CONTRACT DOCUMENTS

FOR

D-4002 DVC San Ramon Campus Renovation and Expansion

INCREMENT 1 - RENOVATION

AT

DIABLO VALLEY COLLEGE
SAN RAMON CAMPUS
1690 Watermill Rd.
San Ramon, CA 94582

CONTRA COSTA COMMUNITY COLLEGE DISTRICT

Consist of the following:
DSA Application #01-117630

Volume 2 of 2 - Divisions 2 thru 49

Architect: Noll & Tam
729 Heinz Ave. #7
Berkeley, CA 94710
(510) 542-2200

October 25, 2018
Architect:
NOLL & TAM ARCHITECTS
729 Heinz Avenue
Berkeley, CA 94710

Christopher Noll
Number 15916
Expires 12/31/19

Civil:
BKF Engineers
1646 N. California Blvd., #400
Walnut Creek, CA 94596

Eric S. Swanson
Number 64607
Expires 06/30/19
Structural:
Walter P. Moore and Associates Inc.
596 Market Street, Suite 2130
San Francisco, CA 94105

Signature  Date  Seal

William A. Andrews
Number 3773
Expires 03/31/20

Mechanical:
Interface Engineering Inc.
135 Main Street, Suite 400
San Francisco, CA 94105

Signature  Date  Seal

Richard Russell
Number 31923
Expires 03/31/20
Electrical:

**Interface Engineering Inc.**
135 Main Street, Suite 400
San Francisco, CA 94105

[Signature]

Date: 6/20/18

Seal

**Jason Lau**
Number 16806
Expires 09/30/18


Plumbing:

**Interface Engineering Inc.**
135 Main Street, Suite 400
San Francisco, CA 94105

[Signature]

Date: 6/20/18

Seal

**Richard Russell**
Number 31923
Expires 03/31/20
Fire Protection:
**Interface Engineering Inc.**
135 Main Street, Suite 400
San Francisco, CA 94105

[Signature]

6/20/18

[Date]

Richard Russell
Number 31923
Expires 03/31/20

[Seal]

Fire Alarm:
**Interface Engineering Inc.**
135 Main Street, Suite 400
San Francisco, CA 94105

[Signature]

6/20/18

[Date]

Jason Lau
Number 16806
Expires 09/30/18

[Seal]
Telecom:
Charles M. Salter and Associates
130 Sutter Street, Floor 5
San Francisco, CA 94104

Signature

Date

Seal

Kenneth Graven
Number 15135
Expires 06/30/18

Landscape:
Merrill Morris Partners, Inc.
249 Front Street
San Francisco, CA 94111

Signature

Date

Seal

Dan Morris
Number 2533
Expires 04/30/20

END OF DOCUMENT
# List of Required Structural Tests & Special Inspections - 2016 CBC

**IMPORTANT:** This form is only a summary list of structural tests and some of the special inspections required for the project. Generally, the structural tests and special inspections noted on this form are those that will be performed by the Geotechnical Engineer of Record, Laboratory of Record, or Special Inspector. The actual complete test and inspection program must be performed as detailed on the DSA approved documents. The appendix at the bottom of this form identifies work NOT subject to DSA requirements for special inspection or structural testing. The project inspector is responsible for providing inspection of all facets of construction, including but not limited to, special inspections not listed on this form such as structural wood framing, high-load wood diaphragms, cold-formed steel framing, anchorage of non-structural components, etc., per Title 24, Part 2, Chapter 17A.

**NOTE:** This form is also available for projects submitted for review under the 2007, 2010, and 2013 CBC.

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**INSTRUCTIONS:** Click a plus sign (+) before any category or subcategory to reveal additional tests and special inspections. A shaded box indicates a test or special inspection that may be required, depending on the scope of the construction and other issues. A shaded box can be clicked indicating your selection of that test. **Note:** A minus (-) on a category or subcategory heading indicates that it can be collapsed. However, any selections you may have made will be cleared. Click on the "Compile" button to show only the tests and inspections finally selected. For more information on use of this form, see DSA-103.INSTR.

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## Required Tests or Special Inspection

<table>
<thead>
<tr>
<th>Required</th>
<th>Test or Special Inspection</th>
<th>Type</th>
<th>Performed</th>
<th>Code Reference and Notes</th>
</tr>
</thead>
</table>

### SOILS

#### 4. CAST-IN-PLACE DEEP FOUNDATIONS (PIERS):

- **X** Inspect drilling operations and maintain complete and accurate records for each pier. **Continuous** GE<sup>*</sup> By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)
- **X** Verify pier locations, diameters, plumbness, bell diameters (if applicable), lengths, and embedment into bedrock (if applicable). Record concrete or grout volumes. **Continuous** GE<sup>*</sup> By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)
- **X** Concrete piers. **X** Provide tests and inspections per CONCRETE section below.

### CONCRETE

#### 7. CAST IN PLACE CONCRETE

**Material Verification and Testing:**

- **X** Verify use of required design mix. **Periodic** SI<sup>*</sup> Table 1705A.3 Item 5, 1910A.1 (1909.2.3<sup>†</sup>), * To be performed by qualified batch-plant inspector and concrete sampling technician.
- **X** Identify, sample, and test reinforcing steel. **Test** LOR 1910A.2 (1909.2.4<sup>†</sup>); ACI 318-14 Section 26.6.1.2; DSA IR 17-10.16
- **X** During concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete. **Test** LOR Table 1705A.3 item 6; ACI 318-14 Sections 26.5 & 26.12
- **X** Test concrete (f<sub>c</sub>). **Test** LOR 1905A.1.16 (1909.3.7<sup>†</sup>); ACI 318-14 Section 26.12.

**Inspection:**

- **X** Batch plant inspection **Continuous** **Periodic** See Notes SI Default of "Continuous" per 1705A.3.3. If approved by DSA, batch plant inspection may be reduced to "Periodic" subject to requirements in Section 1705A.3.3.1 or eliminated per 1705A.3.3.2 (See Appendix for exemptions.)

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**Note:** References are to the 2016 edition of the California Building Code (CBC) unless otherwise noted.

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**DSA-103** (Issued 9-1-17) + In the CODE REFERENCE AND NOTES column indicates DSA-SS/CC sections that may be used by community colleges, per 2016 CBC Sec. 1.9.2.2.
### 11. POST-INSTALLED ANCHORS:

<p>| | | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>X</td>
<td>a.</td>
<td>Inspect installation of post-installed anchors</td>
<td>See Notes</td>
</tr>
</tbody>
</table>

### MASONRY

- **TMS 402-13/ACI 530-13/ASCE 5-13 Table 3.1.2, TMS 602-13/ACI 530.1-13/ASCE 6-13 Table 5**

<p>| | | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>X</td>
<td>a.</td>
<td>Verify proportions of site-prepared mortar and grout and/or verify certification of premixed mortar.</td>
<td>Periodic SI TMS 402-13 Table 3.1.2 Item 2a &amp; 3d, TMS 602-13 Table 4 Item 2a &amp; 3d.</td>
</tr>
<tr>
<td>X</td>
<td>b.</td>
<td>Inspect placement of units and construction of mortar joints.</td>
<td>Periodic SI TMS 402-13 Table 3.1.2 Item 2b &amp; 3e, TMS 602-13 Table 4 Item 2b &amp; 3e.</td>
</tr>
<tr>
<td>X</td>
<td>c.</td>
<td>Inspect placement of reinforcement, connectors and anchors.</td>
<td>Periodic SI TMS 402-13 Table 3.1.2 Item 3c, TMS 602-13 Table 4 Item 3c.</td>
</tr>
<tr>
<td>X</td>
<td>d.</td>
<td>Inspect type, size, and location of anchors and other items to be embedded in masonry including details of anchorage of masonry to structural members, frames and other construction.</td>
<td>Periodic SI TMS 402-13 Table 3.1.2 Item 2d, 3b &amp; 4b, TMS 602-13 Table 4 Item 2d, 3b &amp; 4b.</td>
</tr>
<tr>
<td>X</td>
<td>e.</td>
<td>Verify preparation, construction, and protection of masonry during cold weather (temperature below 40°F) or hot weather (above 90°F).</td>
<td>Periodic SI* TMS 402-13 Table 3.1.2 Item 4d; TMS 602-13 Table 4 Item 4d. * May be performed by the project inspector when specifically approved by DSA.</td>
</tr>
</tbody>
</table>

### STEEL, ALUMINUM

- **Table 1705A.2.1, AISC 303-10, AISC 360-10, AISC 341-10, AISC 358-10, AISI S100-07/S2-10**

### 17. STRUCTURAL STEEL, COLD-FORMED STEEL, AND ALUMINUM USED FOR STRUCTURAL PURPOSES

**Material Verification:**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>X</td>
<td>a.</td>
<td>Verify identification of all materials and:</td>
<td>Periodic * 2203A.1 (2203.1.), Table 1705A.2.1 Item 3a-3c; AISI S100-07/S2-10 Section A2.1 &amp; A2.2, AISI S220-12 Section A3, AISI S220-11 Section A4. * By special inspector or qualified technician when performed off-site.</td>
</tr>
<tr>
<td>X</td>
<td>b.</td>
<td>Test unidentified materials.</td>
<td>Test LOR 2203A.1 (2203.1).</td>
</tr>
</tbody>
</table>

**Inspection:**

<p>| | | | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>X</td>
<td>e.</td>
<td>Verify and document steel fabrication per DSA approved construction documents.</td>
<td>Periodic SI Not applicable to cold-formed steel light-frame construction, except for trusses (1705A.2.4).</td>
</tr>
</tbody>
</table>

### 18. HIGH STRENGTH BOLTS:

- **RCSC 2009**

**Material Verification of High-Strength Bolts, Nuts, and Washers:**

<p>| | | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>X</td>
<td>a.</td>
<td>Verify identification markings and manufacturer's certificates of compliance conform to ASTM standards specified in the DSA approved documents.</td>
<td>Periodic SI Table 1705A.2.1 Item 1, 2203A.1; RCSC 2009 Section 2.1. DSA IR 17-9</td>
</tr>
<tr>
<td>X</td>
<td>b.</td>
<td>Test high-strength bolts, nuts and washers.</td>
<td>Test LOR 2213A.1 (2212.6.1*). RCSC 2009 Section 7.2 DSA IR 17-8.16</td>
</tr>
</tbody>
</table>

**Inspection of High-Strength Bolt Installation:**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>X</td>
<td>c.</td>
<td>Bearing-type (&quot;snug tight&quot;) connections.</td>
<td>Periodic SI Table 1705A.2.1 Item 2a; RCSC 2009 Section 9.1. DSA IR 17-9</td>
</tr>
</tbody>
</table>

### 19. WELDING:

**Verification of Materials, Equipment, Welders, etc:**

<p>| | | | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>X</td>
<td>a.</td>
<td>Verify weld filler material identification markings per AWS designation listed on the DSA approved documents and the WPS.</td>
<td>Periodic SI DSA IR 17-3.</td>
</tr>
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</tr>
<tr>
<td>X</td>
<td>b. Verify weld filler material manufacturer’s certificate of compliance.</td>
<td>Periodic</td>
<td>SI</td>
</tr>
<tr>
<td></td>
<td><strong>19.1</strong> SHOP WELDING:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>a. Inspect groove welds, multi-pass fillet welds, single pass fillet welds &gt; 5/16&quot;, plug and slot welds</td>
<td>Continuous</td>
<td>SI</td>
</tr>
<tr>
<td>X</td>
<td>b. Inspect single-pass fillet welds ≤ 5/16&quot;, floor and roof deck welds</td>
<td>Periodic</td>
<td>SI</td>
</tr>
<tr>
<td></td>
<td><strong>19.2</strong> FIELD WELDING:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>a. Inspect groove welds, multi-pass fillet welds, single pass fillet welds &gt; 5/16&quot;, plug and slot welds</td>
<td>Continuous</td>
<td>SI</td>
</tr>
<tr>
<td>X</td>
<td>b. Inspect single-pass fillet welds ≤ 5/16&quot;</td>
<td>Periodic</td>
<td>SI</td>
</tr>
<tr>
<td>X</td>
<td>e. Inspect welding of structural cold-formed steel</td>
<td>Periodic</td>
<td>St*</td>
</tr>
<tr>
<td></td>
<td><strong>22. SPRAY APPLIED FIRE-PROOFING:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>a. Examine structural steel surface conditions, inspect application, take samples, measure thickness, and verify compliance of all aspects of application with DSA approved documents.</td>
<td>Periodic</td>
<td>SI</td>
</tr>
<tr>
<td>X</td>
<td>b. Test bond strength.</td>
<td>Test</td>
<td>LOR</td>
</tr>
<tr>
<td>X</td>
<td>c. Test density.</td>
<td>Test</td>
<td>LOR</td>
</tr>
</tbody>
</table>

**WOOD**

**OTHER**

Indicates DSA-SS/CC sections that may be used by community colleges, per 2016 CBC Sec. 1.9.2.2.
List of required verified report(s):

