor.

3.02 PREPARATION
A. Verify base is dry, certified by General Contractor as meeting material, installation and grade specifications.
B. Verify that base is clean, dry, and ready to accept tack coat, bitumen setting bed, pavers, and imposed loads.

3.03 INSTALLATION
A. Concrete base preparation
   1. Fill any cracks under 3/16 in. (5 mm) wide with mortar.
   2. Sweep the surface clean.
B. Bituminous setting bed
   1. Place in panels between ¾ in. (20 mm) high screed rails spaced approximately 12 ft (4 m). Rake and screed smooth with strike board.
   2. Use screed rails to achieve a level setting bed conforming to elevations and slope shown on the drawings. After one panel is complete, advance screed rails to the next position in readiness for screeding adjacent panels with strike board. Fill depressions left from removed screed rails and smooth to height consistent with panel.
   3. Place an area in size that will remain at least 270° F (130° C) during compaction.
   4. Compact the setting bed with a powered roller compactor to an even, nominal thickness of ¾ in. (20 mm) after compaction.
   5. Re-heat, fill, and compact low areas with setting bed materials to conform to slope and elevation shown on the drawings.
   6. Re-heat, remove, level, and compact setting bed in high areas to conform to slope and elevation shown on the drawings.
   7. Irregularities or evenness in the grade of the concrete base surface may be corrected with setting bed materials only with approval by the [Architect].
C. Neoprene modified asphalt adhesive
   1. Apply to cold asphalt setting bed with a squeegee in a thickness not exceeding 1/16 in. (2 mm). Do not apply pavers to adhesive until dry skin forms on surface of adhesive.
D. Concrete pavers
   1. Free from dust, dirt, and stains. Do not use soiled, cracked, or broken units.
   2. Place paving units firmly onto adhesive with joints not to exceed 1/8 in. (3 mm), or as recommended in manufacturer’s literature. Maintain straight pattern lines, joint lines and coursing per the drawings.
   3. Cut pavers to fit edges with a masonry saw. No cut paver shall be smaller than 1/3 of a whole unit if exposed to vehicular traffic. Firmly place all edge units on adhesive.
E. Joint filler and sealant
   1. Extend control and structural joints through full depth of paving units. Do not extend joints through bituminous bedding materials from joints in concrete base that control shrinkage cracking.
   2. Install joints at all building facades or other vertical surfaces.
   3. Install pre-molded joint filler as units are set in bituminous bed. Maintain top of filler 3/8 in. (10 mm) below exposed faces of paving units for insertion of sealant.
   4. Install joint sealant per manufacturer’s recommendations.
F. Joint sand
   1. After the pavers, joint filler, and sealant are installed, spread dry joint sand and fill joints between the slabs.
2. Sweep surface clean.

3.04 FIELD QUALITY CONTROL

A. The final surface tolerance from grade elevations shall not deviate more than ±3/8 in. (±10 mm) under a 10 ft (3 m) straightedge.
B. Check final surface elevations for conformance to drawings.
C. The surface elevation of pavers shall be 1/8 in. to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.
D. Lippage: No greater than 1/8 in. (3 mm) difference in height between adjacent pavers.

3.05 [CLEANING] [SEALING] [JOINT SAND STABILIZATION]

A. [Clean] [Seal] [Apply joint sand stabilization materials between] concrete pavers in accordance with the manufacturer’s written recommendations.

3.06 PROTECTION

A. After work in this section is complete, the General Contractor shall be responsible for protecting work from damage due to subsequent construction activity on the site.

END OF SECTION 32 14 13
SECTION 32 20 00 – CONCRETE FENCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Perimeter concrete fence wall and associated columns

1.2 REFERENCES

A. Precast concrete shall have a minimum compression strength of 5,000 psi @ 28 days.
B. Fiberglas and steel reinforced components. All reinforcing steel shall conform to ASTM – A615, Grade 60. All ties and stirrups shall conform to the requirements of ASTM -A 615, Grade 40.

1.3 SUBMITTALS

A. Submit to Owner’s representative for review prior to purchase and install, including footing recommendation by manufacturer.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Concrete Fence Wall System: SUPERIOR-LEDGESTONE™ as manufactured by Superior Concrete Products (817.277.2955; https://concretefence.com/) or approved Equal.

B. Height: 7’-6”
C. Panels, posts and caps to have same texture on both sides
D. Reinforced with wire-mesh
E. Includes decorative textured panel caps and post caps.
F. Posts are set five feet apart (maximum)
G. Posts shall have a typical cross sectional dimension of 5” as measured from face-to-face.
H. Panels shall have typical dimensions of 56 3/4” long by 12” high by 1” minimum thickness and 1 5/8” maximum thickness.
I. Panels shall be horizontal.
J. Columns (SUPERIOR STONE COLUMNS™) to be placed at terminus of wall section and at even spacing not to exceed 45’ on center; height 8’-0”
K. Color: Integral throughout fencing system; “White”

PART 3 - EXECUTION

3.1 PER MANUFACTURER’S RECOMMENDATION

END OF SECTION 32 20 00
SECTION 32 20 01 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fence and gate framework, PVC coated fabric, fence line and terminal posts, and accessories.

B. Excavation for post bases; concrete foundation for posts, and center drop for gates.

C. Manual gates and related hardware.

1.2 RELATED SECTIONS

A. Section 16010 - Electrical Systems: Site Grounding Systems.

1.3 REFERENCES

A. ASTM A116 - Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric.


C. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

D. ASTM A392 - Zinc-Coated Steel Chain-Link Fence Fabric.

E. ASTM A428 - Weight of Coating on Aluminum-Coated Iron or Steel Articles.

F. ASTM A446 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.

G. ASTM A569 - Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip Commercial Quality.

H. ASTM C94 - Ready-mixed Concrete.

I. ASTM F567 - Installation of Chain-Link Fence.

J. ASTM F668 - Poly (Vinyl Chloride) (PVC) Coated Steel Chain Link Fence Fabric.

K. ASTM F669 - Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence.

L. ASTM F1083 - Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
M. ASTM F1234 - Protective Coatings on Steel Framework for Fences.

N. Chain Link Fence Manufacturers Institute (CLFMI) - Product Manual.

1.4 SUBMITTALS FOR REVIEW

A. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.

C. Samples: Submit two samples of fence fabric, 30 x 30 inch in size illustrating construction and colored finish.

1.5 QUALITY ASSURANCE

A. Material standards: Comply with Chain Link Fence Manufacturers Institute Galvanized Steel Chain Link Fence Fabric and Industrial Steel Specifications for Fence Posts, Gates and Accessories.

1.6 QUALIFICATIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. Materials and Components: Conform to CLFMI Product Manual.


C. Intermediate Posts: Type II round.

D. Terminal, Corner, Rail, Brace, and Gate Posts: Type II round.

2.2 MATERIALS

A. General:
   1. Pipe sizes indicated are commercial pipe sizes.
   2. Tube sizes indicated are nominal flange dimensions.
   3. Roll form section sizes are nominal outside dimensions.
   4. Open seam material not allowed.
5. Hot dip galvanizing for iron or steel components:
   a. On pipe: Comply with ASTM-A53, 1.8 OZ/SF, minimum.
   b. On square tubing: Comply with ASTM-A123, 2 OZ/SF.
   c. On roll formed sections: Comply with ASTM-A53, minimum 1.8 OZ/SF.
   d. On hardware and accessories: Comply with ASTM-A153, minimum 1.4 OZ/SF.
   e. On fabric: Comply with ASTM-A392, Class 2, 2 OZ/SF, and withstand test of coating, as specified.
   f. On barbed wire: Comply with ASTM-A585, Type I.
   g. On miscellaneous items: Comply with ASTM-A53, minimum 1.8 OZ/SF.

B. Chain Link Fabric:
   1. Woven 2 IN mesh of 9 GA wire for perimeter fencing; see plan callout and details for backstop material.
   2. Steel wire: minimum tensile strength after coating: 70,000 PSI.
   3. Twisted and barbed at top selvages.

C. Line Posts:
   1. 2 IN steel pipe, 1-7/8 O.D.
   2. Of sufficient length to permit minimum 24 IN to be set in concrete footing.

D. Top, Mid and Bottom Rails:
   1. 1-1/4 in steel pipe, 2.27 LB/LF.
   2. Provide expansion couplings of outside sleeve type which provide rigid attachment and allow for anticipated movement.
   3. Interrupt rails only at posts.
   4. Provide top and bottom rails only at 42 IN site fence.

E. Terminal and Corner Posts (Non-backstop related):
   1. 2-7/8 IN steel pipe.
   2. Including end and pull posts.
   3. Gate posts: 4 IN steel pipe.
   4. Of sufficient length to permit minimum 36 IN to be set in concrete footing.
   5. Gate post strength to support gate without sagging in open or closed position.