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Soils testing and Inspection: Geotechnical Verified Report - Form DSA-293</td>
</tr>
<tr>
<td>2</td>
<td>All Structural Testing: Laboratory Verified Report - Form DSA-291</td>
</tr>
<tr>
<td>3</td>
<td>Concrete Batch Plant Inspection: Laboratory Verified Report - Form DSA-291</td>
</tr>
<tr>
<td>4</td>
<td>Masonry Inspection: Laboratory Verified Report - Form DSA-291, or, for independently contracting SI, Special Inspection Verified Report - Form DSA-292</td>
</tr>
<tr>
<td>5</td>
<td>Shop Welding Inspection: Laboratory Verified Report - Form DSA-291, or, for independently contracting SI, Special Inspection Verified Report - Form DSA-292</td>
</tr>
<tr>
<td>6</td>
<td>Field Welding Inspection: Laboratory Verified Report - Form DSA-291, or, for independently contracting SI, Special Inspection Verified Report - Form DSA-292</td>
</tr>
<tr>
<td>7</td>
<td>HS Bolt Installation Inspection: Laboratory Verified Report - Form DSA-291, or, for independently contracting SI, Special Inspection Verified Report - Form DSA-292</td>
</tr>
<tr>
<td>8</td>
<td>Fire-Proofing Application Inspection: Laboratory Verified Report - Form DSA-291, or, for independently contracting SI, Special Inspection Verified Report - Form DSA-292</td>
</tr>
</tbody>
</table>

**KEY to Columns**

<table>
<thead>
<tr>
<th></th>
<th>Type -</th>
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<tbody>
<tr>
<td>1</td>
<td>Continuous – Indicates that a continuous special inspection is required</td>
</tr>
<tr>
<td>2</td>
<td>Periodic – Indicates that a periodic special inspection is required</td>
</tr>
<tr>
<td>3</td>
<td>Test – Indicates that a test is required</td>
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</tr>
</tbody>
</table>

Name of Architect or Engineer in general responsible charge

William A. Andrews, SE

Name of Structural Engineer (When structural design has been delegated)

Signature of Architect or Structural Engineer 10-25-2018

IDENTIFICATION STAMP
DIV OF THE STATE ARCHITECT
APP. # 01-117630

AC N/A F/LS N/A SS M65

DATE 10/25/2018

+ In the CODE REFERENCE AND NOTES column indicates DSA-SS/CC sections that may be used by community colleges, per 2016 CBC Sec. 1.9.2.2.
Appendix: Work Exempt from DSA Requirements for Special Inspection or Structural Testing

Exempt items given in IR A-22 or the 2016 CBC (including DSA amendments) and those items identified below with an "X" by the design professional are NOT subject to DSA requirements for the structural tests or special inspections noted. Items marked as exempt shall be identified by either: 1) listing specific details/sheets noted in the spaces provided below OR 2) on the approved construction documents. The project inspector shall verify all construction complies with the approved construction documents.

### Soils:

1. Deep foundations acting as a cantilever footing designed based on minimum allowable pressures per 2016 CBC Table 1806A.2 and having no geotechnical report for the following types of structures: free standing sign, scrolling message sign, scoreboard, covered walkway or shade structure with dead load less than 5 psf and other light-weight structures of which the apex is less than 8' above the highest adjacent grade.

2. Shallow foundations meeting the exception item #1 criteria specified in 2016 CBC Section 1803A.2.

### Concrete/Masonry:

1. Post-installed anchors for the following: 1) exempt non-structural components (e.g., mechanical, electrical, plumbing equipment - see item 7 for "Welding") given in CBC Section 1619A.1.15 (which replaces ASCE 7-10, Section 13.1.4) or 2) interior nonstructural wall partitions meeting criteria listed in exempt item 3 for "Welding."

### Welding:

1. Solid-clad and open-mesh gates with maximum leaf span or rolling section for rolling gates of 10' and apex height less than 8'-0" above lowest adjacent grade. When located above circulation or occupied space below, these gates are not located within 1.5x gate/fence height (max 8'-0") to the edge of floor or roof.

2. Handrails, guardrails, and modular or relocatable ramps associated with walking surfaces less than 30" above adjacent grade (excluding post base connections per the "Exception" language in Section 1705A.2.1); fillet welds cannot be ground flush.

3. Non-structural interior cold-formed steel framing spanning less than 15'-0", such as in interior partitions, interior soffits, etc. supporting only self weight and light-weight finishes or adhered tile, masonry, stone, or terra cotta veneer no more than 5/8" thickness and apex less than 20'-0" in height and not over an exit way. Maximum tributary load to a member shall not exceed the equivalent of that occurring from a 10'x10' opening in a 15' tall wall for a header or king stud.

4. Manufactured support frames and curbs using hot rolled or cold-formed steel (i.e., light gauge) for mechanical, electrical, or plumbing equipment weighing less than 2000# (equipment only) (connections of such frames to superstructure elements using welding will require special inspection as noted in selected item(s) for section 19, 19.1 and/or 19.2 of listing above).

5. Manufactured components (e.g., Tolco, B-Line, Alcon, etc.) for mechanical, electrical, or plumbing hanger support and bracing (connections of such components to superstructure elements using welding will require special inspection as noted in selected item(s) for section 19, 19.1 and/or 19.2 of listing above).
2. Concrete batch plant inspection is not required for items given in CBC Section 1705A.3.3.2 subject to the requirements and limitations in that section.

3. Masonry retaining walls less than 4'-0" above the top of foundation not supporting a surcharge and free standing non-bearing non-shear masonry walls up to 6'-0" above adjacent grade do not require grout, mortar or masonry core testing or DSA special inspection.

4. Epoxy shear dowels in site flatwork.

(Optional) List details for applicable exempt items:

8. TV Brackets, projector mounts with a valid listing (see DSA IR A-5) and recreational equipment (e.g., playground structures, basketball backstops, etc.) (connections of such elements to superstructure elements using welding will require special inspection as noted in selected item(s) for section 19, 19.1 and/or 19.2 of listing above).

7. Any support for exempt non-structural components given in CBC Section 1616A.1.18 (which replaces ASCE 7-10, Section 13.1.4) meeting the following: 1) when supported on a floor/roof, <400# and resulting composite center of mass (including component's center of mass) <= 4' above supporting floor/roof, or 2) when hung from a wall or roof/floor, <200# for discrete units or <6 plf for distributed systems.
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**SECTION 00 01 07** Seals Page
**SECTION 00008** DSA Form 103
**SECTION 00010** Table of Contents

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- Section 03 20 00 Concrete Reinforcing
- Section 03 30 00 Cast-In-Place Concrete
- Section 03 35 00 Concrete Finishing
- Section 03 53 00 Concrete Topping

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- Section 05 40 00 Cold-Formed Metal Framing
- Section 05 45 00 Metal Support Assemblies
- Section 05 50 00 Metal Fabrications
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Section 10 28 13 Toilet Accessories
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Section 10 56 13 Metal Storage Shelving

DIVISION 11 - EQUIPMENT

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Section 11 52 00 Audio-Visual Equipment

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Section 22 05 23 General-Duty Valves for Plumbing Piping
Section 22 05 29 Hangers and Supports for Plumbing Piping and Equipment
Section 22 05 48 Vibration and Seismic Controls for Plumbing Piping and Equipment
Section 22 05 53 Identification for Plumbing Piping and Equipment
Section 22 05 93 Testing, Adjusting, and Balancing for Plumbing
Section 22 07 00 Plumbing Insulation
Section 22 10 00 Plumbing Piping
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Section 23 00 00 Heating, Ventilating and Air Conditioning (HVAC) Basic Requirements
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Section 23 05 23  General-Duty Valves for HVAC Piping
Section 23 05 29  Hangers and Supports for HVAC Piping, Ductwork and Equipment
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Section 23 05 53  Identification for HVAC Piping, Ductwork and Equipment
Section 23 05 93  Testing, Adjusting, and Balancing for HVAC
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Section 23 08 00  Commissioning of HVAC
Section 23 09 00  Instrumentation and Control Performance Specifications
Section 23 21 13  HVAC Piping
Section 23 21 16  Hydronic Piping Specialties
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Section 23 33 00  Air Duct Accessories
Section 23 34 00  HVAC Fans
Section 23 36 00  Air Terminal Units
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Not Used

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Section 26 05 26  Grounding and Bonding for Electrical Systems
Section 26 05 29  Hangers and Supports for Electrical Systems and Equipment
Section 26 05 33  Raceways
Section 26 05 34  Boxes
Section 26 05 53  Identification for Electrical Systems
Section 26 08 10  Building Lighting Acceptance Testing and Documentation
Section 26 09 00  Contactors and Control Devices
Section 26 09 23  Occupancy and Vacancy Sensors
Section 26 09 24  Daylighting Controls
Section 26 27 26  Wiring Devices
Section 26 28 00  Overcurrent Protective Devices
Section 26 28 16  Enclosed Switches and Circuit Breakers
Section 26 51 00  Lighting
DIVISION 27 - COMMUNICATIONS

Section 27 00 00  Communications General
Section 27 05 26  Communications Grounding and Bonding
Section 27 08 20  Copper Testing
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Section 27 16 00  Communications Connecting Cords, Devices and Adapters

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

Section 28 00 00  Basic Security Requirements
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Section 28 05 13  Security System Cabling
Section 28 05 53  Security System Labeling
Section 28 08 80  Security System Acceptance Testing
Section 28 13 00  Access Control and Alarm Monitoring System
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DIVISIONS 29 THROUGH 30

Not Used

DIVISION 31 - EARTHWORK

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Section 32 05 23  Concrete for Exterior Improvements
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Section 32 17 23  Pavement Markings

DIVISIONS 33 THROUGH 49

Not Used
SECTION 02 41 13
SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes all work necessary to successfully complete demolition to prepare site for the phasing and new construction, including the following:
   1. Clean line saw cutting of existing asphalt pavement, concrete sidewalks, concrete curb/gutter, etc., as specified herein.
   2. Protection from injury or defacement existing building elements to be preserved.
   3. Removal of debris and deleterious materials such as rubbish.
   4. Removal and stockpile of materials for landscaping use at approved location.
   5. Disposal of unwanted or objectionable materials off site.
   6. Disconnecting, capping or sealing, and abandoning site utilities in place.
   7. Disconnecting, capping or sealing, and removing site utilities.
   8. Removing above-grade site improvements within limits indicated.

1.2 REGULATORY REQUIREMENTS:

A. No burning shall be allowed.
B. Do not use explosives.
C. Comply with the following California Code of Regulations:
   1. Title 8: CAL/OSHA, Chapter, Subchapter 4 – Construction Safety Orders.
   2. Title 24: Part 2, California Building Code, Chapter 33, Protection of Pedestrian during Construction or Demolition.
D. Owner’s requirements

1.3 DEFINITIONS

B. CAL-OSHA: California Occupational Safety and Health Administration.
E. EPA: Environmental Protection Agency.

G. Remove: Detach items from existing construction and legally dispose of them off-site unless they indicated to be removed and salvaged or recycled.

H. Remove and Salvage: Detach items from existing construction, prior to demolition, and deliver them to the Equipment yard adjacent to Central Plant or to District designated location. Coordinate with District.

I. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or recycled.

1.4 SUBMITTALS

A. Follow Submittal procedure outlined in Division 1– General Requirements.

1.5 PROJECT CONDITIONS

A. In all circumstances ensure that demolition work does not adversely affect adjacent water courses groundwater and wildlife, or contribute to excess air and noise pollution.

B. Do not dispose, of waste or volatile materials such as mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers. Ensure proper disposal procedures are maintained throughout project.

C. Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.

D. Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authorities.

E. Protect trees, plants and foliage on site and adjacent properties where indicated.

F. Except for materials indicated to be stockpiled or to remain, cleared materials are the Contractor's property. Remove cleared materials from site and dispose of in lawful manner.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Backfill excavations resulting from demolition operations with on-site or import materials conforming to structural backfill defined in Section 31 23 33 Trenching and Backfilling.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points during construction.
B. Protect existing site improvements to remain during construction.

C. Provide the following temporary facilities to facilitate the demolition operations, as necessary:
   1. Temp Traffic Controls
   2. Protection of Persons and Property
   3. Protection of Utilities
   4. Protection of Trees
   5. Noise and Dust Abatement
   6. Clear and restore area to their original condition
   7. Protect existing site improvements and adjacent structures from removal and damage.
   8. Protect and maintain benchmarks and survey control points during construction.

3.2 RESTORATION

A. Restore areas and existing works outside areas of demolition to match conditions to their original condition, as acceptable to the District.

B. Restore damaged improvements to their original condition, as acceptable to the District.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed or abandoned.

B. Arrange to shut off indicated utilities with utility companies or verify that utilities have been shut off.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by District or others unless authorized in writing by the District and then only after arranging to provide temporary utility services according to requirements indicated.

D. Coordinate utility interruptions with utility company affected.

E. Do not proceed with utility interruptions without the permission of the District and utility company affected. Notify the District and the utility company affected 14 working days prior to utility interruptions.

F. Excavate and remove underground utilities that are indicated to be removed.

G. Securely close ends of abandoned piping with tight fitting plug or wall of concrete minimum 6-inches thick.

H. Adjustment of manhole frames and other castings Sacramento Standard Specifications.
3.4 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, and gutters, as indicated. Where concrete slabs, curb, gutter and asphalt pavements are designated to be removed, remove bases and subbase to surface of underlying, undisturbed soil.

C. Unless the existing full-depth joints coincide with line of pavement demolition, neatly saw-cut to full depth the length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

D. Remove driveways, curbs, gutters and sidewalks by saw cutting to full depth. If saw cut falls within 30-inches of a construction joint, expansions joint, score mark or edge, remove material to joint, mark or edge.