F. Terminal and Corner Posts (For Backstops Only)
   1. 3-1/2 IN steel pipe, 9.10 LB/LF
   2. Including end and pull posts.
   3. Gate posts: 6 IN steel pipe
   4. Of sufficient length to permit 48 IN to be set in concrete footing.
   5. Gate post strength to support gate without sagging in open or closed position.

G. Top Marcelled Tension Wire:
   1. 7 GA, comply with ASTM A-824.
H. Bracing:
   1. Compression and tension members.
   2. Compression: 1-1/4 IN steel pipe, 2.27 LB/LF.
   3. Tension: 3/8 IN diameter steel truss rod with turnbuckles.

I. Tension Bars:
   1. Minimum 3/16 x 3/4 IN, steel.
   2. One piece for full height of fabric.

J. Metal Bands:
   1. Minimum 0.115 x 7/8 IN wide steel.

K. Gates:
   1. Minimum 1-1/2 IN steel pipe, 2.72 LB/LF, weld corners.
   2. Fasten fabric with adjustable hook bolts on every side.
   3. Provide tension rods.
   4. Fabricate with padlock hasp for Agency furnished padlock for swinging gates.
   5. Provide 3 strands of barbed wire fastened to extended verticals of gate frame.

L. Concrete and Reinforcing: See Division 3.

M. Tie Wire:
   1. 9 GA galvanized steel tie wires.

2.3 ACCESSORIES

A. Caps: Aluminum alloy, sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

C. Gate Hardware: Fork latch with gravity drop; two 180 degree gate hinges per leaf and hardware for padlock.

2.4 FINISHES

A. Components: Galvanized to ASTM A123; 2.0 oz/sq ft (600 g/sq m) coating.

B. Fabric: Galvanized to ASTM A123; 2.0 oz/sq ft (600 g/sq m) coating.

C. Vinyl Components: Not Applicable.

D. Hardware: Galvanized to ASTM A153, 2.0 oz/sq ft (600 g/sq m) coating.

E. Accessories: Same finish as fabric.
PART 3 - EXECUTION

3.1 INSPECTION

A. Verify suitability of areas to accept installation.
B. Correct unsatisfactory existing conditions.
C. Installation constitutes acceptance of responsibility for performance.
D. Install framework, fabric, accessories and gates in accordance with ASTM F567.
E. Place fabric on outside of posts and rails.
F. Set line terminal and gate posts plumb, in concrete footings with top of footing 2 inches (50 mm) above finish grade. Slope top of concrete for water runoff.

G. Line Post Footing Depth Below Finish Grade: two (2) feet.

H. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: three (3) feet.

I. Brace each gate and corner post to adjacent line post with horizontal center brace rail. Install brace rail one bay from end and gate posts.

J. Provide top rail through line post tops and splice with 6 inch (150 mm) long rail sleeves.

K. Install center and bottom brace rail on corner gate leaves.

L. Do not stretch fabric until concrete foundation has cured 28 days.

M. Stretch fabric between terminal posts or at intervals of 100 feet (30 m) maximum, whichever is less.

N. Position bottom of fabric 1 inch (25 mm) above finished grade.

O. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches (380 mm) on centers.

P. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

Q. Install bottom tension wire stretched taut between terminal posts.

R. Do not attach the hinged side of gate from building wall; provide gate posts.

S. Install gate with fabric to match fence. Install three hinges per leaf, latch, catches, drop bolt retainer and locking clamp.

T. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

3.2 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm).

B. Maximum Offset From True Position: 1 inch (25 mm).

C. Components shall not infringe adjacent property lines.

END OF SECTION 32 20 10
SECTION 32 31 00  Steel Roll Gate System

PART 1 – GENERAL

1.01 WORK INCLUDED
The contractor shall provide all labor, materials and appurtenances necessary for installation of the steel roll gate system defined herein at (specify project site).

1.02 RELATED WORK
Division 31 - Earthwork
Division 03  - Concrete

1.03 SYSTEM DESCRIPTION
The manufacturer shall supply a total roll gate system of Ameristar® PassPort® Commercial Ornamental design series and Majestic style. The system shall include all components (i.e., pickets, rails, gate uprights, wheels and hardware) required.

1.04 QUALITY ASSURANCE
The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.05 REFERENCES
 ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
 ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
 ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
 ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
 ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.

1.06 SUBMITTAL
The manufacturer’s submittal package shall be provided prior to installation.

1.07 PRODUCT HANDLING AND STORAGE
Upon receipt at the job site, all materials shall be checked to ensure that no damages occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage and to protect against damage, weather, vandalism and theft.
2.01 MANUFACTURER
The steel roll gate system shall conform to Ameristar PassPort Commercial Ornamental design series, Majestic style and 3-rail frame configuration manufactured by Ameristar Fence Products, Inc. in Tulsa, Oklahoma. Substitute manufacturers are acceptable if they meet specifications.

2.02 MATERIAL
A. Steel material for roll gate components (i.e. pickets, rails, diagonals and uprights), shall be commercial steel with a minimum yield strength of 45,000 psi (344 MPa).

B. Ornamental picket material shall be 3/4” square x 14 Ga. Tubing. Picket spacing shall be 2-3/4” on center. Material for toprails, uprights and diagonals rails shall be 2” square x 12 Ga. Material for the bottom rail shall be 2” x 4” x 11 Ga. Posts shall be a minimum of 4” square x 11 Ga.

2.03 FABRICATION
A. Pickets, rails, uprights and posts shall be precut to specified lengths. Diagonals shall be precut to specified lengths and angles. Frame materials shall be joined by welding. Pickets shall be face welded to roll gate frame, except for Invincible gates over 18’ long. Invincible style gates over 18’ long shall have pickets face-welded to 2” x 2” angle iron to form panels equal in length to the gate frame bay width.

B. The manufactured roll gates and bolt-on panels (if applicable) shall be subjected to the PermaCoat® thermal stratification coating process (high-temperature, in-line, multi-stage, multi-layer) including, as a minimum, a six-stage pre-treatment/wash (with zinc phosphate), an electrostatic spray application of an epoxy base, and a separate electrostatic spray application of a polyester finish. The base coat shall be a thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2 mils (0.0508mm). The topcoat shall be a “no-mar” TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be Black. The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 1.

C. Completed gates shall be capable of supporting a 200 lb. load applied at midspan without permanent deformation.

PART 3 – EXECUTION

3.01 PREPARATION
All new installation shall be laid out by the contractor in accordance with the construction plans.

3.02 INSTALLATION
Gateposts shall be set in accordance with the spacing’s shown in the construction plans. The “Earthwork” and “Concrete” sections of this specification shall govern post base material requirements. 6” wheels shall be bolted to the gate (between the wheel plates welded near the ends of the gate bottom rail). The gate shall be set upright with the V-grooved wheels positioned over the pre-installed steel V-track that
traverses the gate opening. Roller guides shall be affixed to the gateposts at a height even with the gate toprail to hold the gate in a vertical position. Gate stops shall be welded to the end of the gate or track so gate cannot pass rollers in either direction.

3.03 CLEANING
The contractor shall clean the jobsite of excess materials; post hole excavations shall be scattered uniformly away from posts.

<table>
<thead>
<tr>
<th>Quality Characteristics</th>
<th>ASTM Test Method</th>
<th>Performance Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhesion</td>
<td>D3359 – Method B</td>
<td>Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).</td>
</tr>
<tr>
<td>Corrosion Resistance</td>
<td>B117, D714 &amp; D1654</td>
<td>Corrosion Resistance over 1,000 hours (Scribed per D1654; failure mode is accumulation of 1/8” coating loss from scribe or medium #8 blisters).</td>
</tr>
<tr>
<td>Impact Resistance</td>
<td>D2794</td>
<td>Impact Resistance over 60 inch lb. (Forward impact using 0.625” ball).</td>
</tr>
<tr>
<td>Weathering Resistance</td>
<td>D822, D2244, D523 (60° Method)</td>
<td>Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).</td>
</tr>
</tbody>
</table>
SECTION 32 84 23 - IRRIGATION

PART I - GENERAL

1.01 SCOPE

A. Provide complete sprinkler installation as detailed and specified herein. Includes furnishing all labor, materials, and equipment for the proper installation. Work includes but is not limited to:

1. Trenching and backfill
2. Automatic controlled system.
3. Upon completion of installation, supply as-built drawings showing details of construction including location of mainline piping, manual and automatic valves, electrical supply to valves, and specifically exact location of automatic valves.

B. NOTE: All sleeves as shown on plans will be furnished by General Contractor. Water Meter and electrical power source to be provided by General Contractor.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. See Irrigation Plans. See plans for controller, heads, and valves.

1.03 APPLICABLE STANDARDS

B. D2464 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings Threaded, Schedule 40
C. D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings Socket Type, Schedule 40
D. D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings
E. Standard recommended practice for:

1.04 MAINTENANCE AND GUARANTEE

A. Materials and workmanship shall be fully guaranteed for one (1) year after final acceptance.

B. Provide maintenance of system, including raising and lowering of heads to compensate for lawn growth, cleaning and adjustment of heads, raising and lowering of shrub heads to compensate for shrub growth, for one (1)
year after completion of installation.