3.5 SALVAGED IMPROVEMENTS

A. Salvaged Improvements: Carefully remove items indicated to be salvaged and store where indicated on plans or where designated by the District. Avoid damaging materials designated for salvage.

3.6 DISPOSAL

A. Remove surplus obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off the District’s property.

B. Remove: Unless items are otherwise to remain or be reinstalled, remove and dispose of items. Do not store removed items that is of value to the contractor on site.

C. Remove and Reinstall: Remove items; clean, service and otherwise prepare for service; reinstall in the same location (or in the location indicated by the District).

D. Unidentified Materials: If unidentified materials are discovered, including hazardous materials that will require additional removal other than is required by the Contract Documents, immediately report the discovery to the District. If necessary, the District will arrange for any testing or analysis of the discovered materials and will provide instructions regarding the removal and disposal of the unidentified materials.

3.7 CONSTRUCTION WASTE MANAGEMENT

A. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the General Contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.
SECTION 02 41 14

SELECTIVE BUILDING DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Selective demolition of building elements.
   1. Protect items in place as indicated on the Drawings.

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

C. Related Section

1.2 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the District’s property.

B. Remove and Salvage: Items indicated to be removed and salvaged remain the District’s property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to the District’s designated storage area.

C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in locations indicated.

D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Architect, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

E. Materials Ownership: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the District’s property, demolished materials shall become the Contractor’s property and shall be removed from the site with further disposition at the Contractor’s option.

1.3 SUBMITTALS

A. Schedule of selective demolition activities indicating the following:
   1. Interruption of utility services and security devices.
   2. Coordination for shutoff, capping, and continuation of utility services and security devices.
   3. Removal and/or relocation of components and systems indicated on the Drawings and as required for new work as shown.
B. Work Description: Submit proposed methods and operations of protection of existing finishes to the Architect and District for review and approval prior to the commencement of work. Mockups may be required.
   1. Submit a complete set of shop drawings indicating the protection methods and materials. Include attachment and support details and all required dimensions. Include proposed method of protecting construction previously not exposed to the elements from adverse weather conditions until the building is weather tight.
   2. Include an inventory of items to be removed and salvaged.

C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by selective demolition operations.

D. Record drawings at Project closeout identifying and accurately locating capped utilities and other subsurface structural, electrical, plumbing, mechanical, and security devices.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. The Contractor is hereby directed to recognize the value and significance of the building, and exercise special care during all phases of the work to ensure that the existing building, its details, materials and finishes that are to remain or to be salvaged for the intention of reinstallation are not damaged by the work being performed.
   1. The Contractor shall be responsible for the actions of his/her personnel and of the Contractor’s subcontractors.

1.5 PROJECT CONDITIONS

A. Conditions existing at time of inspection for bidding purposes will be maintained by the District as far as practical.

B. Coordinate the performance of work in this Section with related or adjacent work.

C. Protection of items should be completed prior to commencement of new construction and demolition procedures. At the end of working day or during inclement weather, cover work exposed to weather with waterproof coverings, securely anchored.

D. Hazardous materials are not expected to be encountered in the Work. If any materials suspected of containing asbestos or lead are encountered, do not disturb the materials. Immediately notify the Architect and the District’s Project Manager.

E. Provide minimum 72 hours notification for any shutdown or isolation requests that will impact General Conditions of the Contract or work restrictions.
PART 2 - PRODUCTS

2.1 PROTECTION MATERIALS

A. Polyethylene Sheets: 4 mil.

B. Lumber: Species to be selected by the Contractor, with sizes to fit field conditions. Lumber shall be fire retardant treated.

C. Plywood: 1/2-inch or 3/4-inch fire retardant treated.

D. Soft Fiberboard
   1. 1/2-inch Homasote.
   2. 1/2-inch NCFR Homasote for exposed locations.

E. Neoprene: 1/4-inch or 1/2-inch strips stock sizes.

F. Polyurethane Foam Sheets: 4-inches thick.

G. Plastic Film Tape: As manufactured by 3M, "Scotch Brand No. 472"; Surface Armor LLC; American Biltrite Inc., or equal.

H. Kraft paper.

I. Accessories: Provide necessary and related parts, fasteners, devices and anchors required for complete installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that affected utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
   1. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.
   2. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

C. When unanticipated plumbing, mechanical, electrical, security, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Architect.

D. Survey the condition of the buildings to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of the structures during selective demolition.
E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

A. General
   1. Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   2. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized by the District’s Project Manager.
   3. Provide minimum 72 hours notification for any shutdown or isolation requests when authorized by the District’s Project Manager.
   4. Provide temporary services during interruptions to existing utilities, as acceptable to the District’s Project Manager and to governing authorities.

B. Conform to the District’s specific procedures relating to utility services where utility services are required to be removed, relocated, or abandoned during selective building demolition.

3.3 PREPARATION

A. Conduct demolition operations and remove debris to ensure minimum interference with streets, walks, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the District’s Project Manager and authorities having jurisdiction.

B. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around selective demolition area.
   1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
   2. Protect existing site improvements, appurtenances, and landscaping to remain.
   3. Provide temporary weather protection, during interval between demolition and removal of existing construction, on exterior surfaces to ensure that no water leakage or damage occurs to structure or interior areas.
   4. Protect walls, ceilings, floors, and other existing finish work that are to remain and are exposed during selective demolition operations.

C. Provide and maintain interior and exterior bracing or structural support to preserve stability and prevent movement, settlement, or collapse of portions of building to be selectively demolished.
   1. Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.

B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
C. Clean adjacent site areas of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before start of selective demolition.

3.5 INSTALLATION OF PROTECTION

A. General
   1. Alternative methods to specified protection may be acceptable if equal or greater protection is provided. Submit alternative methods to the Architect for review as specified. Do not proceed with alternative methods until specified approvals are secured. Mockups may be required.
   2. Protection may be required to remain in place for the duration of the Project. As such, materials shall be installed to provide adequate protection throughout the full extent of construction activities. Repair or reinstall protection as required throughout the duration of construction. Changes to protection shall be proposed to the Architect for approval prior to making changes.
   3. All protection assemblies should be self-supporting and self bracing, and secured at the base, unless otherwise noted.

3.6 SELECTIVE DEMOLITION

A. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:
   1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
   2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire suppression devices during flame-cutting operations.
   4. Maintain adequate ventilation when using cutting torches.
   5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
   6. Dispose of demolished items and materials promptly.
   7. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.

B. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain, using power-driven masonry saw or hand tools; do not use power-driven impact tools.
   1. Use a pacometer to locate all existing rebar within any existing concrete to be demolished. Before drilling or cutting any rebar, obtain bar-by-bar permission in writing from the Architect.
3.7 CUTTING AND PATCHING

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

B. Cutting: Cut existing construction using methods least likely to damage elements retained or adjoining construction. Where possible, review proposed procedures with the original installer; comply with the original installer’s recommendations.
1. In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
3. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.
4. Comply with requirements of applicable Sections where cutting and patching requires excavating and backfilling.
5. Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Where removing walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch after the area has received primer and second coat.
4. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. Burning: Do not burn demolished materials.
C. Disposal
1. Transport demolished materials off the District’s property and legally dispose of them.
2. When hauling is done over highways or city streets, loads shall be trimmed and the vehicle shelf areas cleaned after each loading.
3. Contractor shall pay all permit and disposal fees for off-hauled materials.

3.9 CLEANING

A. Sweep the building broom clean on completion of selective demolition operation.

B. All residue and debris from protection work shall be removed from existing construction leaving the premises clean and neat.

3.10 SELECTIVE DEMOLITION SCHEDULE

A. Remove the Following: Demolished site construction materials.

END OF SECTION
SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

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 SUMMARY

A. Section includes formwork, shoring, falsework, bracing, and other temporary supports required to form and support all cast-in-place concrete shown on the drawings including but not limited to all slabs, curbs, and equipment pads.

B. Related Sections

1. Section 03 20 00 – Concrete Reinforcement

2. Section 03 30 00 – Cast-in-Place Concrete

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.

2. 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 concrete formwork that are similar to that indicated for this Project in material.

3. Shores: Vertical or inclined support members designed to carry the weight of formwork, concrete, and construction loads above.

1.4 CODES AND STANDARDS

A. Comply with the provision of the following codes, specifications and standards except where more stringent requirements are shown or specified:

1. California Code of Regulations, Title 24, 2016 edition, also known as California Building Code (CBC), with Division of the State Architect (DSA) amendments.

2. ACI 301 "Specifications for Structural Concrete for Buildings"

3. ACI 318 "Building Code Requirements for Reinforced Concrete"
4. ACI 117 "Specifications for Tolerances for Concrete Construction and Materials"

5. ACI 347, “Guide to Formwork for Concrete.”


7. Concrete Reinforcing Steel Institute "Manual of Standard Practice"

1.5 RESPONSIBILITY

A. The design, construction and safety of all formwork shall be the responsibility of the General Contractor. All forms, shores, 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, backshores, and other bracing may be safely removed.

B. The design of all concrete formwork, formwork removal, and shoring requirements shall be performed by a California registered professional engineer experienced in the design of concrete formwork. The Contractor shall employ the formwork engineer.

C. Formwork shall conform to ACI 347

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.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. 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.

B. Smooth-Formed Finished Concrete: 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:

1. Medium Density Overlay on Hardwood Face, Class 1 or better, mill release agent treated and edge sealed.

C. Formed surfaces designated as “Architectural Concrete” on the Architectural Drawings: Use overlaid plywood complying with U.S. Product Standard PS-1 “A-C or B-B High Density Overlaid Concrete Form”, Class 1.

2.2 TOPS OF DRILLED PIERS, COLUMN BASES, AND SUPPORTS

A. Round section members shall be formed with metal, fiberglass, reinforced plastic, paper or fiber tubes, unless otherwise specified. Paper or fiber tubes shall be constructed of laminated plies using water-resistant adhesive with wax impregnated exterior for weather and moisture protection. Units shall have sufficient wall thickness to resist loads imposed by wet concrete without detrimental deformation. Forms shall be lined or otherwise fabricated so as to produce seamless concrete members.

2.3 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.

2.4 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-cocheres.

2.5 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 1 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 corrodoible 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 1 inch in diameter in concrete surfaces when the ends or end-fasteners are removed.

2.6 CHAMFER STRIPS

A. Provide wood, metal, PVC, or rubber strips, ¾ by ¼ inch, minimum.

2.7 POLYSTYRENE FOAM BOARD

A. Provide rigid, cellular polystyrene boards which conform to ASTM D6817, with a minimum compressive strength of 15 psi at 1% deformation. Subject to compliance with requirements, acceptable manufacturers include:

   1. “STYROFOAM Brand Square Edge” (XPS 26) Dow Chemical Company
   2. “R-Control EPS Geofoam” - All grades, R-Control Building Systems
   4. “Knauf Geofoam”, Knauf Polystyrene

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine excavated areas where formwork will be constructed and verify:

   1. Excavations are adequate to permit placement, inspection and removal of forms.
   2. Excavations for earth forms have been accurately and neatly cut.
   3. Proper conditions are present for formwork construction

B. Contractor shall inspect formwork to verify that conditions meet ACI 347 and the requirements of the construction documents.

3.2 EARTH FORMS

A. Construct wood edge strips at top sides of excavations

B. Provide forms for footings wherever concrete cannot be placed against solid earth excavation.

C. Remove loose dirt and debris prior to concrete placement.

D. Foundation concrete may be placed directly into neat excavations provided the trench walls are stable as determined by the Geotechnical engineer, subject to the approval of DSA.
1. The plan dimension of unfomed footings shall be increased 1 inch at every surface at which concrete is placed directly against the earth.

E. The minimum formwork described herein is mandatory to ensure clean excavations immediately prior to and during the placing of concrete.

3.3 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.

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 and 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 cement paste.

C. 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.

D. 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.

E. 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.

F. Chamfer exposed corners and edges as indicated, using specified chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

G. 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.

3.4 CONSTRUCTION JOINTS

A. Provide construction joints per ACI 318 Section 26.5.6 where shown on the structural drawings, the approved shop drawings, or as directed by the Architect, subject to the review and approval of DSA.

B. The surface of all horizontal construction joints shall be cleaned and roughened by exposing clean aggregate solidly embedded in mortar matrix to 1⁄4” amplitude.
3.5 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 mortar leaks and maintain proper alignment.

3.6 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.

3.7 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.

3.8 SHORES AND SUPPORTS

A. Comply with requirements of ACI 301 for shoring, reshoring and backshoring in concrete construction and as herein specified where more stringent.

B. Design: Shores must be designed to carry all loads transmitted to them. A rational analysis shall be used to consider, but shall not necessarily be limited to, the following:

1. Structural design load of the slab or member including live load, partition loads, and other loads for which the engineer designed the slab. The reduced live load and an allowance for construction loads shall be taken into consideration when performing the analysis.

2. Dead load weight of the concrete and formwork.
3. Construction live loads, such as placing crews and equipment or stored materials.
5. Strength of concrete at time it is required to support shoring loads from above.
6. The distribution of loads at the time of placing concrete, stripping formwork, and removal of reshoring or backshoring.
7. Span of slab or structural member between permanent supports.
8. Type of formwork systems, i.e., span of horizontal formwork components, individual shore loads, etc.
9. Minimum age where appropriate.
10. Alignment of shores.

3.9 REMOVAL OF FORMS AND SUPPORTS

A. Determination by Contractor's Registered Engineer: The Contractor's registered engineer shall determine and submit for District's record the time and sequence of formwork and shore removal subject to the criteria as specified below.

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.

C. Records of Weather Conditions: The General 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 24 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 should 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.

E. Formwork Supporting Weight of Concrete: Formwork supporting weight of concrete such as beam soffits, joists, slabs and other structural elements shall not be removed until concrete has attained at least the following percentages of the design compressive strength:

   Beam Bottoms - 75%, but not less than 2800 psi
   Slabs - 75%, but not less than 2800 psi

F. Placing Shores:
1. All shoring operations shall be carried out in accordance with a planned sequence as determined by the Contractor's shoring engineer.

2. Shoring operations shall be performed so that at no time will areas of new construction be required to support combined dead and construction loads in excess of the available strength as determined by the design loads (as specified in the General Notes) and the developed concrete strength (as determined by field cured cylinders) at the time of stripping and reshoring or backshoring.

3. Shores shall not be removed until the structural member supported has sufficient strength to support all applied loads.

3.10 FIELD QUALITY CONTROL

A. Field Inspection

2. 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.

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

4. Curbs and Piers
   a. Verify that forms are plumb and straight, braced against movement, lubricated for removal, and conform to approved shop drawings.
   b. Verify proper dimensions, elevations and orientation.

END OF SECTION
SECTION 03 20 00
CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. The work of this 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 fabric, ties and supports shown on the drawings and as specified.

B. Related Sections

1. Section 03 10 00 – Concrete Formwork

2. Section 03 30 00 – Cast-in-Place Concrete

1.3 REFERENCES

A. Codes and Standards: Comply with all provisions of the following codes, specifications and standards except where more stringent requirements are shown or specified:

1. California Code of Regulations, Title 24, 2016 edition, also known as California Building Code (CBC), with Division of the State Architect (DSA) amendments.

2. ACI 301 - "Specifications for Structural Concrete for Buildings".

3. ACI 117 - "Specifications for Tolerances for Concrete Construction and Materials."


5. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".

6. ANSI/AWS D1.4 “Structural Welding Code – Reinforcing Steel”

1.4 SUBMITTALS

A. 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.
2. Submit shop drawings indicating which members, if any, will use fusion welding process for assembly. Shop drawings shall show complete structural details indicating the size of stirrups, the size of holding wires, and welding requirements.

B. Mill Certificates: Submit, for record, mill certificates and/or test results signed by Contractor and Producer, for all reinforcement.

C. Product Data: Submit manufacturer’s product data with application and installation instructions for proprietary materials and items, including mechanical splices, hooked anchorage systems, large-headed stud punching shear reinforcement, dowel bar substitute systems, and dowel bar sleeves.


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.

1.5 QUALITY CONTROL

A. The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

B. The Reinforcing-Placing subcontractor shall attend the Pre-Concrete Conference conducted by the Concrete Contractor as described in Specification Section “Cast-in-Place Concrete”.

1.6 TESTING AND INSPECTION

A. Perform all tests and inspections of reinforcing steel as specified herein.

B. Any testing laboratory retained to run tests required by this specification shall meet the basic requirements of ASTM E 329.

C. Provide inspection of welding, including fit-up, welding equipment, weld quality and welder certification in accordance with AWS D1.4. Where bars do not conform to ASTM A706, chemical analysis shall be made of representative bars to be welded, sufficient to determine carbon equivalent and minimum preheat temperature. Comply with the requirements of CBC Section 1903A.8 and ACI 318.26.6.4.

PART 2 - PRODUCTS

2.1 MATERIALS

A. 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. Reinforcing steel sampling and testing per CBC 1910A.2:
   a. Where bundles are identified as to heat number and accompanied by mill analyses, one tensile test and one bend test shall be made from a specimen of each ten (10) tons, or fraction thereof, of each size and grade of reinforcing steel.
   b. When reinforcement is not positively identified by heat numbers or where random samples are intended, one tensile test and one bend test shall be made of each 2½ tons, or fraction thereof, of each size and grade of reinforcing steel.
   c. Tests of reinforcing bars may be waived by the structural engineer with the approval of DSA where certified mill test reports are provided to the Inspector of Record for each shipment of reinforcement.

3. Reinforcing Bars: Reinforcing bars shall conform to ASTM A615 Grade 60 as noted on the drawings.

4. Weldable Reinforcing Bars: All reinforcing bars noted on the drawings to be welded shall conform to ASTM A706.

5. Deformed Bar Anchors: AWS Type C studs manufactured in conformance with ASTM A 1064 with a minimum tensile strength of 80,000 PSI. Standard ASTM A615 Grade 60 or Grade 40 reinforcing bars may not be substituted for deformed bar anchors. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of use on the project:
   b. Tru-Weld Division, TFP Corporation; Deformed Bar Anchors (ESR-2823)

7. Wire: Smooth wire for spiral reinforcement shall conform to ASTM A 82 with a minimum yield strength of 70,000 PSI.

8. Joint Dowel Bars: Smooth bars used to dowel across slab-on-grade construction joints shall conform to ASTM A615, Grade 60. Cut bars true to length with ends square and free of burrs.

9. 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.

10. Plain Steel Welded Wire Reinforcement: ASTM A185 with a yield strength of 65,000 PSI. Provide in flat sheets only.

11. 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.

12. Supports for Reinforcement: Provide supports for reinforcement including bolster, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations.
   
a. Slabs-on-Grade: Use precast concrete bar supports (dobies) or supports with sand plates or horizontal runners designed for use on ground.
   
b. Spread Footing and grade beam bottom reinforcement: Use precast concrete bar supports (dobies) or chairs designed for soil-supported slabs.
   
c. Exposed to View Concrete: Provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).
   
d. Where bar supports do not come into contact with exposed concrete surfaces: CRSI Class 3.

2.2 SPLICES

A. Mechanical Tension Splices:

1. Mechanical splices shall conform to Type 1 splices, typical unless otherwise noted on the structural drawings.
   
a. Type 1 splice shall develop 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. The bar ends that are to attach to the splice shall be prepared and installed in accordance with the manufacturer’s requirements.

3. Splices shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Report submitted for Engineer review. The following are acceptable mechanical tension splices (splices qualified for use with grade 75 bars are parenthetically noted):
   
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. Barsplice Products, Inc.; ZAP Screwllok (qualified for use with grade 75 bars) (ER-5461). (Type 1 and Type 2)

j. Erica Products, Inc.; Lenton Coupler (ER-3967). (Type 1 or Type 2) (for grade 75 bars #9 and larger, use only Standard Coupler).

k. Splice Sleeve North America; NMB Splice-Sleeve (ER-5645). (Type 1 or Type 2).

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 Spread Footing Reinforcing Steel

1. Bottom Steel: Support bottom reinforcing mat to provide the specified clearance to the bars. Spacing between supports shall not exceed 4'-0" centers each way.
2. Top Steel: Support top reinforcing on steel angle frames braced in both directions or on special standee support bars. Spacing between supports shall not exceed 4'-0" centers each way. The depth of the supports shall provide the specified clearance from the bars to the top of the concrete. The design of the support steel shall be the responsibility of the Contractor.

F. Install welded wire reinforcement in as long lengths as practicable. Lap adjoining pieces at least one full mesh plus two inches 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 barrier 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. 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 District.

3.3 SPlicing REINFORCING STEEL

A. Provide splice 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 between reinforcing bars at splices.

D. Lap reinforcing bars as noted on the structural drawings. Lap welded wire fabric a minimum of one full wire mesh plus two inches.

E. Manufacturer of mechanical tension splice shall be present for first day's installation.

3.4 WELDING REINFORCING STEEL

A. Welding reinforcing steel is permitted only where specifically shown on the drawings. All welding shall conform to AWS D1.4. Only weldable reinforcing steel conforming to
ASTM A 706 or deformed bar anchors conforming to ASTM A 496 shall be permitted. ASTM A 615 bars may not be welded for structural use.

B. Tack welding of reinforcement shall not be permitted.

C. Fusion welding of preassembled cages shall be permitted only under the following conditions and as specified in CBC 1903A.8:

1. Fusion welding of holding wires to ties, stirrups, and hoops in beams, columns and grade beams to preassemble reinforcing cages is permissible. The holding wire area shall not exceed 5% of the beam, column or grade beam cross sectional longitudinal steel area. Fusion welding is not allowed to longitudinal reinforcing steel in any beam, column or grade beam.

2. Fusion welding of holding wires to the ends of the reinforcing steel placed in mats (spread footings, slab reinforcement, etc.) is permitted provide the fusion weld occurs within 6 bar diameters of the free end of the bar (e.g. not allowed a the end of coupled, T-headed, or weld spliced bars).

3. Fusion welding of holding wires shall not occur on a bent portion of a reinforcing bar. Bars may not be bent where a fusion weld occurs.

4. Holding wires shall conform to ASTM A496.

5. All reinforcing steel to be welded shall comply with ASTM A706.

6. Submit complete structural plans indicating which members will use fusion welding process for assembly. Provide complete structural details indicating the size of stirrups and holding wires and welding requirements. Submit a complete shop welding program which includes the following: a) Type of the specific fusion welding machine; b) Periodic inspection protocol of the in-plant welding. This information shall be submitted to the Structural Engineer (SEOR) and Inspector of Record (IOR) for approval. Fusion welding and fabrication is not permitted until approved by the SEOR and IOR.

3.5 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.

3.6 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 one full wire spacing plus 2" across the entire concrete surface and not interrupted by beam or girders.

3.7 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 3" bottom cover to the reinforcing steel. Beam bolsters used shall be designed and manufactured for support on soil.

3.8 REINFORCEMENT IN TOPPING SLABS AND FILL IN METAL PANS

A. Provide welded smooth wire reinforcement minimum 6 x 6 W1.4 x W1.4 in all topping slabs and fill at metal pans unless specified otherwise on the drawings.

3.9 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.

3.10 REINFORCEMENT IN SIDEWALKS

A. Provide welded smooth wire reinforcement minimum 6 x 6 W1.4 x W1.4 in all sidewalks unless detailed otherwise on the Architectural, Civil, Landscape or Structural 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. The District will engage a qualified DSA approved testing and inspection agency (The District’s Testing Laboratory) and a special inspector (IOR) to perform field tests and inspections and prepare test reports.

B. Special Inspections:

1. Steel reinforcement placement. Inspect 100% of reinforcement before each concrete pour to verify the information noted below:
   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 concreting operation.
   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/Contraction/Expansion joint spacing and reinforcement.
l. Reinforcement around embedded items is installed according to details.

2. Steel reinforcement welding: Periodic inspection of the welding of reinforcing bars to assure compliance with the requirements of AWS D1.4.

3. Mechanical Tension Splices:

a. The Laboratory shall provide 100% visual inspection of mechanical tension splices on the project and consult the ICC-ESR report and manufacturer regarding recommendations for installation. Inspection shall verify compliance with specifications and ICC-ESR report, and conformance with the manufacturer’s recommendations for installation. The manufacturer shall be present for the first installation of the splice on the project.

END OF SECTION
SECTION 03 30 00
CAST-IN-PLACE CONCRETE

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 SUMMARY

A. Extent of structural concrete work is shown on drawings, including schedules, notes and details which show size and location of members and type of concrete to be poured. Furnish all labor, materials, services, equipment and hardware required in conjunction with or related to the forming, delivery and placement of all poured-in-place concrete work. Concrete paving and walks are specified in other Sections.

B. Related Sections

1. Section 03 10 00 – Concrete Forming
2. Section 03 20 00 – Concrete Reinforcing
3. Section 03 35 00 – Concrete Finishes
4. Section 03 53 00 – Concrete Topping
5. Section 05 12 00 – Structural Steel
6. Section 31 63 29 – Drilled Concrete Piers

1.3 REFERENCES

A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:

1. California Code of Regulations, Title 24, 2016 edition, also known as California Building Code (CBC), with Division of the State Architect (DSA) amendments.

2. ACI 301 – “Specifications for Structural Concrete for Buildings”.


4. ACI 305 – “Recommended Practice for Hot Weather Concreting”

5. ACI 318 – “Building Code Requirements for Reinforced Concrete”.

1.4 QUALIFICATIONS

A. The concrete supplier shall have a minimum of five years’ experience in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment. The supplier must be certified according to the National Ready Mixed Concrete Association’s Certification of Ready Mixed Concrete Production Facilities.

B. The concrete contractor shall have a minimum of five years’ experience with installation of concrete similar in material, design and extent to that indicated for this Project and whose work has resulted in construction with a record of successful service performance.

C. Any testing laboratory retained to run tests required by this specification shall meet the basic requirements of ASTM E 329.

1.5 QUALITY CONTROL

A. The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

B. 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.

C. Inspection and Testing of the Work: Materials and installed work may require testing and retesting, as directed by the DSA, or the Architect/Engineer, at any time during progress of work.

1. The Contractor shall provide adequate notification to the IOR and the District’s Testing Agency of construction operations including the project schedule to allow the Testing Agency to schedule inspections. Failure to sufficiently notify may result in additional costs incurred by the Testing Laboratory that may be back-charged to the Contractor by the District.

2. The Contractor shall cooperate with laboratory personnel, provide access to the work, and to manufacturer's operations.

3. The Contractor shall make adequate arrangement with the IOR and the District’s Testing Agency for inspection of material stockpiles and facilities.