C. Guarantee is limited to repair and replacement of defective materials or workmanship, including repair of backfill settlement.

1.05 SUBMITTALS

A. Use of materials differing in quality, size, or performance from those specified will only be allowed upon written approval of Owner/Landscape Architect. The decision will be based on comparative ability of material or article to perform fully all purposes of mechanics and general design considered to be possessed by item specified. Bidders desiring to make a substitution for specified sprinklers shall submit manufacturer's catalog sheet showing full specification of each type sprinkler proposed as a substitute, including discharge in GPM maximum allowable operating pressure at sprinkler. Approval of substitute sprinkler shall not relieve Contractor of his responsibility to demonstrate that final installed sprinkler system will operate according to intent of originally designed and specified system.

B. It is the responsibility of the Irrigation Contractor to demonstrate that final installed sprinkler system will operate according to intent of originally designed and specified system. If Irrigation Contractor notes any problems in head spacing or potential coverage, it is his responsibility to notify the Landscape Architect in writing, before proceeding with work. Irrigation Contractor guarantees 100% coverage of all areas to be irrigated.

1.06 TESTING

A. Perform testing required with other trades, including earthwork, paving, and plumbing, to avoid unnecessary cutting, patching and boring.

1.07 COORDINATION

A. Coordinate installation with other trades, including earthwork, paving, and plumbing, to avoid unnecessary cutting, patching and boring.

PART 2 - PRODUCTS

2.01 GENERAL

A. Sprinkler mains: Sprinkler mains are that portion of piping from water source to operating valves. This portion of piping is subject to surges, being a closed portion of sprinkler system. Hydrant lines are considered a part of sprinkler main.

B. Lateral Piping: Lateral piping is that portion of piping from operating valve to sprinkler heads. This portion of piping is not subject to surges, being an "open end" portion of sprinkler system.

2.02 POLY VINYL CHLORIDE PIPE (PVC PIPE)
A. PVC pipe shall be manufactured in accordance with commercial standards noted herein.

B. Marking and Identification: PVC pipe shall be continuously and permanently marked with the following information: manufacturer's name, pipe size, type of pipe, and material, SDR number, product standard number, and the NSF (National Sanitation Foundation) seal.

C. PVC Pipe Fittings: Shall be of the same material as the PVC pipe specified and shall be compatible with PVC pipe furnished.

2.03 COPPER TUBING

A. Hard, straight lengths of domestic manufacture only. No copper tube of foreign extrusion or any so called irrigation tubing (thin wall) shall be used.

2.04 COPPER TUBE FITTINGS

A. Cast brass or wrought copper, sweat-solder type.

2.05 WIRE

A. Type UF with 4-64" insulation which is Underwriter's Laboratory approved for direct underground burial when used in a National Electric Code Class 11 Circuit (30 volts AC or less).

2.06 SCHEDULE 80 PVC NIPPLES

A. Composed of Standard Schedule 40 PVC Fittings and PVC meeting noted standards. No clamps or wires may be used.

2.07 MATERIALS - See Irrigation Plan

A. Sprinkler heads in lawn area as specified on plan.

B. PVC Pipe: Class 200, SPR 21
   Copper Tubing (City Connection): Type "K", 24V Wire: Size 14, Type U.F.

C. Electric valves to be all plastic construction as indicated on plans.

D. Refer to drawing for backflow prevention requirements and flow valve.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

A. Staking: Before installation is started, place a stake where each sprinkler is to be located, in accordance with drawing. Staking shall be approved by Landscape Architect before proceeding.
B. Excavations: Excavations are unclassified and include earth, loose rock, rock or any combination thereof in wet or dry state. Backfill trenches with material that is suitable for compaction and contains no lumps, clods, rocks, debris, etc. Special backfill specifications, if furnished take preference over this general specification.

C. Backfill: Flood or hand-tamp to prevent after settling. Hand rake trenches and adjoining area to leave grade in as good or better condition than before installation.

D. Piping Layout: Piping layout is diagrammatic. Route piping around trees and shrubs in such a manner as to avoid damage to plantings. Do not dig within ball of newly planted trees or shrubs.

3.02 PIPE INSTALLATION

A. Sprinkler Mains: Install in a four (4") inch wide minimum trench with a minimum of eighteen (18") inches of cover.

B. Lateral Piping: Install in a four (4") inch wide minimum trench deep enough to allow for installation of sprinkler heads and valves, but in no case, with less than twelve (12") of cover.

C. Trenching: Remove lumber, rubbish, and large rocks from trenches. Provide firm, uniform bearing for entire length of each pipe line to prevent uneven settlement. Wedging or blocking of pipe will not be permitted. Remove foreign matter or dirt from inside of pipe before welding, and keep piping clean by approved means during and after laying of pipe.

3.03 PVC PIPE AND FITTING ASSEMBLY

A. Solvent: Use only solvent recommended by manufacturer to make solvent-welded joints. Thoroughly clean pipe and fittings of dirt dust and moisture before applying solvent

B. PVC to metal connection: Work metal connections first. Use a non-hardening pipe dope such as Permatex No. 2 on threaded PVC adapters into which pipe may be welded.

3.04 COPPER TUBING AND FITTING ASSEMBLY

A. Clean pipe and fitting thoroughly and lightly sand pipe connections to remove residue from pipe. Attach fittings to tubing in an approved manner using 50-50 soft solid core solder.

3.05 POP-UP SPRAY HEADS

A. Supply pop-up spray heads in accordance with materials list and plan. Attach sprinkler to lateral piping with a 12" minimum length of 1/2" Flex PVC as
manufactured by Excalper, not less than three (3") inches or more than six (6") inches long.

3.06 VALVES

A. Supply valves in accordance with materials list and sized according to drawings. Install valves in a level position in accordance with Manufacturer's Specifications. See plan for typical installation of electric valve, valve box.

3.07 WIRING

A. Supply wire from the automatic sprinkler controls to the valves. No conduit will be required for U.F. wire unless otherwise noted on the plan. Wire shall be tucked under the piping.

B. A separate wire is required from the controller to each electric valve. A common neutral wire is also required from each controller to each of the valves.

C. Bundle multiple wires and tape them together at ten (10') foot intervals. Install ten (10") inch expansion coil at not more than one hundred (100') foot intervals. Make splices waterproof.

3.08 AUTOMATIC SPRINKLER CONTROLLED

A. Supply in accordance with Irrigation Plan. Install according to manufacturer's recommendations.

3.09 TESTING

A. Sprinkler Mains: Test sprinkler main only for a period of twelve (12) to fourteen (14) hours under normal pressure. If leaks occur, replace joint or joints and repeat test.

B. Complete tests prior to backfilling. Sufficient backfill material may be placed in trenches between fittings to insure stability of line under pressure. In each case, leave fittings and couplings open to visual inspection for full period of test.

3.10 FINAL ADJUSTMENT

A. After installation has been completed, make final adjustment of sprinkler system in preparation for Landscape Architect's final inspection. Completely flush system to remove debris from lines and turning on system. Check sprinklers for proper operation and proper alignment for direction of flow. Check each section of spray heads for operating pressure and balance to other sections by use of flow adjustment and top of each valve. Check nozzling for proper coverage. Prevailing wind conditions may indicate that arch angle of spray should be other than shown on drawings. In this case, change nozzles to provide correct coverage.

END OF SECTION 32 84 23
SECTION 32 92 23 - SOD

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Provide all materials, labor to install and maintain for the guarantee period all areas sodded.
B. Related Work Specified Elsewhere:
   1. Specifications for Trees, Shrubs and Ground Cover.
   2. Specifications for Irrigation System.
C. Definitions:
   1. Sod: Thick matting of growing and living grass on a smooth bed free of foreign material, rocks larger than ¾ inch in diameter and weeds.

1.2 QUALITY ASSURANCE
A. Reference Standards:
B. Source Quality Control:
   1. The Owner reserves the right to inspect and approve the sod before it is cut and the source of the sod.
   2. Inspection of sod at the source does not preclude the right of rejection at the job site.

1.3 SUBMITTALS
A. Certificates: Grower certification that the sod meets the specification requirements. Submit certification to Owner’s representative prior to delivery to the site.
B. Maintenance Instructions: Submit to Owner’s representative prior to the final inspection.

1.4 JOB CONDITIONS
A. Environmental Requirements:
   1. Sodding shall be performed between March 15 and August 15 or as approved by Owner.
2. Frozen sod may not be used nor shall sod be placed on frozen ground.

3. In times of drought, special provisions must be made to prevent the drying of the sod. All provisions shall be approved by Owner’s representative.

4. Do not sod when soil is excessively wet or dry.

B. Protection: Restrict foot and vehicular traffic from sodded areas after laying until final inspection and acceptance.

1.5 GUARANTEE AND MAINTENANCE

A. Substantial Completion: Sod shall be approved as being in accordance with specifications upon completion of the installation.

B. Guarantee Period: A stand of grass for 90 days after substantial completion shall be guaranteed.

C. Maintenance Period:
   1. Maintain newly laid sod for 90 days from the date of substantial completion.
   2. Any sodded areas that become eroded, damaged or any areas of sod that fail to become established satisfactorily, according to the Owner, shall be repaired and/or replaced at no additional expense to the Owner.
   3. Repair construction related damage to other plants or lawns during the maintenance period at no additional expense to the Owner.
   4. Maintenance shall consist of, but not be limited to:
      a. Weeding
      b. Watering
      c. Mowing
      d. Spraying
      e. Fertilizing

D. Final Acceptance: Ten days before end of the 90-day maintenance period. The Contractor shall notify the Owner’s representative of mutually agreeable final inspection date.

1.6 RESTORATION

A. The Contractor shall be responsible for repairing any damages done to the site caused by the Contractor at no additional expense to the Owner.
PART 2 - PRODUCTS

2.1 MATERIAL

A. Sod

1. Species: Common bermudagrass (Cynodon Dactylon).

2. A minimum of 95% of the plants in cut sod shall be bermudagrass. The sod shall be free of weeds or undesirable foreign plants, large stones, roots or other materials which might be detrimental to the development of the sod or to future maintenance.

3. Sod shall be cut with approved sod cutters so that after it is places, but before it is compacted, it shall have a uniform thickness of not less than 3/4-inch. The sod sections shall be cut in uniform widths, not less than ten inches and in lengths of not less than 18 inches.

4. Sod shall be uniform in color, leaf texture and shoot density.

B. Fertilizer:

1. Uniform composition

2. Palletized.

3. Containing following minimum percentage of plant food by weight:

   a. Nitrogen: 16%

   b. Phosphoric Acid: 8%

   c. Potash: 8%

4. The fertilizer shall be delivered to the site in bags or other sealed containers, each fully labeled, conforming to the applicable state fertilizer laws, and bearing the name, trade name or trademark and warranty of the producer.

C. Water: Potable, available on-site. Contractor shall furnish temporary hoses and connections as required.

PART 3 - EXECUTION

3.1 INSPECTION

A. Contractor shall check that preceding work affecting ground surface is completed, properly graded and drains well.

B. Contractor shall verify that soil is within allowable range of moisture content.
C. Contractor shall see that the soil is free of weeds and foreign material immediately before sodding. Remove rocks and stones which are larger than 3/4 –inch in diameter, remove from the site and dispose of in an approved location.

D. Contractor shall not start work until conditions are satisfactory. To begin work indicates acceptance of conditions.

3.2 PREPARATION

A. All areas to be sodded are to be bladed and graded smooth. All topsoil shall be incorporated into existing soil. All debris shall be disposed of off the site at an approved location.

B. Till fertilizer into top two inches of soil at rate of 12 pounds per 1,000 square feet.

3.3 APPLICATION

A. The sod shall be moist and shall be placed on a moist soil bed.

B. Sod shall be harvested, delivered and laid within a period of 24 hours, unless a suitable preservation method is approved prior to delivery. Sod not transplanted within this period shall be inspected for acceptance by the Owner’s representative prior to its installation.

C. The sod shall be carefully placed by hand, edge-to-edge (with no gaps), and with staggered joints in rows parallel with the contours. Do not stretch or overlap sod.

D. The sod shall immediately be pressed firmly into contact with the sod bed by rolling with approved equipment to provide a true and even surface.

E. Screened soil of acceptable quality shall be used to fill all cracks between pads of sod; however, the quantity of the top dressing soil shall not be so great as to smother the grass.

F. The surface of the soil in the sod after compaction shall be flush with or just below adjacent paving.

G. Water sodded areas to a minimum depth of two inches after planting.

3.4 PROTECTION

A. Immediately after sodding, erect barricades and warning signs as required to protect seeded areas from traffic until sod is established.

3.5 SOD ESTABLISHMENT

A. Watering:

1. The sod shall be kept moist from the time of its placement until it has become established and its continued growth assured.
2. Watering shall be done at a rate which will avoid erosion and excessive runoff.

B. Mowing:

1. When grass reaches approximately four inches in height, mow to 2 to 2 1/2 inches in height.

2. Do not cut off more than 40% of grass leaf in single mowing.

3. Remove grass clippings and dispose of off-site.

D. Repairing: Any areas that become eroded, damaged or any areas of sod that fails to become established satisfactorily, according to the Owner, shall be repaired and/or replaced at no expense to the Owner.

3.6 CLEAN-UP

A. Remove trash and excess materials from site.

B. Maintain paved areas in clean condition.

C. Remove barriers and signs from site at termination of the maintenance period.

END OF SECTION 32 92 23
SECTION 32 92 24 - HYDRAULIC SEEDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Provide all material and labor to install and maintain for the guarantee period all areas to be seeded and hydromulched.

1.2 RELATED SECTIONS

A. Section 32 8423 - Irrigation
B. Section 31 2300 - Landscape Grading
C. Section 32 9300- Trees, Shrubs and Ground Cover

1.3 UNIT PRICE- MEASUREMENT AND PAYMENT

A. Seeded Areas-By the square foot. Includes placing topsoil, fine grading, seeding, water and maintenance to specified time limit.

1.4 DEFINITIONS

A. The Contractor will be required to establish a stand of turf grass and native grass prior to acceptance of the job. A uniform stand of grass shall be defined as a total coverage of the planting soil by the specified grass or wildflower species to the satisfaction of the Owner. The Contractor is responsible for all watering, weeding, and replanting during the time which is necessary to establish a uniform stand of grass.

1.5 SUBMITTALS

A. Test Reports: Results of seed purity and germination tests.
B. Certificates: Manufacturer's certification that seed and mulch meet specification requirements.
C. File all results and certificates with the Owner prior to the final acceptance.
D. Maintenance Instructions: Submit to the Owner prior to the final acceptance.
E. Test Reports: Submit certification of fertilizer analysis.

1.6 QUALITY ASSURANCE

A. Reference Standards:

Official Method of Analysis of the Association of Official Analytical Chemists.
B. Source Quality Control: Producer's test for purity and germination of seed, dated within nine months of sowing and submit to Owner.

1.7 JOB CONDITIONS

A. Environmental Requirements:

1. Do not seed when excessively wet or dry.

2. Do not perform seeding or hydromulching when wind exceeds 15 mph.

B. Protection: Restrict foot and vehicular traffic from seeded areas after hydromulching until final inspection and acceptance.

1.8 GUARANTEE AND MAINTENANCE

A. Provisional Acceptance: Planting shall be approved as being in accordance with specifications upon completion of the installation.

B. Guarantee Period: A stand of grass within 45 days after substantial completion shall be guaranteed.

C. Maintenance Period:

1. Maintain new seeding until entire project is accepted by the Owner.

2. Reseed during this period as required to meet minimum standards at no additional expense to the Owner.

3. Repair damage to other plants or lawns during maintenance period at no additional expense to the Owner.

4. Maintenance shall consist of but not be limited to:
   a. Weeding
   b. Watering
   c. Mowing and edging
   d. Spraying
   e. Fertilizing
   f. Temporary Erosion Control & Erosion Repair
D. Final Acceptance will be provided by the Owner only upon completion of the entire project and the establishment of a stand of grass as defined herein.

1.9 RESTORATION

The Contractor shall be responsible for repairing any damage done to any existing site improvements caused by the Contractor, at no additional expense to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Turf Areas

1. Seed (April 15 until September 15)
   a. Species: 100% Hulled Common Bermuda Grass (Cynodon dactylon) of 98% purity.
   b. Percent of Live Seed: 85%
   c. Clean, dry, new crop seed.
   d. Free of all weeds.

2. Temporary Turf - Seed (September 15 until March 15)
   a. Species: 100% Rye Grass (Lolium multiflorum) of 85% purity

C. Fertilizer (For Turf Grass Areas Only)

1. Uniform composition.

2. Pelletized.

3. Containing following minimum percentage of plant food by weight:
   a. Nitrogen: 15% or 16%
   b. Phosphoric Acid: 4% or 5%
   c. Potash: 8% or 10%

4. The fertilizer shall be delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable state fertilizer laws, and bearing the name, trade name or trademark, and warranty of the producer.

D. Mulch with Tackifier

1. Maximum Moisture Content.................10% ± 3%
2. Virgin Wood Fiber Content..................92.2% ± 0.5% O.D. Basis

3. Tackifier Content..........................3% ± 0.5% O.D. Basis

4. Ash Content.................................0.8% ± 0.2% O.D. Basis

1. PH........................................4.8 ± 0.5

2. Minimum Water Holding Capacity (grams of water per 100 grams of fiber)..................1,000

3. Wood fiber shall be dyed green with a biodegradable dye that does not inhibit plant growth.

4. Wood fiber SHALL NOT be produced from recycled material such as sawdust, paper, cardboard, or residue from pulp and paper plants.