4. The Contractor shall provide to the IOR and Laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.

5. 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.
D. Inspection or testing by the District 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 District's expense, including retesting of rejected materials and installed work, shall be done at the Contractor's expense. Acceptance Criteria for Concrete Strength: The strength level of an individual class of concrete shall be considered satisfactory if both 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 0.1 \( f'c \) or 500 psi, whichever is greater.

3. A strength test is defined as the average strength of two 6” x 12” cylinder breaks or three 4” x 8” cylinder breaks tested at the strength age indicated on the drawings for that class of concrete.

E. 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.

F. Manufacturer Representative Presence:

1. Post-installed anchors: The manufacturer's representative for each post-installed anchor product (adhesive, expansion, undercut, screw, or insert anchor) shall be present during the first day's installation of the product to observe whether the anchors are installed according to manufacturer's instructions.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer’s product data with application and installation instructions for proprietary materials and items, including admixtures, epoxies, grouts, joint systems, curing compounds, sealers mechanical splices, hooked anchorage systems, dowel bar substitute systems, dowel bar sleeves, joint fillers, and others as requested by Architect/Engineer.

B. Samples: Submit samples of materials specified if requested by Architect/Engineer, including names, sources and descriptions.

C. Mix Designs: Submit mix designs as specified herein.

D. Material and Mill Certificates: 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. Provide certification from admixture manufacturers that chloride ion content complies with specified requirements.
E. Construction Joints: Submit drawing of proposed construction joint locations in concrete for slab on grade, mat foundations, structural floors, roofs and walls. Submit any additional or changed reinforcing that is required at construction joints that differs from that shown on the drawings.

F. Minutes of preconstruction conference.

G. Surveys: Submit report certifying that all anchor rods and reinforcing dowels into columns above are in their proper location prior to placing of concrete.

1.7 PROVISION FOR OTHER WORK

A. 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.

B. Protect adjacent finish materials against damage and spatter during concrete placement.

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, Type II.

2. Use one brand of cement, for each class of concrete, throughout the project, unless approved otherwise by the Architect/Engineer and the District’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 District, Architect, Engineer or District’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 F.

E. Slag Cement: ASTM C 989, Grade 100 or 120, or ASTM C 595, Type IS or Type S.
F. Normal Weight 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 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.

G. Light Weight Aggregates: ASTM C330, 3/8” pea gravel, weight = 110 PCF.

H. Water: Comply with the requirements of ASTM C 1602

2.2 ADMIXTURES


Subject to compliance with requirements, provide one of the following products and
manufacturers:

"Darex" or "Daravair" series; W. R. Grace & Co.
"MB-VR", "MB-AE90" or "Micro-Air"; BASF Admixtures, Inc
"Sika AER"; Sika Corporation
"Air Mix" or "AEA-92"; The Euclid Chemical Company
"Eucon Air 30" or "Eucon Air 40", The Euclid Chemical Company.

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.

Subject to compliance with requirements, provide one of the following products and
manufacturers:

"Pozzolith" series; BASF Construction Chemicals
"Plastocrete 161"; Sika Chemical Corp.
"Eucon WR-75 or WR-91"; The Euclid Chemical Company.
"WRDA \"series W.R. Grace & Co.
"Eucon NW\" or "Eucon LW", The Euclid Chemical Company

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.

Subject to compliance with requirements, provide one of the following products and
manufacturers:
“Polyheed” series, BASF Construction Chemicals
“Eucon MR”, The Euclid Chemical Company
“Sikament HP”, Sika Chemical Corp.
“Daracem” or “Mira” series, W.R. Grace & Co.
“Eucon X15” or “Eucon X20”, The Euclid Chemical Company

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.

Subject to compliance with requirements, provide one of the following products and manufacturers:

"ADVA" or "Daracem" Series; W.R. Grace & Co.
"Rheobuild 1000" or "Glenium" series; BASF Construction Chemicals
"Sikament"; Sika Chemical Corp.
"Eucon 37/1037" or "Plastol" series; The Euclid Chemical Company
“Eucon SP” or “Eucon RD”, The Euclid Chemical Company

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.

Subject to compliance with requirements, provide one of the following products and manufacturers:

"Pozzutec 20+; BASF Construction Chemicals
"Accelguard 80/90"; “NCA”, or “AcN”, The Euclid Chemical Company
“Plastocrete 161FL”, Sika Chemical Co.
“Eucon AcN”, The Euclid Chemical Company

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.

Subject to compliance with requirements, provide one of the following products and manufacturers:

"Daratard" series, W.R. Grace & Co.
"Pozzolith" series or "DELVO" series; BASF Construction Chemicals
"Plastiment"; Sika Chemical Co.
“Eucon Retarder”, Series, The Euclid Chemical Company
Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.

G. Calcium Chloride and Chloride Ion Content: Calcium chloride or admixtures containing more than 0.5% chloride ions by weight of the admixture are 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 mix design review by the Engineer.

2.3 RELATED MATERIALS

A. Waterstops: Provide waterstops at joints where shown on the drawings. Size to suit joints. Provide flat, dumbbell type or centerbulb type.

1. ADCOR ES waterstops: W.R. Grace & Co.

2. Polyvinyl chloride (PVC) waterstops: Corps of Engineers CRD-C 572.


   Manufacturers: Synko-Flex Products, Inc.


B. Vapor Retarder: Provide vapor retarder cover chosen from products specified below over prepared base material where indicated.

1. Plastic Vapor Retarder 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
   d. Acceptable products include the following:

   "Stego Wrap Vapor Barrier (15 mil)", Stego Industries, LLC
   "EcoShield-E" (15 mil), Epro Waterproofing Systems
   W.R. Meadows, Inc; “Perminator” (15 mil)

2. Tape for Plastic Vapor Retarders: High-density polyethylene tape with pressure sensitive adhesive having a minimum width of 4 inches having a maximum water vapor transmission rate of .3 perms.

C. Slip-resistant Emery Aggregate or Aluminum Granule Finish: Provide fused aluminum-oxide granules, or crushed emery, as abrasive aggregate for slip-resistant finish. The emery aggregate shall contain not less than 50% aluminum oxide and not less than 20% ferric oxide. The aluminum aggregate material shall contain not less than 95% fused aluminum-
oxide granules. Use material that is factory-graded, packaged, rust-proof and non-glazing, and is unaffected by freezing, moisture and cleaning materials.

Subject to compliance with requirements, provide one of the following:

"Emery Tuff Non-Slip", Dayton-Superior
"Grip-It" or “Grip-It AO”, L&M Construction Chemicals, Inc
“Frictex NS”, Sonneborn-ChemRex

D. Sealers: Refer to specifications Section 03 35 00 Concrete Finishes.

E. Bonding Compound: Polyvinyl acetate or acrylic base, for use in cosmetic and/or nonstructural repairs.

Products: Subject to compliance with requirements, provide one of the following:

1. Acrylic or Styrene Butadiene:
   
   "Day-Chem Ad Bond (J-40)"; Dayton Superior
   "SBR Latex"; The Euclid Chemical Company
   "Daraweld C"; W. R. Grace
   "Acrylic Additive" BASF Building Systems
   "SikaLatex", Sika Chemical Co.
   "Intralok", W. R. Meadows
   "Akkro 7-T”, The Euclid Chemical Company

2. Polyvinyl Acetate (Interior Use Only)
   
   "Tammseld"; The Euclid Chemical Company
   "Everweld"; L & M Construction Chemicals, Inc.
   "Superior Concrete Bonder (J-41)," Dayton Superior

F. Epoxy Products: Two component material suitable for use on dry or damp surface, complying with ASTM C 881.

1. Products for Crack Repair:
   
   "Sikadur 35 Hi Mod LV"; Sika Chemical Company – injection type
   "Sikadur 52", Sika Chemical Company – injection type
   "Sikadur 55 SLV", Sika Chemical Company – gravity feed
   "Eucopoxy Injection Resin," The Euclid Chemical Company
   "Sure-Inject (J-56)," Dayton Superior
   “Duralcrete LV”, The Euclid Chemical Company

2. Products for Epoxy Mortar Patches:
   
   "Sikadur Lo-Mod LV", Sika Chemical Corporation
   "Duralcrete”, The Euclid Chemical Company
"Sure Grip Epoxy Grout (J-54)," Dayton-Superior
"Epofil", BASF Building Systems
"Duralcrete LV", The Euclid Chemical Company

3. Products for Adhesive Anchors or Reinforcing Steel in Normal weight Concrete:
Product that conforms to ASTM C 881-02, Type IV, Grade 3, Class A, B, & C
except gel times, and that is dispensed from a two-component cartridge system
through a mixing nozzle that thoroughly mixes the two components as it is injected
into the hole.

a. ICC Approval: Only anchors evaluated by the ICC Evaluation Service,
   Inc. (ICC-ES) with a published, currently valid, Evaluation Report
   showing it as having passed Acceptance Criteria 308 shall be approved for
   use.

b. Consult with the manufacturer for the minimum temperature of the
   concrete substrate allowed.

c. All epoxy anchors require continuous inspection.

d. Install only anchors identified on the drawings by manufacturer and
   product.

G. Self-Leveling Mortars, Underlayment Compound: Freeflowing, self-leveling, pumpable
   cementitious base compound. Follow manufacturer's instruction regarding the use of a
   bonding agent.

Products: Unless specified otherwise, provide one of the following:

"Sonoflow," BASF Building Systems
"Sikatop 111", Sika Chemical Co.
"Flo-Top" or "Super Flo-Top"; The Euclid Chemical Company
"Levelayer I," Dayton Superior
"Level Magic", The Euclid Chemical Company

H. Polymer Patching Mortar: Polymer and microsilica modified cementitious based
   compounds.

Products:

Horizontal Application

"Thin Top Supreme, Concrete Top Supreme," The Euclid Chemical Company
"Sikatop 121 or 122," Sika Chemical
"Emaco R310 CI," BASF Building Systems
"Sonopatch 100 or 200", BASF Building Systems
"US Spec H2 or NuTop" US Mix Co.
"Speed Crete PM", The Euclid Chemical Company

Upwardly Inclined Application

"Verticoat/Verticoat Supreme," The Euclid Chemical Company
"Sikatop 123," Sika Chemical
"Emaco R350 CI," BASF Building Systems
"Sonopatch 200", BASF Building Systems
"Speed Crete PM", The Euclid Chemical Company

1. 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 9000 psi @ 28-days at a 9-inch slump.

Products:

  "Road Patch", BASF Building Systems
  "Eucocrete", The Euclid Chemical Company
  "Form and Pour", The Euclid Chemical Company

J. Expansion Anchors in Concrete:

1. ICC Approval: Only anchors evaluated by the ICC Evaluation Service, Inc. (ICC-ES) with a published, currently valid, Evaluation Report showing it as having passed Acceptance Criteria 193 and approval for use in cracked concrete and resisting wind and seismic loads shall be approved for use.

2. Type: All expansion and undercut anchors in concrete shall be only wedge type expansion, sleeve-type expansion, or undercut type anchors.

3. Interior Use: All anchors, nuts and washers 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.

4. 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.

5. Nuts and Washers: Nuts and washers shall be furnished from the manufacturer and used with the anchors.

6. Install only anchors identified on the drawings by manufacturer and product. Special inspection is required on all anchor installations.

K. Screw and Insert Anchors in Concrete

1. Approvals: Only anchors evaluated by the ICC Evaluation Service, Inc. (ICC-ES) with a published, currently valid, Evaluation Report showing it as having passed Acceptance Criteria 193 and approved for use in cracked concrete and resisting wind and seismic loads shall be approved for use.
2. Interior Use: All screw 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.

3. Exterior or Exposed Use: All screw 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.

4. Acceptable Products and Manufacturers – All Conditions:
   
   “Titen HD”, Simpson Strong-Tie Co., Inc (continuous inspection), ICC ESR-2713

5. Install only anchors identified on the drawings by manufacturer and product. Special inspection is required for all anchor installations.

L. Threaded Rods Chemically Anchored in Concrete

1. Type: Threaded rods installed in holes using a chemical anchoring process shall have a 45° chiseled end on one end.

2. Interior Application: Meet the requirements of ASTM A307, A36 or A193, grade B7.

3. Exterior Application: Meet the requirements of ASTM A153 galvanized steel, or F 593, Group 1 or 2, condition CW stainless steel.

M. Non-Shrink Grout:

1. Type: Grout for anchoring rebar in sleeves, base plates, bearing plates and grouting under precast or tilt-up wall panels shall be a non-metallic, shrinkage resistant, premixed, non-corrosive, non-staining product containing Portland cement, silica sands, shrinkage compensating agents and fluidity improving compounds.

2. Specifications: Non-shrink grout shall conform to ASTM C 1107.

3. Compressive Strength: Provide the minimum strength as shown below as determined by grout cube tests at 28 days:

   a. Unless noted otherwise on the drawings, grout strength on supporting concrete shall be 8000 psi.

4. Products: Acceptable non-shrink grouts are listed below:

   a. L&M Construction Chemicals, Inc.; Crystex.
   b. BASF Corporation; Masterflow 713.
   c. BASF Corporation; MasterFlow 100.
   d. The Euclid Chemical Company; NS Grout.
e. Dayton Superior Corporation, Inc; 1107 Advantage Grout
f. Hilti, Inc.; Precision Grout.
g. W.R. Meadows, Inc; CG-86 Grout.
i. SpecChem, LLC; SC Multipurpose Grout

N. Reglets: Where resilient or elastomeric sheet flashing or bituminous membrane are terminated in reglets, provide reglets of not less than 26 gage galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

O. 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:

“Sure-Lift”, Dayton Superior Corporation, Inc.
SpecChem, LLC; SpecTilt 100.

P. Rigid-Cellular-Polystyrene Boards use as Fill under Topping Slabs, Equipment Pads, 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 48 kg/m³. 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)

2.4 PROPORTIONING AND DESIGN OF CONCRETE MIXES

A. The Contractor shall submit concrete mix designs for each class of concrete indicated on the structural drawings and in the Specifications for approval by the Engineer and District'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 mix design. The Contractor shall not begin work with a particular mix until that mix design has been approved.

B. The Contractor, acting in conjunction with his Concrete Supplier and his Testing Laboratory, shall submit in writing, with his mix designs, the method used to select mix proportions.

1. For concrete with 15% or less fly ash (or other pozzolans) replacement of Portland cement (by weight), either of the following methods, as outlined in ACI 301 and ACI 318, may be used.

   a. Field Experience Method
   b. Laboratory Trial Mixture Method

C. Required types of structural concrete and compressive strengths shall be as indicated on the Structural Drawings.
D. All mix designs shall state the following information:

1. Mix design number or code designation by which the Contractor shall order the concrete from the Supplier.
2. Structural slab or member for which the concrete is designed (i.e., columns, shear walls, footings, slab on grade, etc.).
3. Wet and dry unit weight.
4. 28 day compressive strength.
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 mix 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 exposed to 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 mix designs that maximize cement replacement while meeting strength requirements per ACI 318 Section 26.4 and finishability criteria.

2. The use of fly ash or slag in architecturally exposed structural concrete shall be coordinated with the Architect, Engineer of Record, and Contractor.

3. If fly ash is used, it must be at a minimum replacement percentage of 15%.

4. 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 mix shall not exceed the maximum identified with fly ash alone.

5. Replacement percentages exceeding the maximum may be permitted at the discretion of the Architect, Engineer of Record, and Contractor.

6. 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.

7. Except for Mass Concrete, the Contractor may submit for approval a revised mix design 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 in.) or 8% - 22% for smaller top size aggregates (1 in. or 3/4 in.) 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 District’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.

I. Adjustments of Concrete Mixes: Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Such mix design adjustments shall be provided at no additional cost to the District. Any adjustments in approved mix designs including changes in admixtures shall be submitted in writing with the specified Concrete Mix Design Submittal Form to the Engineer and District's Testing Laboratory for approval prior to field use.

J. Shrinkage: Concrete so identified on the drawings shall be proportioned for a maximum allowable unit shrinkage as noted on the drawings, measured at 28 days after curing in lime water as determined by ASTM C 157 (using air storage). Submit results of test for each class of applicable concrete after every 500 cubic yards placed.

K. 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 318-08 Table 4.3.1 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 mix design submittal and each time a change is made to the mix design (such as change in aggregate type or source).
2. The Concrete Supplier shall certify in the Mix Design Submittal that the chloride ion content in all concrete mix designs used on the project does not exceed the limits stated above.

2.5 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with requirements of ANSI/ASTM C 94, "Ready Mixed Concrete" and this specification.

B. Concrete Fill at Stairs: Mix in proportions by volume of one part cement, two parts fine aggregate, one part coarse aggregate (3/8 inch), with as little water as possible to create a stiff, workable plastic mix.

2.6 SOURCE QUALITY CONTROL

A. Concrete Batch Plant Inspection: An initial batch plant inspection shall be made by the District’s Testing Laboratory prior to the start of concrete work. The scope of batch plant inspection shall include the following:

1. Inspection of Batch Plant Facilities: The Laboratory shall inspect batch plant facilities proposed for use in the work and report in writing inspection results to the Architect, Engineer, and District for approval. The inspection shall confirm the batch plant conforms to the standards set forth in ASTM C94 and can show proof of certification by the National Concrete Ready Mix Association. Inspection shall include:

   a. Batch Plant operations and equipment
   b. Truck mixers
   c. Scales
   d. Stockpile placement
   e. Material storage
   f. Admixture dispensers

2. Multiple Batch Plants: The Contractor shall reimburse the District for the costs accrued to the District’s Testing Laboratory for visits to more than 1 batch plant.

3. Waiver of Batch Plant Inspection

   a. Continuous batch plant inspection may be waived in accordance with CBC Section 1705A3.3.1 if the plant complies with ASTM C94 and has been certified by an agency acceptable to DSA to comply with the requirements of the National Ready Mix Concrete Association.

   b. When batch plant inspection is waived, the following is required:

      (1) The District’s Testing Agency shall check the first batching at the start of concrete work and furnish mix proportions to the licensed Weighmaster.

      (2) Licensed Weighmaster shall identify material quantities and certify each load by a ticket.

      (3) The Project Inspector shall collect truck mix tickets with load identification and maintain a daily record of placement.
without a load ticket identifying the mix shall be rejected. Copies of daily placement record shall be submitted to DSA.

c. At project closeout, the Weighmaster shall submit an affidavit to DSA certifying that all concrete supplied conforms to the proportions established by mix designs.

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 inch of the design slump noted on the approved mix design. Water may be added to the concrete in the field only to the extent that the prescribed water/cementitious ratio noted in the approved mix design is not exceeded.

3.2 VAPOR RETARDER INSTALLATION

A. Install vapor retarder in accordance with ASTM E 1643 and manufacturer’s instructions.

B. Lap all seams 6" 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.

3.3 JOINTS IN CONCRETE

A. Construction Joints: Locate and install construction joints as indicated on the DSA approved drawings.

1. Keyways: Provide keyways with a depth of one tenth of the member thickness (1 1/2" minimum or as shown on the DSA approved drawings) in construction joints only where shown on the drawings.

2. Joint Construction: Unless noted otherwise on the DSA approved drawings, place construction joints in the center one third of suspended spans and grade beams and as shown on the DSA approved 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. Joint Preparation: The surfaces of horizontal construction joints shall be cleaned and roughened by exposing clean aggregate solidly embedded in mortar matrix.
4. 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.

B. Contraction Joints in Slabs-on-Ground and Unbonded Topping Slabs: Maximum joint spacing shall be 36 times the slab thickness or 20 feet, whichever is less and at a minimum on column lines unless otherwise noted on the drawings. 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.

1. Sawed Joints
   a. Primary Method: Early-Entry, dry-cut method, by Soff-Cut International, Corona, CA (800) 776-3328. Finisher must have documented successful experience in the use of this method prior to this project. Install cuts within 1 to 4 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 1 1/4” inch into the slab.
   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 4 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 1/4 of the slab thickness but not less than 1 inch. Cut to a depth of 1/3 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 1/4 the slab thickness, but not less than 1 inch. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.

   a. Remove dirt and debris from the joint by vacuuming immediately prior to filling joint. Clean the joint of curing compounds and sealers.
   b. Filler material shall be applied to the joints when the building is under permanent temperature control, but no less than 90 days after slab construction.
   c. Follow the manufacturer's recommended procedure for installing filler material. The joint filler must be flush with the adjacent concrete. A concave profile on the top of the joint filler is unacceptable and will be grounds for removal and replacement.

4. 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. 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.

C. Do not install sleeves in concrete slabs, pier caps, footings or walls except where shown on the structural drawings or approved by the Architect, Engineer and DSA.

D. 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 casting 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 Inspector of Record shall collect and retain concrete batch trip tickets and maintain a daily record of placement. 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 Inspector of Record and Testing Laboratory shall immediately notify the Architect/Engineer and Contractor of tickets not meeting the criteria specified.

C. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

D. Comply with ACI 301 and as herein specified.

1. Place concrete in accordance with ACI 318 Section 26.5.2.

2. Concrete Temperature: The maximum acceptable concrete temperature at the truck discharge point shall be 90°F.

3. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which 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-handled, square-ended shovels, or come-alongs.

4. 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.

5. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use internal vibrators of the largest size and power that can properly be used in the work as described in the table entitled “Range of characteristics, performance, and applications of internal vibrators” found in ACI 301.

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 rapidly penetrate 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. 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.

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 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.

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. Definitions 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 in. wide or 1/2 in. 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 1.1 (SF-1.1):
   a. No formwork facing material is specified
   b. Patch voids larger than 1 in. wide or 1/2 in. deep
   c. Remove projections larger than 1/2 inch.
d. Provide surface tolerance Class C as specified in ACI 117

e. Tie holes need not be patched

3. Surface Finish 2.0 (SF-2.0):

   a. Provide specified formwork-facing material
   b. Patch voids larger than 3/4 in. wide or 1/2 in. deep
   c. Patch tie holes
   d. Remove projections larger than 1/4 in.
   e. Provide surface tolerance Class B as specified in ACI 117
   f. Provide mock-up of concrete surface appearance.

4. Surface Finish 2.2 (SF-2.2):

   a. Provide specified formwork-facing material
   b. Patch voids larger than 3/4 in. wide or 1/2 in. deep
   c. Patch tie holes
   d. Remove projections larger than 1/4 in.
   e. Provide surface tolerance Class B as specified in ACI 117

5. Surface Finish 2.3 (SF-2.3):

   a. No formwork-facing material is specified
   b. Patch voids larger than 3/4 in. wide or 1/2 in. deep
   c. Patch tie holes
   d. Remove projections larger than 1/4 in.
   e. Provide surface tolerance Class B as specified in ACI 117

C. Standard Finish: Provide SF-1.0 on all concrete surfaces not exposed to view in the final condition unless otherwise specified.

D. Exposed Finishes: Provide SF-2.0 on all concrete surfaces exposed to view in final condition unless otherwise specified.

E. 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

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.

A. 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.

B. 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.

C. 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 which would telegraph through applied floor covering system.

D. 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.

E. Slip-Resistive Broom Finish: Apply slip-resistant broom finish to 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.

F. Penetrating Sealer Finish: Apply a chloride-and-water-repelling-penetrating-sealer finish to surfaces as described below and where indicated on the drawings. Apply liquid penetrating sealer after complete curing and drying of the concrete surface. Apply proprietary sealers in strict accordance with manufacturer's printed instructions. The Contractor shall verify the compatibility of the sealer product with the paint used to stripe parking decks and coordinate the sequencing of the sealing and striping operations. Apply to the following surfaces:

1. Top surfaces of exposed exterior walkways

G. Slip-Resistive Aggregate Finish: Apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps and elsewhere as indicated on the Architect's or Structural Drawings.

After completion of float finishing, and before starting trowel finish, uniformly spread 25 lbs. of dampened slip-resistive aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as herein specified.
After curing, lightly work surface with a steel wire brush, or an abrasive stone, and water to expose slip-resistive aggregate.

H. Finish of Top of Spread Footings:

1. Top Surface below Finished Slab: The top of the footing or mat shall be screeded level and smooth with a flatness F-number, \( F_F \leq 15 \) (overall), \( F_F \leq 10 \) (minimum local) and a levelness F-number, \( F_L \leq 12 \) (overall), \( F_L \leq 10 \) (minimum local).

2. Top Surface as Finished Slab: The top surface of a footing or mat that is to serve as the finished slab in the building shall be leveled, cured, and surface prepared as specified for the finished slab in the building shall be leveled, cured, and surface prepared as specified for the finished floor construction appropriate to the space usage as defined in the Architectural Drawings.

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 - \( \pm \frac{3}{4}" \).

2. Top surfaces of formed slabs measured prior to removal of supporting shores - \( \pm \frac{3}{4}" \).

3. Top surfaces of all other slabs - \( \pm \frac{3}{4}" \).

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.

<table>
<thead>
<tr>
<th>Floor Surface Classification</th>
<th>SOF(_F)</th>
<th>SOF(_L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Moderately Flat</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Flat</td>
<td>35</td>
<td>25</td>
</tr>
<tr>
<td>Very Flat</td>
<td>45</td>
<td>35</td>
</tr>
<tr>
<td>Super Flat</td>
<td>60</td>
<td>40</td>
</tr>
</tbody>
</table>

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 1/4” 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.

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, 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

G. 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 District'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 District'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 District'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 District'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 District'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 District and with no extension to the construction schedule.

3. Removal and Replacement:

a. If, in the opinion of the Architect/Engineer or District'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 District's Representative.

f. The judgment of the Architect/Engineer or District's Representative on the need for replacement shall be final.

g. All replacement work shall be performed at no additional cost to the District 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 lb./sq. ft. - hr for concrete containing silica fume and 0.2 lb./sq. ft. - hr 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 7 days for all concrete except high early strength concrete which shall be cured for 3 days minimum.

3. 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 Shearwalls Not 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, liquid membrane-forming curing and sealing compound conforming to ASTM C 1315, type I, Class A or B for method 3.

2. Columns and Shearwalls 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.

3. Sides and Soffits of Beams, 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.

4. 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. Ramps and Horizontal Surfaces of Parking Areas, Exposed Exterior Balconies: Cure using only methods 1 or 2 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. 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:

   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, curing/hardener, liquid membrane-forming curing, or curing and sealing compound as follows:

   Apply specified compound to concrete slabs as soon as final finishing operations are complete (within 2 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. Recount areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period. Apply second coat for sealing 2 to 3 hours after the first coat was applied.

   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 mixes 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.