5. Wood fiber mulch shall be packaged in units not exceed 100 lbs. The package shall contain current labels, the manufacturer's name and the net weight.

E. Water: Potable, available on-site. Contractor shall furnish temporary hoses and connections as required.

PART 3 - EXECUTION

3.01 INSPECTION

A. Contractor shall check that preceding work affecting ground surface is completed.

B. Contractor shall verify that soil is within allowable range of moisture content.

C. Contractor shall see that the soil is free of weeds and foreign material immediately before seeding. Remove rocks and stones which are larger than 2 inches in diameter and remove from the site.

D. Contractor shall not start work until conditions are satisfactory. To begin work indicates acceptance of conditions.

3.02 PREPARATION

A. All areas to be seeded are to be bladed and graded smooth. All clods shall be removed or incorporated into existing soil and all debris shall be disposed of off the site.

B. Soil should be watered to a minimum depth of 4 inches at least 48 hours prior to seeding.

3.03 APPLICATION (Hydromulch Seed Only)
A. Apply hydromulch material with an approved spray applicator equipment suitable for the seed, mulch and stabilizer specified.

B. Apply materials at the following rates or as approved by the Owner.
   1. Mulch with Tackifier 1,600 pounds per acre (36.75 lbs/1000 sf).
   2. Fertilizer: 523 pounds per acre (12.0 lbs/1000 sf).
   3. Hulled Common Bermuda Grass, 87 pounds per acre (2 lbs/1000 sf).
   4. Temporary Turf, 200 pounds per acre (4.5 lbs/1000sf).

C. Water all hydromulched areas to a minimum depth of 4 inches.

3.04 PROTECTION

Immediately after seeding and hydromulching, erect barricades and warning signs as required to protect seeded areas from traffic until grass is established.

3.05 SEED ESTABLISHMENT

A. Watering
   1. Keep soil moist during seed germination period.
   2. Supplement rainfall as required until a stand of grass is established.

B. Mowing (Turf Areas)
   1. When grass reaches 4 inches in height, mow to 2 to 2-1/2 inches in height.
   2. Do not cut off more than 40% of grass leaf in single mowing.
   3. Mow using 2 mulching blades, leaving no unsightly piles of grass clippings.

C. Reseed all bare spots not having a uniform stand of grass at no additional expense to the Owner.

D. The Contractor will be required to establish a stand of grass prior to acceptance of the job. A uniform stand of grass shall be defined as a total coverage of the planting soil by the specified turfgrass to the satisfaction of the Owner. The Contractor is responsible for all watering, weeding, weekly mowing and replanting during the time which is necessary to establish a uniform stand of grass.

3.06 CLEANUP

A. Remove trash and excess materials from project site.
B. Maintain paved areas in clean condition.

C. Remove barriers and signs from site at termination of establishment period.

END OF SECTION 32 92 24
SECTION 32 93 00 - TREES, SHRUBS, AND GROUND COVER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and install trees, shrubs, ground cover, and soil amendments.

B. Maintenance.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Plants: By the unit. Includes preparation of planting soil mix, planting, watering and maintenance to specified time period.

1.3 REFERENCES

A. ANSI Z60.1 - Nursery Stock.

B. NAA (National Arborist Association) - Pruning Standards for Shade Trees.


1.4 DEFINITIONS


B. Plants: Living trees, plants, and ground cover specified in this Section, and described in ANSI Z60.1.

1.5 SUBMITTALS

A. Certificates

1. Submit fertilizer analysis with invoice.

2. File with Owner prior to material acceptance.

B. Product Data: Submit list of plant life sources.

C. Maintenance Instructions: Submit written maintenance schedule for maintaining plant material after completion of job to Owner before final inspection.

1.6 QUALITY ASSURANCE
A. Nursery Qualifications: Company specializing in growing and cultivating the plants with three years documented experience.

B. Installer Qualifications: Company specializing in installing and planting the plants with three years documented experience on projects of similar size.

C. Maintenance Services: Performed by installer.

D. Pest Control Applicator: Licensed landscape pest control advisor.


F. Provide plant material as shown on Drawings. Plants shall be subject to inspection and approval by Owner at place of growth or upon delivery to site for conformity to specified requirements.

G. Samples: Owner reserves right to take and analyze samples of materials. Furnish samples upon request.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Delivery
   1. Balled and Burlapped (BB) Plants
      a. Dig and prepare for shipment in manner that will not damage roots, branches, shape, and future development after planting.
      b. Ball with firm, natural ball of soil.
      c. Wrap ball firmly with burlap.
      d. Ball Size and Ratios: Conform to American Association of Nurserymen (AAN) standard sizes and plant list, if conflict occurs, notify Owner.
   2. Pack plant material to protect against climatic, seasonal, and breakage injuries during transit.
   3. Securely cover plant tops with tarpaulin or canvas to minimize windwhipping and drying. Use antidesiccant upon approval of Owner.
   4. Pack and ventilate to prevent sweating of plants during transit by rail. Ensure prompt delivery and careful handling to point of delivery at planting job site.

B. Delivery
   1. Fertilizer and Soil Amendments: Original unopened containers bearing manufacturer's guaranteed chemical analysis, name, trademark and conformance to State law.
   2. Plants: Provide legible identification labels. Minimum one plant of each species delivered to site shall have identification tag. Do not remove tag until after final inspection.
      a. Prevent damage to root ball or desiccation of leaves.
      b. Notify Owner 10 days in advance of delivery.
C. Inspect trees, shrubs, and ground cover plants for injury, insect infestation, and trees and shrubs for improper size and shape.

D. Storage

1. Protect roots of plant material from drying or other possible injury with soil or acceptable material.
2. Store plant material in area which is shaded and protected from weather.
3. Maintain and protect plant material not to be planted immediately upon delivery in healthy, vigorous condition.

E. Handling

1. Do not drop plants.
2. Do not pick up container or balled plants by stem or trunks.
3. Lift and handle balled plants from bottom of ball.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install plant life when ambient temperatures may drop below 35 degrees F (2 degrees C) or rise above 95 degrees F (32 degrees C).

B. Do not install plant life when wind velocity exceeds 30 mph (48 k/hr).

1.9 SCHEDULING

A. Install trees, shrubs, and ground cover plants prior to lawn installation.

B. Coordinate scheduling with underground irrigation system installation.

1.10 WARRANTY

A. Warrant plant materials to be in healthy, vigorous and attractive growing condition for period of 6 months for shrubs and ground cover and 1 year for trees after Final Acceptance.

B. Replace plants which die, become diseased or unhealthy, or are otherwise found to be in poor condition, as determined by Owner.

C. Warranty will not apply to damage or injury to plant materials caused by vandalism, vehicles, and storms.

D. Replace plants within 15 days of written notification by Owner.
PART 2 - PRODUCTS

2.1 TREES, PLANTS, AND GROUND COVER

A. Plants:

1. Type and Size: As shown on Drawings.
2. Plants shall have normal habit of growth and shall be sound, healthy, vigorous, and free of insect infestations, plant diseases, sunscalds, windburn, knots, injuries, fresh abrasions of bark, excessive abrasions, or other objectionable disfigurements.
3. Root Conditions of Plants Furnished in Containers: Determine condition by removal of earth from roots of not less than two plants or more than 2 percent of total number of plants of each species or variety. Where container grown plants are from several sources, roots of not less than two plants of each species or variety from each source will be inspected. In case sample plants inspected are found to be defective, Owner reserves right to reject entire lot or lots of plants represented by defective samples. Owner will be sole judge as to acceptability. Plants rendered unsuitable for planting will be considered samples.
4. Root Conditions of Balled and Burlapped Plants: Determine condition by examination of plant balls and removal of 1/3 to 1/2 of burlap covering from not less than two plants or more than 2 percent of the total number of plants of each species or variety. Where balled and burlapped plants are from several sources, balls of not less than two plants of each species or variety from each source will be inspected. In case sample plants inspected are found to be defective, Owner reserves right to reject entire lot or lots of plants represented by defective samples. Owner will be sole judge as to acceptability. Plants rendered unsuitable for planting will be considered samples.
5. Size and shape of plants shall correspond with that normally expected for species and variety of commercially available nursery stock or as shown on Drawings. Overall shape and minimum acceptable size of plants measured before pruning with branches in normal position shall conform with AAN standards. Plants larger in size than specified may be used with approval of Owner, at no additional cost to Owner. If use of larger plants is approved, ball of earth or spread of roots for each plant will be increased proportionately.
6. Plant material shall be true to botanical and common name and variety.
B. Trees:

1. Weak, thin trunks not capable of support will not be acceptable.
2. Trees with specified trunk caliper of 3 inches or more shall not branch less than 5 feet above finish grade, unless specified as multi-trunk.
3. Trunks:
   a. Sturdy, with hardened systems and vigorous and fibrous root systems which are not root or pot-bound.
   b. Single straight trunks unless otherwise shown on Drawings.