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 District'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 3 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. Limits:

1. Concrete shall not be placed when the outside air temperature is 40°F or less.

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. Installation of Adhesive Anchors Using Injectable Epoxy or Adhesive: The District's Testing Laboratory representative or the project IOR shall provide special inspection of the installation of all adhesive anchors. A representative of the adhesive manufacturer shall be present for the first day that adhesive anchors are installed. After drilling the hole to the diameter and depth recommended by the manufacturer, clean the hole with a wire or nylon
brush. Blow the dust out of the hole using compressed air with a nozzle that reaches to the bottom of the hole. When using adhesive from a new pack, the adhesive that is discharged from the mixing nozzle should be a uniform gray color before any adhesive is installed in the hole. Fill the hole with adhesive starting from the very bottom of the hole until the hole is about 2/3 full. Do not leave an air pocket at the bottom of the hole. Insert the anchor rod or dowel by slowly twisting it into the hole.

3.13 CONCRETE SURFACE REPAIRS

A. Definition - Defective Areas:

1. Formed Surfaces: Concrete surfaces requiring repairs shall include all cracks in excess of 0.01" 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 0.01" wide or cracks which 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 binder, 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 1 inch in depth.
3.14 FIELD QUALITY ASSURANCE

A. The District will engage a special inspector (IOR) and qualified testing and inspection agency (the District’s Testing Laboratory) to perform field tests and inspections and prepare test reports.

B. Special Inspections: The District’s Testing Laboratory or a separate agency 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 2016 CBC. 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. Verification of use of required design mixture
2. Concrete placement, including conveying and depositing
3. Curing procedures and maintenance of curing temperatures
4. Verification of concrete strength before removal of shores and forms from beams and slabs.
5. Anchor rods, bolts and other embeds installed in concrete.

C. Qualifications of Special Inspector (IOR): The IOR shall be a qualified person who is approved by DSA.

D. Duties and Responsibilities of the Special Inspector:

1. The IOR 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.

2. The IOR shall furnish inspection reports to DSA, the Architect/Engineer, and the District. All discrepancies shall be brought to the immediate attention of the Architect/Engineer, Contractor, and District. A report that the corrected work has been inspected shall be sent to DSA, the Architect/Engineer, and the District.

3. The IOR 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.

E. Qualifications Of Testing Laboratory

1. The Testing Laboratory shall meet the basic requirements of ASTM E329 and shall submit to the District, 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 of
   the city wherein the project is located 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.

F. Authorities And Duties Of The Laboratory

1. Attending Preconstruction Conferences: The District’s Testing Laboratory shall
   receive from the District and review the project plans and specifications with the
   Architect and Engineer as soon as possible prior to the start of construction. The
   Laboratory shall attend preconstruction conferences with the Architect, Engineer,
   Project Manager, General Contractor, and Material Suppliers as required to
   coordinate materials inspection and testing requirements with the planned
   construction schedule and shall participate in such conferences throughout the
   course of the project.

2. Cost Proposal: The Testing Laboratory's proposal to the District 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.

3. Cooperation with Design Team: The Laboratory shall cooperate with the
   Architect, Engineer, and Contractor and provide qualified personnel promptly on
   notice.

4. The Laboratory shall perform the required inspections, sampling, and testing of
   materials as specified under each section and observe methods of construction for
   compliance with the requirements of the Contract Documents and the applicable
   building code.

5. 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.

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

7. Reports:
   a. Information on Reports: The Laboratory shall submit copies of reports of
      inspections and tests promptly and directly to the parties named below.
      The reports shall contain at least the following information:
      (1) Project Name
      (2) Date report issued
(3) Testing Laboratory name and address
(4) Name and signature of inspector
(5) Date of inspection and sampling
(6) Date of test
(7) Identification of product and Specification section
(8) Location in the project
(9) Identification of inspection or test
(10) Record of weather conditions and temperature (if applicable)
(11) Results of test regarding compliance with Contract Documents

b. Copies: The Laboratory shall send signed copies of test and inspection reports to the following parties:
   (1) 1 copies to the District or his representative
   (2) 1 copies to the General Contractor
   (3) 1 copy to the Architect
   (4) 1 copy to the Engineer of responsibility

8. Certification: Upon completion of the job, the Laboratory shall furnish to the District, 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.

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

10. 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 District, Architect, and Engineer when those submittals are not made in a timely manner.

11. 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.

G. Concrete Mix Designs: The District’s Testing Laboratory shall review the submitted mix designs for conformance to the specifications and for suitability for use in the project. The Testing Laboratory shall attend the Mix Design Conference and the Pre-Concrete Conference as noted in the Cast-in-Place Concrete Specification.

H. Job Site Inspection: The scope of the work to be performed by the inspector on the jobsite shall be as follows:

1. Prior to Concrete Placing
   a. Spread Footings
      (1) Verify footing dimension.
      (2) Verify top of footing elevation.
(3) Verify that forms are plumb and straight, braced against movement, and lubricated for removal.
(4) Inspect reinforcement per REINFORCING STEEL section.

b. Drilled Piers
(1) Verify pier dimension.
(2) Verify bottom and top of pier elevations.
(3) Verify that pier form at top is plumb and straight, braced against movement, and lubricated for removal.
(4) Inspect pier hole to verify hole is clean and dry.
(5) Inspect reinforcement per REINFORCING STEEL section.

c. Slab-on-Grade
(1) Verify that moisture retarder is provided, is lapped properly, and is not torn or punctured.
(2) Verify formwork at turndowns and slab edges is plumb and straight, braced against movement and lubricated for removal.
(3) Inspect reinforcement per REINFORCING STEEL section.
(4) Verify there is no standing water or debris in pour area.

d. Curbs and Housekeeping Pads
(1) Verify that forms are plumb and straight, braced against movement, lubricated for removal, and conform to approved shop drawings.
(2) Verify proper dimensions, elevation and orientation.
(3) Inspect reinforcement per REINFORCING STEEL section.
(4) Verify that debris is removed.

2. On-Site Concrete Material Testing and Inspection

a. Verify that the Contractor is following appropriate concreting practices consistent with any extreme environmental conditions at the point of placement in the structure as defined below.

b. Inspect concrete upon arrival to verify that the proper concrete mix number, type of concrete, concrete strength, and that it is meeting job specifications, is being placed at the proper location. Report concrete not meeting the specified requirements and immediately notify the Contractor, Batch Plant Inspector, Architect, Engineer, and District.

c. 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. Record the amount of water added and note if it exceeds that allowed in the mix design. 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.

d. Obtain concrete test cylinders as specified below.

e. Perform tests to determine slump, concrete temperature, unit weight, and air entrainment as specified below. The slump tests shall be made on concrete taken from the same location from which the concrete for the test cylinders is obtained.

f. Record information for concrete test reports as specified below.

g. Verify that concrete being placed meets job Specifications. Report concrete not meeting the specified requirements and immediately notify
the Contractor, Batch Plant Inspector, Architect, Engineer, IOR and District.
h. Pick up and transport to Laboratory, cylinders cast the previous day.

3. During concrete placing, provide continuous monitoring to:
   a. Verify that the concrete is not over 90 minutes old at the time of placement.
   b. Verify that Hot-Weather techniques are being applied as required.
   c. 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.
   d. Verify that there are no cold joints.
   e. Verify that the concrete is properly vibrated.
   f. Verify that the finishing of the concrete surface is done according to specifications.
   g. Verify that sawcut control joints on slab-on-grades are cut within 12 hours of placement.
   h. Verify that the formwork has remained stable during the concreting operation.
   i. Inspect anchor rods, bolts and other items embedded in concrete prior to and during concrete placement for proper grade, size and length and verification they have been properly installed to the specified embedment.

4. 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.

   a. Continuous Inspection: Unless noted otherwise all Post-Installed Anchors shall have Continuous Inspection. Verify each installation of post-installed anchors in concrete in accordance with the requirements stated below for each type of anchor.

   b. 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.
      (1) concrete type, concrete strength and concrete thickness are in accordance with design drawings
      (2) anchor manufacturer and product is in accordance with design drawings or approved substitution
      (3) anchor diameter, length and installed embedment depth
      (4) drill bit type and diameter
      (5) anchor edge distance and spacing
      (6) hole diameter and depth
      (7) hole cleaning procedure and cleanliness
      (8) anchor maximum tightening torque

   c. Adhesive Anchors: In addition to the requirements for All Post-Installed Anchors, verify following design requirements:
      (1) adhesive identification and expiration date
      (2) The installation of all adhesive anchors subject to sustained direct tension loads or installed in a upwardly inclined condition as noted on the drawings shall be continuously inspected.
d. Periodic Inspection: Where Periodic Inspection is specified, 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.

5. In-situ Concrete Strength Verification: The District’s Testing Laboratory shall verify that the concrete has reached the required minimum strength before form removal by evaluating the specified tests.
   
a. 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 joist 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 C31. Field cured test cylinders shall be molded at the same time and from the same samples as Laboratory cured test specimens. The cylinder shall be broken at the time of form removal as directed by the Contractor. The Contractor shall reimburse the District for the cost of making and testing these cylinders.
   
b. If concrete strength for form stripping is to be determined using the Maturity Method, the District’s Testing Laboratory shall verify that the requirements of ASTM C 1074 are being followed and that the proper criteria for determining concrete strength by this method has been established and is being followed.

6. After Concrete Floor Placing and Finishing
   
a. Verify that the curing process is according to specifications and that any curing compound used is applied in accordance with manufacturer’s recommendations.

7. The job site inspector shall report any irregularities that occur in the concrete at the job site or test results to the Contractor, Architect, District, and Engineer.

l. Concrete Test Cylinders: The District’s Testing Laboratory shall cast and test concrete test cylinders as described below.

1. Cylinder Casting and Testing: Cylinders for strength tests shall be casted and Laboratory cured in accordance with ASTM C31 and tested in accordance with ASTM C39. 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 C172.
3. Frequency of Testing: Each set of test cylinders shall consist of a minimum of four standard test cylinders. 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. Spread Footings: One set for each 50 cubic yards or fraction thereof.
c. Floors: One set for each 50 cubic yards or fraction thereof but not less than one set for each 2000 square foot of floor area.
d. Columns: One set for each 50 cubic yards or fraction thereof with a minimum of 2 sets per floor.
e. All Other Concrete: A minimum of one set for each 50 cubic yards or fraction thereof.
f. No more than one set of cylinders at a time shall be made from any single truck.
g. 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.
h. 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.

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

5. 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 one kept in reserve for testing at the Engineers direction.

6. 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 C31.

7. Transporting Cylinders: The District’s 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.

8. Information on Concrete Test Reports: The District’s Testing Laboratory shall make and distribute concrete test reports after each job cylinder is broken. Such reports shall contain the following information:

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 flagged if either cylinder fails to meet Specification requirements.

9. Standards for Tests of Concrete:

a. Slump Tests: Slump Tests (ASTM C143) shall be made 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 plus or minus 1 inch of the slump noted on the mix design submittal form for that class of concrete.

b. Air Entrainment: Air entrainment tests (ASTM C231 or C173, C173 only for lightweight concrete) shall be made at the same time slump tests are made as cited above.

c. Concrete Temperature: Concrete temperature at placement shall be measured (ASTM C1064) at the same time slump tests are made as cited above.

d. Unit Weight Test: ASTM C138

10. Evaluation and Acceptance of Concrete:

a. Strength Test: A strength test shall be defined as the average strength of two cylinder breaks from each set of cylinders tested at the time indicated above.

b. Quality Control Charts and Logs: The District’s 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 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.

J. Investigation of Low Strength Concrete Test Results:

1. Cost of Investigations for Low Strength Concrete: The Contractor shall reimburse the District for the costs of investigations of low strength concrete, as defined above.

2. Scope of Investigations: See Specification Section 03300, Cast-In-Place Concrete, for the investigations that may be required by the Engineer. The District’s Testing Laboratory will conduct these investigations.

K. 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 District’s 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.

END OF SECTION
Example Concrete Mix Design
Submittal Form (Note 1)

I. Project Information
A. Name of Project: ____________________________________________
B. City, State: _______________________________________________
C. General Contractor: __________________________________________
D. Concrete Supplier:
   1. Address: _______________________________________________
   2. Name to Contact: ____________________________________ 3. Phone No.: ________ 4. Fax No.: ____________

II. Concrete Mix Information
A. Concrete Mix Designation (Note 2):
B. Minimum Concrete Strength f’c: ______ psi at ______ days, and
C. Maximum w/c Ratio: __________________________
D. Concrete Type (check one) ______ NW ______ LW
E. Required Wet Weight: _______pcf
F. Concrete Use (member type as specified in General Notes):
G. Required Air Content: _______%
H. Method of Concrete Placement for this Mix:
   (check one) ______ Bucket ______ Pump ______ Chute ______ Tremie ______ Other (Specify) _______________________________________

III. Method of Concrete Mix Design Preparation: (Check One Method Below) (Note 3)
A. _____ Field Experience Method  B. _____ Trial Mixture Method

IV. Concrete Production Facility Information
A. Production facility has field strength test records of specified class or within 1 ksi of class: _____ Yes _____ No
   Answer B thru C only if answer to IV.A is "Yes". If answer to IV.A. is "No", go to V.B.:
B. Test Record Information: (Check either 1, 2, or 3 below)
   1. _____ ≥ 30 consecutive tests  2. _____ Two groups of ≥ 30 tests  3. _____ 15 to 29 tests
C. Standard Deviation (PSI):
   1. Modification Factor (if B.3. checked only. Ref. Table 5.3.1.2 of ACI 318-02.) MF = __________
   2. Standard Deviation S = ______ psi  3. MF x S (if B.3. checked only) = ______ psi

Note: Combined aggregate gradation for slabs and other designated concrete shall be 8%-18% for large top size aggregates (1 1/2 in.) or 8%-22% for smaller top size aggregates (1 in. of 3/4 in.) retained on each sieve below the top size and above the No. 100 sieve.