C. Nursery Grown and Collected Stock:

1. Provide nursery grown stock except as shown on Drawings or as approved by Landscape Architect; grown under climatic conditions similar to those in locality of project.
2. Provide container grown or balled and burlapped stocks (as indicated on drawings) in vigorous, healthy condition. Plants that are root bound, with root system hardened off, or with damaged root balls will not be acceptable.
3. Balled and burlapped stock will have firm root balls with no loose or fractured soil. Balled and burlapped stock will have been collected and re-balled if necessary no less than 4 months prior to delivery at job site.
4. Use well established liner stock plant material, in removable containers or formed homogeneous soil sections.

2.2 SOIL AND AMENDMENT MATERIALS

A. Imported Topsoil for Prepared Soil Mixtures

1. Sandy loam from source approved by Owner; 100 percent passing through 1-inch screen.
   a. Sand (2,000 mm to 0.50 mm): 40 to 50 percent.
      Silt (0.050 mm to 0.005 mm): 30 to 40 percent.
      Clay (0.005 mm and smaller): 10 to 30 percent.
2. Free of subsoil, brush, stumps, roots, organic litter, objectionable weeds, clods, shale, stones 1-inch minimum dimension or larger, or other material harmful to grading, planting, plant growth, or maintenance operations.
3. Presence of vegetative parts of Bermuda grass, Johnson grass, nut grass (Cyperus rotundus), and other hard to eradicate weeds or grass will be cause for rejection of topsoil.

B. Fertilizer: Uniform composition, pelleted; to the following minimum proportions:

1. Nitrogen: 10 percent or 12 percent.
2. Phosphoric Acid: 10 percent or 12 percent.
3. Potash: 10 percent or 12 percent.


D. Sharp Sand: Clean, washed sand, fine to coarse sizes, free of clay lumps or other objectionable materials.
E. Root Activator: Carl Pool Root Activator.

F. Mulch: Composted shredded cypress bark free of insects, debris, trash, weeds, seeds, and other noxious materials.

G. Controlled Release Fertilizer Tablets:
   1. 21 gram tablets with following percentages of available nutrients by weight:
      b. Phosphorus: 8 percent.
      c. Potassium: 4 percent.
   2. Product: Sierra Chemical Co., "Agriform".

H. Peat Moss: Shredded, loose, Canadian, Dutch, or German sphagnum moss; free of lumps, roots, inorganic material or acidic materials; minimum of 85 percent organic material measured by oven dry weight, pH range of 4 to 5; moisture content of 30 percent.

I. Water: Potable, available on site.

J. Landscape Boulders: Native stone material, as approved by Owner.
   1. Small Boulder Exposed Dimensions: Min. of 18" long x 12" high x 15" wide.
   2. Medium Boulder Exposed Dimensions: Min. of 24" long x 12" high x 24" wide.
   3. Large Boulders Exposed Dimensions: Min. of 36" long x 24" high x 24" wide.

2.3 ACCESSORIES

A. Steel Edging: _" x 4"; Ryerson, or approved equal.

B. Guying and Staking Materials: As shown on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify established grades are correct; determine locations of underground utilities prior to planting.

B. Areas shall be free of weed and foreign material prior to planting.

C. Do not begin planting until deficiencies are corrected, or plants replaced. To begin work indicates acceptance of site conditions.

D. Saturate soil with water to test drainage.

3.2 PROTECTION

A. Protect lawn areas from vehicular traffic and from material storage.
3.3 SOIL PREPARATION

A. Plant Locations and Measurements:
   1. Stake outline of planting beds on ground.
   2. Stake locations of trees.
   3. Place shrubs and ground cover in indicated locations.
   4. Notify Owner of discrepancies between plants indicated on Drawings and actual conditions prior to planting.
   5. Plant locations will be approved by Owner prior to planting.

B. Pits
   1. Shape: Vertical sides and crowned bottom; Plant pits shall be circular.
   2. Size for Trees: 2 feet wider and 6 inches deeper than root ball.
   3. Size for Balled and Burlapped Shrubs: 1 foot wider and 3 inches deeper than root ball.
   4. Size for seedling trees: 6 inches larger than root ball and 6 inches deeper than root ball.
   5. Scarify sides of bottom of planting pits to improve root penetration.

C. Ground Cover and Shrub Beds: Excavate existing soil to depth specified.

D. Obstructions Below Ground
   1. Remove rock or underground obstructions to depth of 6 inches below bottom of plant ball or root, measured when plant is properly set at the required grade.
   2. If underground obstructions cannot be removed, notify Owner for new instructions.
   3. Avoid damaging underground utility lines.
   4. Repair damage to existing utilities.

E. Final Grades:
   1. Minor modification to grade may be required to establish final grade.
   2. Ensure proper drainage of site as determined by Landscape Architect.
   3. Fine grade areas so finished grades shall be 1 inch in lawn and 2 inches in shrub beds, below adjacent paved areas, sidewalks, valve boxes, headers, clean-outs, drains, and manholes, etc.
   4. Surface drainage shall be away from building foundations at 2 percent minimum, for 5-foot minimum.
   5. Fill erosion scars and compact prior to planting.
F. Disposal of Excess Soil

1. Use acceptable excess excavated topsoil for filling holes, pits, and beds as directed by the Owner.
2. Dispose of unacceptable or unused excess soil at off-site location as directed by Owner.

G. Shrub and Ground Cover Beds

1. Preplant Weed Control:
   a. If live perennial weeds exist on site at beginning of work, spray with nonselective systemic contact herbicide, as recommended and applied by approved licensed landscape pest control advisor and applicator. Leave sprayed plants intact for minimum 15 days to allow systemic kill. Apply herbicide in accordance with manufacturer's instructions.
   b. Clear and remove existing weeds by scraping or grubbing off plant parts at least ¼-inch below surface of soil over entire area to be planted.

2. Soil Amendment:
   a. Subgrade: 10 inches below finish grade. Layer of soil amendments shall be 8 inches deep, leaving finish grade after watering and settling 2 inches below adjacent paved areas. Excavation and fill may be required to achieve grades.
      1) Organic Soil Conditioner: 4-inch deep layer.
      2) Topsoil: 4-inch deep layer.
      3) Fertilizer: 5 pounds per 1000 square feet of bed area.
   b. Spread amendments uniformly, cultivate thoroughly to light and friable consistency, using mechanical rototiller into top 2 inches of subgrade. Make bed approximately 6-inch total depth of amended soil.

3. Pre-Emergence Herbicide: Apply at rates recommended by manufacturer. Incorporate into top ½-inch of soil by hand raking.

4. Top 2 inches of areas to be planted shall be free of stones, stumps, or other deleterious matter 1-inch in diameter or larger; free from wire, plaster, or similar objects that hinder planting or maintenance.

H. Planting Mixture for Trees and Pocket Planting of Large Shrubs 5 Gallons and Larger:

1. Topsoil: Two parts.
2. Organic Soil Conditioner: One part.
4. Water Release Crystals: Thoroughly incorporate into mixture in accordance with following rates:
   a. Trees: ½ cup per inch if trunk caliper, measured 6 inches above root ball.
   b. Shrubs:
      1) 1 gallon: 1-1/2 tsp.
      2) 2 gallon: 1 tbsp.
      3) 3 gallon: 1-1/2 tbsp.
      4) 5 gallon: 2-1/2 tbsp.
      5) 10 gallon: 5 tbsp.
   c. Ground cover Beds: 2-1/2 pounds per 100 square feet rototilled 4 inches to 6 inches deep into soil.
I. Seedling Tree Pits:
   1. Organic Soil Conditioner: One part
   2. Existing Soil: Four parts
   3. Water Release Crystals: 2 tablespoons

3.4 PLANTING

A. Plant during periods when weather and soil conditions are suitable and in accordance with locally accepted practice, or as approved by Owner.

B. Distribute number of plants which can be planted and watered on same day.

C. Open containers and remove plants in manner to not break root ball. Plant and water as specified immediately after removal from containers. Do not open containers prior to placing plants in planting area.

D. Set plants in pits at level shown on Drawings. Set plants plumb and rigidly braced in position until planting mixture has been tamped solidly around plant ball. Thoroughly settle plant by watering and tamping mixture. Rake planting beds level before and after planting. Thoroughly water trees and shrubs. Stake and guy trees as shown on Drawings.

E. Balled Plants
   1. Place in pit on hand tamped planting mixture.
   2. Place with burlap intact so location of ground line at top of plant ball shall be same as prior to digging.
   3. Remove binding at top of ball and lay burlap back from top _ of plant ball.
   4. Do not pull wrapping from under ball.
   5. Do not plant if ball is cracked or broken before or during planting process or if stem is loose.
   6. Backfill with planting mixture.

F. Container-Grown Plants
   1. Cut cans on two sides with can cutter.
   2. Do not injure root ball.
   3. Remove plants without injury or damage to root balls. Superficially cut edge roots with knife on three sides.
   4. Place in pit on hand tamped planting mixture.
   5. Backfill with planting mixture.

G. Mulching
   1. Cover watering basins or planting beds evenly with layer of mulch minimum of 3 inches deep, after settlement.
   2. Areas on slopes designated to receive erosion control netting shall not be mulched.
   3. Water immediately after mulching.
   4. Hose down planting area with fine spray to wash mulch off of leaves of plants.

H. Pruning
   1. Prune minimum necessary to remove injured twigs and branches, deadwood, suckers.
   2. Do not prune evergreens, except to remove injured branches.
   3. Pruning shall not exceed _ branching structure.
4. Make cuts flush leaving no stubs.
5. Paint cuts over ¾-inch diameter with tree wound paint.

I. Root Activator: Use on trees as recommended by manufacturer.

J. Steel Edging: Install as shown on Drawings and in accordance with manufacturer's recommendations.

K. Staking and Guying: Stake trees immediately after planting as shown on Drawings.
1. Wrap stakes with reflective tape at one foot intervals when tree pits are within 15 feet of pedestrian walks, drives, or parking.

L. Ground Covers
1. Plant in straight rows and evenly spaced, unless otherwise shown; at intervals shown on Drawings. Use triangular spacing unless otherwise shown on Drawings.
2. Irrigate immediately after planting until entire area is soaked to full depth of each root ball.
3. Protect plants after planting. Repair damage to plants caused by trampling or other operations.

M. Controlled Release Fertilizer: Provide fertilizer tablets in accordance with manufacturer's instructions at following rates:
1. Shrub, less than 5 gallons: None.
2. Shrub, 5 gallons or larger: Two each.
3. Trees: One tablet per ½-inch of trunk caliper, measured 1 foot above top of root ball.

N. Watering
1. Water as required when soil moisture is below optimum level for best plant growth.
2. Coordinate watering with Owner and recommend watering schedule for areas to be watered with landscape irrigation system as well as those to be watered manually.

O. Pruning: Prune trees or plant materials or trim in accordance with NAA; alter shape with approval of Owner. Removal of branch leaders (TIPS) will not be acceptable.

3.5 CLEANING

A. Remove trash, excess soil, empty plant containers, and rubbish from property. Repair scars, ruts, or other remarks in ground. Leave ground in neat and orderly condition throughout site.

B. Wash down paved areas, leaving premises in clean condition.

3.6 ADJUSTING

A. Trees, plants, and ground cover shall be in healthy growing condition, weed free, pruning complete and staking and guying secure.

B. Mark materials not conforming to specified requirements as defective and rejected; remove from site and replace with new.
C. Remove dead, injured, or diseased materials, or materials not true to name or size; replace with new.

D. Repair damage to trees, plants, ground cover, and lawns.

END OF SECTION 32 93 00
SECTION 32 9400 – SITE FURNISHINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and supply all labor, equipment, materials and incidentals necessary to assemble, install and otherwise construct furnishings as listed under products.

1.2 QUALITY ASSURANCE

A. Safety:

1. All equipment shall be free of sharp edges and corners, or extremely rough surfaces.

2. Wood shall be pressure treated with a non-toxic preservative as noted in specifications.

B. Allowable Tolerances:

1. All materials shall be new and conform to all standards as specified.

2. The bidder shall be responsible for defects in equipment due to faulty materials or manufacturing, damage or loss.

3. Wood shall be structurally sound and free of heart centers.

4. Wood shall not be noticeably warped or bowed and shall be free of large checks, splinters and wanes.

5. Metal shall be straight or at design radii or bends, without kinks, being bent, crimps, and shall be true to shape.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect from inclement weather: wet, damp, extreme heat or cold.

B. Store wood in a manner to prevent warpage and/or bowing.

C. Keep manufacturers’ labels and installation instructions.

1.4 SUBMITTALS

A. NOT USED.

B. Site Furnishings: Two bound copies of product data, catalog cuts, photo brochures, specifications, and installation procedures, (including diagrams, instructions) or other printed information in sufficient detail and scope to verify compliance with requirements of the contract
documents.

C. Certificates: Two copies of a statement by the equipment manufacturer asserting that the installed equipment is as specified.

D. Samples: Two copies of color charts displaying manufacturer’s color selections and finishes, and identifying those colors and finishes proposed for use.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specifications to be the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):


ASTM A 500 - (1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.


FEDERAL SPECIFICATIONS (FS):
FS L-P-390 - (Rev C; Am 2, Notice 1) Plastic, Molding and Extrusion Material Polyethylene and Copolymers (Low, Medium and High Density).

FS QQ-A-200/8 - (Rev E; Am 1, Notice 1) Aluminum Alloy 6061, Bar, Rod, Shapes, tubes, and wire Extruded.

B. Maintenance Manuals:

1. Two bound copies of procedures and instructions pertaining to frequency of preventive maintenance, inspection, adjustment, lubrications, and cleaning necessary to minimize corrective maintenance and repair. A list of all parts and components for the system, by manufacturer’s name, part number, and nomenclature, shall be attached.

1.6 DELIVERY, STORAGE AND HANDLING

A. Furnishings shall be delivered and stored in accordance with the manufacturer’s recommendations.

PART 2 - PRODUCTS

2.1 MATERIALS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 5 years prior to bid opening.

A. Metals: Metal components shall have factory drilled holes. Extra holes that will not be filled by hardware and could harbor insects shall not be present. The components shall be free of excess weld and spatter.

B. Steel: Steel components shall comply with ASTM A 135, ASTM A 500, or ASTM A 513. All welds shall be continuous and ground smooth.

C. Aluminum: Aluminum components shall be type 6061-T6 or 6062-T6 and shall conform to ASTM B 221 and FS QQ-A-200/8.

D. Wood: Holes in wood products shall be factory drilled. Extra holes that will not be filled by hardware and could harbor insects shall be filled.

E. Lumber: Lumber shall be premium grade, free of heart center, shall be treated with a nontoxic preservative, and shall possess only tight knots. Holes shall be factory drilled.

F. Plywood: Plywood shall be approximately 19 mm (7/8 inch) thick, premium exterior grade, shall be adhered with a waterproof glue that will not separate under conditions of prolonged freezing temperatures, extreme heat, or excessive moisture. Face layers shall be smooth, fine and tightly
grained, free of knots, patches, or surface irregularities, and shall consist of a material with high paint adhesion and retention characteristics. Edges shall be sanded smooth, and shall be eased to a minimum 3 mm (1/8 inch) radius. Voids at edges shall be filled with epoxy prior to sanding.

G. Hardware: Hardware shall be either stainless steel or brass.

H. Coatings:

1. Galvanized Coating: Metal components shall be hot-dipped in zinc after fabrication in accordance with ASTM A 385. Tailings and sharp protrusions formed as a result of the hot-dip process shall be removed and edges burnished.

2. Polyvinyl-chloride (PVC) Coating: Metal components to receive PVC coating shall be primed with a clear acrylic thermosetting solution. The primed parts shall be preheated prior to dipping. The liquid polyvinyl chloride shall be UV stabilized and mold-resistant. The coated parts shall be cured. The coating shall be at least 2 mm (2/25 inch thick plus or minus 0.5 mm (0.020 inch) and shall have an 85 durometer hardness in accordance with ASTM D 3363 with a slip-resistant finish.

3. Wood Finish: Treated wood shall receive two shop coats of paint or clear sealer. Plywood shall be shop primed with penetrating epoxy according to manufacturer's instructions and shall be painted with two spray coats of two-component polyurethane, applied at the factory.

4. Color: Color of site equipment components shall be in accordance with Section 09050, INTERIOR/EXTERIOR FINISHES, MATERIALS AND FINISH SCHEDULES.

2.2 SITE FURNISHINGS

A. Park Bench, Type A – Pre-Cast Concrete Bench

Manufacturer: Wausau Tile. (800) 388-8728 or approved equal
Seating surface: Pre-Cast Concrete
Finish: Acid wash finish
Color: A20 White in standard acid wash finish
Anchoring: Surface plate affixed to concrete paving by use of manufacturer recommended hardware affixed
Model No.: 72” long TF5027
Total Number Required: 16

B. Park Bench, Type B – Steel Bench with Back

Manufacturer: Dumor, Inc. (800) 598-4018 or approved equal
Seating surface: Cast bench, steel seat
Finish: Zinc rich coating and then polyester powder coated finish
Color: To be selected by owner.
Anchoring: Surface plate affixed to concrete paving by use of manufacturer recommended
hardware affixed to Picnic Table form and bolted into pavement.
Model No.: 160-60; 72” long
Total Number Required: 1

C. Trash Receptacles

Manufacturer: Dumor, Inc. (800) 598-4018
Material: Steel
Finish: 187 mil min. poly-vinyl coated finish
Color: To be selected by owner.
Anchoring: Surface plate affixed to concrete paving by use of manufacturer recommended hardware affixed to trash receptacle form and bolted into pavement.
Model No.: Receptacle 87-22-FTO, 22 gallon with bonnet cover and liner
Total Number Required: 4

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasteners: Nuts and bolts shall be upset and tack welded to prevent disassembly.

B. Install in accordance with manufacturer's instructions, unless otherwise stated.
SECTION 32 9401 - FLAGPOLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Aluminum flagpole, ground mounted.

1.2 RELATED SECTIONS

A. Section 03300 - cost-in-Place-Concrete: Concrete base and foundation construction.
B. Section 09900 - Painting: Site painting.

1.3 REFERENCES

A. AASHTO M-36 - Corrugated Metal Culvert Pipe.
B. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
D. ASTM A312 - Seamless and Welded Austenitic Stainless Steel Pipe.
E. ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.
G. CDA (Copper Development Association) - Handbook.

1.4 PERFORMANCE REQUIREMENTS

A. Flagpole With Flag Flying: (40 foot high pole: X = 130, Y = 209. 50 foot high pole: x = 130, Y = 209.) Resistant without permanent deformation to X miles per hour (Y km per hour) wind velocity; non-resonant, safety design factor of [2.5].
B. Flagpole Without Flag: (40 foot high pole: X = 195, Y = 314. 50 foot high pole: X = 183, Y = 295.) Resistant without permanent deformation to X miles per hour (Y km per hour) wind velocity; non-resonant, safety design factor of [2.5].

1.5 SUBMITTALS

A. Shop Drawings: Indicate detailed dimensions, [base] [attachment] details, anchor requirements, and imposed loads.
B. Product Data: Provide data on pole, accessories, and configurations.
C. Samples: Submit two samples 6 inches by 6 inches in size illustrating pole material, color, and finish.
D. Operation Data: Provide operating data for the controller [and timer].
E. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules.

1.6 QUALIFICATIONS

A. Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Arkansas.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.

B. Protect flagpole and accessories from damage or moisture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Aabec Pole Division, Morgan-Francis Co.

B. American Flagpole Division, Kearney-National, Inc.

C. Baartol Co., Inc.

D. Concord Industries, Inc.

2.2 POLE MATERIALS

A. Aluminum: ASTM B241 alloy, T6 temper.

2.3 POLE CONFIGURATIONS

A. Pole Height: 22’
   1. Size: 22’ flag pole, model Commercial Internal Halyard Flagpole
   2. Anchoring: Per Sheet L5.1 Detail 5
   3. Pole Material: Aluminum. ASTM B241 alloy, T6 temper
   4. Total Number Required: 5
   5. Misc: To include revolving internal track, winch assembly, crank handle, sling, weight, access door, aircraft cable, snaps and decorative finial ball with aluminum flash collar.
   6. City will provide flags.
B. Pole Height: 30’
1. Size: 30’ flag pole, model Commercial Internal Halyard Flagpole
2. Anchoring: Per Sheet L5.1 Detail 5
3. Pole Material: Aluminum. ASTM B241 alloy, T6 temper
4. Total Number Required: 3
5. Misc: To include revolving internal track, winch assembly, crank handle, sling , weight, access door, aircraft cable , snaps and decorative finial ball with aluminum flash collar.
6. City will provide flags.

2.4 OPERATOR
A. Hand Crank: Removable handle type.

2.5 MOUNTING COMPONENTS
A. Foundation Tube Sleeve: AASHTO M-36, corrugated 16 gage (1.5 mm) steel, galvanized, depth as indicated.
B. Pole Base Attachment: Tube steel base with base cover.
C. Lighting Ground Rod: 48 inches (120 cm) long copper rod, 3/4 -inch (19 mm) diameter.
D. Lightning Ground Cable: Copper No. 6 AWG, soft drawn.

2.6 FINISHES
A. Metal Surfaces in Contact With Concrete: Asphalitic paint.
B. Aluminum: Mill finish.
C. Bronze: Dark bronze, lacquered finish.
D. Finial: Spun finish.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify site conditions.
B. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.
3.2 PREPARATION

A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.3 INSTALLATION

A. Install flagpole and fittings in accordance with manufacturer's instructions.

B. Electrically ground flagpole installation.

C. Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.

3.4 ERECTION TOLERANCES


3.5 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION
SECTION 32 95 00 - METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated ferrous metal items, prime painted.

1.02 RELATED SECTIONS

A. Section 09900 - Painting.

1.03 REFERENCES

A. ASTM A36 - Structural Steel.

B. ASTM A283 - Carbon Steel Plates, Shapes and Bars.


D. ASTM A325 - High Strength Bolts for Structural Steel Joints.

E. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.

F. ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

G. AWS A2.0 - Standard Welding Symbols.

H. AWS D1.1 - Structural Welding Code.

I. SSPC - Steel Structures Painting Council.

1.04 SUBMITTALS

A. Submit under provisions of Section 5, "Supplementary Conditions".

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Reproduction of contract drawings in any form will not be allowed.

C. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.05 QUALIFICATIONS

A. Prepare Shop Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Texas.

B. Welders Certificates: Submit certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.06 FIELD MEASUREMENTS
A. Verify that field measurements are as indicated on Drawings and shop drawings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Sections: ASTM A36.
B. Steel Tubing: ASTM A500, Grade B.
C. Plates: ASTM A283.
E. Bolts, Nuts, and Washers: ASTM A325.
F. Welding Materials: AWS D1.1; type required for materials being welded.
G. Shop and Touch-Up Primer: SSPC 15, Type 1, red oxide.

2.02 FABRICATION

A. Fit and shop assemble in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Continuously seal joined members by continuous welds.
D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FINISHES

A. Clean surfaces of rust, scale, grease and foreign matter prior to finishing.
B. Do not prime surfaces in direct contact with concrete or where field welding is required.
C. Prime paint items with one coat.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.
B. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION
A. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION
A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
C. Field weld components indicated on Drawings and shop drawings.
D. Perform field welding in accordance with AWS D1.1.
E. Obtain Architect/Engineer approval prior to site cutting or making adjustments not scheduled.
F. After erection, prime welds, abrasions and surfaces not shop primed.

3.04 ERECTION TOLERANCES
A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.

3.05 FIELD QUALITY CONTROL
A. Field inspection and testing will be performed by the independent testing agency employed by the Contractor. Provide access to places where structural steel work is being fabricated or produced and to the site at all times when structural steel is being erected.
B. Correct deficiencies in steel fabrications which inspections have indicated to be out of compliance with requirements.

END OF SECTION 32 95 00
SECTION 32 96 00 - PAINTING (EXTERIOR SITEWORK)

PART 1  GENERAL

1.1  SECTION INCLUDES
A. Surface preparation and field application of paints, stains and coatings.

1.2  RELATED SECTIONS
A. Section 05500 - Metal Fabrications.

1.3  REFERENCES
A. ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer and Related Products.
B. NACE (National Association of Corrosion Engineers) - Industrial Maintenance Painting.
E. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.

1.4  SUBMITTALS
A. Submit under provisions of Section 5, "Supplementary Conditions".
B. Product Data: Provide data on all finishing products.
C. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.

1.5  QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.
B. Applicator: Company specializing in performing the work of this section with minimum five years documented experience.

1.6  FIELD SAMPLES
A. Provide field samples of each finish requested by the Architect or Owner’s representative
B. Provide field samples of sufficient size to demonstrate the final appearance of each finish.
C. Accepted sample may remain as part of the Work.
1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products in accordance with manufacturer's recommendations.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. Container label to 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.

D. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints, enamels, stains, varnishes, and admixtures of first line quality as manufactured by Sherwin Williams, Pratt and Lambert, Glidden, Benjamin Moore, Pittsburgh, Devoe, or Blair/Jones.

2.2 FINISHES

A. Refer to schedule at end of section for surface finish schedule.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Verify that shop applied primer is compatible with subsequent cover materials.

3.2 PREPARATION

A. Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
B. Correct defects and clean surfaces which affect work of this section. Remove existing coatings that exhibit loose surface defects.

C. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

3.3 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry.

C. Apply each coat to uniform finish.

D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.

E. Sand metal lightly between coats to achieve required finish.

F. Allow applied coat to dry before next coat is applied.

3.4 CLEANING

A. Collect waste material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.5 SCHEDULE - SURFACES FOR SITE FINISHING

A. Steel Structure and Exposed Exterior Miscellaneous Steel:
   1. First Coat: Rust inhibitive primer.

B. Hollow Metal Doors, Frames and Sectional Overhead Doors:
   1. First Coat: Rust inhibitive primer.

C. Interior Hollow Metal Frames:
   1. First Coat: Rust inhibitive primer.

D. Gypsum Board:
   1. First Coat: Latex wall primer with light orange peel texture.

E. Wood Millwork and Trim:
   1. First Coat: Oil Based Transparent wood stain.
   2. Second Coat: Sanding Sealer (Sand or wipe with steel wool)

END OF SECTION 32 96 00