V. Required Average Compressive Strength f’c (psi)
A. Calculation of f’c from S (fill out only if IV.A. is "yes") (larger of 1 or 2 below controls)
   1. f’c = f’c + 1.34 x S = ______ psi  2. f’c = f’c + 2.33 x S - 500 = ______ psi
B. Calculation of f’c from ACI 318-02 Table 5.3.2.2: (fill out if IV.A. is "No")
   1. f’c = f’c + ______ psi = ______ psi

VI. Concrete Mix Design by Field Experience Method: (fill out below only if III.A is checked)
Note: This method requires one or more mix designs with a 45 day minimum field record of at least ten consecutive test results using similar materials and conditions as the proposed mix design.
A. Available field record is based on how many mix designs? _________ (specify number)
B. Average strength of field record is ______ psi (must be ≥ f’c in V.)

VII. Concrete Mix Design by Trial Mixture Method: (fill out below only if III.B is checked)
Note: This method requires using at least three different trial mixes with varying W/C ratios or cement contents with a plot of average strength vs. W/C ratio or cement content. Submit scale graph of results.
A. Trial Mixes: (Note: All other ingredients as specified in VIII. below)

<table>
<thead>
<tr>
<th>Mix 1</th>
<th>Mix 2</th>
<th>Mix 3</th>
<th>Selected (interpolated) values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cements (lbs.)</td>
<td>______</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>W/C Ratio</td>
<td>______</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>Compressive Strength (psi) at Specified Days</td>
<td>______</td>
<td>______</td>
<td>______</td>
</tr>
</tbody>
</table>

VIII. Proposed Mix Design
A. Sources of Materials:
2. Fly Ash: Type: ______ Manufacturer ______ Sp. Gr. ______
3. Silica Fume: Manufacturer: ______ Type (check one): __________ Slurry ___ Powder
   Slurry: Specific Gravity ______ Water Content by Wt. ______% Silica by Wt. ______%
   Powder: Specific Gravity ______ Silica by Wt. ______%
   (Note 4) Oven-dry Rodded Density: ______ PCF Absorption: ______% (moist. content at SSD cond.)
   (Note 4) Ovendry Rodded Density: ________ PCF Absorption: ________% (moist. content at SSD cond.)
6. Fine Aggregate: Type: ________ Source: ________________ Fineness Modulus: ________
   (Note 4) Ovendry Sp. Gr. ________ Absorption (moisture content at SSD condition): ________%
7. Air Entraining Agent (AEA): Manufacturer and Name: ____________________________ ASTM No. ________
   Note: Specify below all types and combinations of admixtures anticipated to be used for all anticipated weather
   conditions. Explain in (12) below.
8. Water Reducers (WR):
   a. (Plain) Manufacturer and Name: ____________________________ ASTM No. ________
   b. (w/Accelerator) Manufacturer and Name: ____________________________ ASTM No. ________
   c. (w/Retarder) Manufacturer and Name: ____________________________ ASTM No. ________
9. Accelerators: Manufacturer and Name: ____________________________ ASTM No. ________
10. Retarders: Manufacturer and Name: ____________________________ ASTM No. ________
11. High Range Water Reducer (HRWR) (Superplasticizers):
   a. (Plain) Manufacturer and Name: ____________________________ ASTM No. ________
   b. (w/Retarder) Manufacturer and Name: ____________________________ ASTM No. ________
12. Comments:

B. Mix Proportions: (Per Cubic Yard)
   Item Wt. (lbs.) Absolute Vol. (Cu. Ft.)
   1. Cement
   2. Fly Ash
   3. Silica Fume
   4. Coarse Agg. (SSD Wt.)
   5. Lightweight Agg. (SSD Wt.)
   6. Fine Agg. (SSD Wt.)
   7. AEA oz/100# cement Added at: ________ Batch Plant ________ Site
   8. a. WR (Plain) oz/100# cement Added at: ________ Batch Plant ________ Site
   b. WR (W/Acc.) oz/100# cement Added at: ________ Batch Plant ________ Site
   c. WR (W/Ret.) oz/100# cement Added at: ________ Batch Plant ________ Site
   9. Accelerator: oz/100# cement Added at: ________ Batch Plant ________ Site
   10. Retarder: oz/100# cement Added at: ________ Batch Plant ________ Site
   11. a. HRWR (Plain) oz/100# cement Added at: ________ Batch Plant ________ Site
   b. HRWR (w/Ret.) oz/100# cement Added at: ________ Batch Plant ________ Site
   12. Other: ________ (Specify Units)

C. Mix Design Characteristics: (Pozzolan = flyash and/or silica fume)
   1. Water (including free water on aggregates)/(Cement + pozzolan): W/C = ________ (lbs.) ________ (lbs.)
   (Not applicable for LW concrete)
   2. Fine Aggregate/Total Aggregate = ________ (lbs.) ________ 3. Pozzolan/Pozzolan+Cement) = ________ (lbs.) ________
   4. Concrete Density: a. Unit Wet Weight ________ pcf  b. Unit Dry Weight: ________ pcf ________ (lbs.) ________
   5. Air Content: ________%
   6. Slump or Slump Flow a. Initial Slump (before adding WR or HRWR) ________ in.
   b. Final Slump or Flow (after adding WR or HRWR or SCC) ________ in.

D. Chloride Ion Content: The Concrete Supplier certifies that total chloride ion content of the concrete mix, as
   tested by ASTM C 1218 does not exceed the amounts specified in Table 4.4.1 of ACI 318.
E. Alkali Content: The Concrete Supplier certifies, if required by specification section 3300, that the total alkali
   content contributed from cementitious materials does not exceed 4.0 lbs./cu. yd. of concrete or certifies that the
   aggregate contains no deleterious material that react with alcalis in the concrete mix.
F. Mix Water Purity: The Concrete Supplier certifies that the appropriate specified chemical concentration limits
   are not exceeded in the total volume of mix water.

Notes:
1. This form is required to be submitted to Engineer and District’s Testing Laboratory for all concrete mixes on the job.
   When any mix ingredient changes during the course of the job, this submittal form shall be resubmitted for approval.
   All information must be filled in for approval of mix design. Submit all backup data for calculations.
2. The mix designation should be that used by the Contractor to order the concrete from the Supplier and as noted on
   the batch ticket.
3. Refer to ACI 318 for requirements of each concrete mix design preparation method.
4. Submit sieve analysis of fine and course aggregates. Include chart indicating combined aggregate retained on each
   sieve size.

X. Certification by Concrete Supplier

Signature: __________________________ Representing: __________________________ Date: __________
SECTION 03 35 00

CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Concrete finishes.

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

C. Related Sections
   1. Section 03 30 00 - Cast-In-Place Concrete: Provision of cast-in-place concrete.
   2. Section 03 53 00 - Concrete Topping: Provision of concrete topping.
   4. Section 09 97 25 - Vapor Emission Treatment Systems: Provision of vapor emission treatment system, as required.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

1.3 SYSTEM DESCRIPTION

A. Performance Requirements
   1. Provide smooth concrete surfaces at exposed cast-in-place concrete, utilizing steel, fiberglass or plastic coated forms or any other kind of material that will impart no pattern to concrete.
   2. Pour joints of cast-in-place concrete shall align with reveals, rustication joints and/or control joints as indicated on the Drawings.

1.4 QUALITY ASSURANCE

A. Mockups of Floor and Slab Areas Remaining Exposed Where Self-Leveling Underlayment/Topping and Sealer Have Been Applied: Construct mockup for finish required to demonstrate aesthetic effects. Build mockup to comply with the following requirements, using materials indicated for final unit of Work.
1. Locate mockup on-site in the location and of the size indicated or, if not indicated, as directed by the Architect.
2. Notify the Architect 1 week in advance of the dates and times when mockup will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. In presence of the Architect, demonstrate the repair of a blemished or damaged portion of an exposed-face surface.
5. Obtain the Architect’s approval of mockup before start of final unit of Work.
6. Retain and maintain mockup during construction in an undisturbed condition as a standard for judging the completed Work.
7. When directed, demolish and remove mockup from the Project site.
8. Approved mockup in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete: As specified in Section 03 30 00.

B. Curing Compound: ASTM C309, and shall conform with all applicable air pollution regulations.

C. Crack Repair Materials
   1. Sealer: As manufactured by Radon Mitigation & Concrete Waterproofing Co., “RadonSeal Concrete Sealer”, or equal.
   2. Filler: 2-component injectable compound, quick curing, high strength bonding for permanent repair, as manufactured by Radon Mitigation & Concrete Waterproofing Co., “RadonSeal CrackWeld”, or equal.

D. Self-Leveling Underlayer and Topping: Cement-based, polymer-modified, self-leveling product that shall be applied in thicknesses from 1/8-inch and that shall be feathered at edges to match adjacent floor elevations as required.
   1. Cement Binder: ASTM C150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
   2. Primers: Concrete shall be tested for vapor emission by the Relative Humidity test method in compliance with ASTM F2170. Relative humidity shall be in the range of 75-85 percent.
      a. At Floor and Slab Areas Beneath Floor Coverings Where RH of Concrete Substrate is Acceptable: Solvent-free, blue synthetic resin dispersion priming system, which after drying to a clear film inhibits water penetration, as manufactured by Ardex, Inc., “Ardex P 51”, or equal.
      b. At Floor and Slab Areas Remaining Exposed Where RH of Concrete Substrate is Acceptable: Solvent-free, low viscosity, 2-component, 100 percent solids epoxy resin primer, as manufactured by Ardex, Inc., “Ardex EP 2000”, or equal.
      c. At Areas Where RH of Concrete Substrate is Greater Than 85 Percent: 1-coat, 100 percent solids epoxy moisture management system formulated to suppress excessive moisture vapor emissions, as manufactured by Ardex, Inc., “MC Rapid”, or equal.
3. Aggregate: Well-graded, washed gravel, 1/8-inch to 1/4-inch or coarse sand as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4,100 psi at floor and slab areas beneath floor coverings and not less than 5,000 psi at floor and slab areas remaining exposed; tested at 28 days according to ASTM C109.

5. Underlayment/Topping Products
      1) Color: Gray.
      2) Finish: Smooth without visible aggregate.
         a) At thicknesses greater than 2 inches, provide two lifts, the first with aggregate and then the finished layer without aggregate.
      3) Sealer: High-performance, high solids concrete sealer that is easy to apply, quick drying, nonflammable and UV stable, as manufactured by Ardex, Inc., “Ardex CG Concrete Guard”, or equal.
         a) Sheen: As selected by the Architect or as indicated on the Drawings.

E. Sealer at Areas Without Moisture-Sensitive Flooring and Without Underlayment/Topping Products
   1. At New Exposed Concrete: Clear liquid applied, dual barrier penetrating slab and water repellent sealer to form crystalline barrier beneath surface that is not affected by ultra-violet light or abrasion, which also creates a water repelling membrane of methylsilane at the surface to prevent penetration of moisture, oils, fuel, chloride ions and other contaminates into the substrate.
   2. At Existing Exposed Concrete: Highly durable, 1-component, clear, acrylic-polyurethane sealer to improve resistance to staining, abrasion, and the effects of UV radiation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting application of subsequent finishes.

B. Do not proceed with application until unsatisfactory conditions have been corrected.
3.2 FINISHING FORMED SURFACES

A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by stock form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4-inch in height rubbed down or chipped off.

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

3.3 MONOLITHIC SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, pavers and other bonded applied cementitious finish flooring material, and where indicated.
   1. After placing slabs, finish surface to tolerance not exceeding 1/2-inch in 10 feet when tested with a 10 feet straightedge, or to tolerance of F(F) not less than 15 (floor flatness) and F(L) not less than 13 (floor levelness) measured according to ASTM E1155. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, or as otherwise indicated.
   1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to a tolerance not exceeding 5/16-inch in 10 feet when tested with a 10 feet straightedge or to tolerance of F(F) not less than 20 (floor flatness) and F(L) not less than 15 (floor levelness) measured according to ASTM E1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, relloat surface to a uniform, smooth, granular texture. Provide square corners in slab depressions.

C. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with access flooring, resilient flooring, carpet, thin set ceramic or paver, or thin film finish coating system.
   1. After floating, begin first trowel finish operation using a 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 surface plane tolerance not exceeding 3/16-inch in 10 feet when tested with a 10 feet straightedge or to tolerances of not less than F(F) 30 (floor flatness) and F(L) not less than 20 (floor levelness) measured according to ASTM E1155. Grind smooth any surface defects that would telegraph through applied floor covering system.
D. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps, loading dock and other accessible routes of travel as indicated. Provide slip resistance of minimum 0.6 coefficient of friction in accordance with ASTM D2047.
   1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with the Architect before application.
   2. Finish equal to medium broom finish at slopes less than 6 percent.
   3. Finish equal to heavy broom finish at slopes greater than or equal to 6 percent.

E. Refer to Section 03 30 00 for additional concrete finishing and curing requirements.

3.4 POLISHED CONCRETE

A. Preparation
   1. Ensure substrate is clean of materials and debris.
   2. Protection adjacent surfaces as required to prevent damage by the concrete polishing procedure.
   3. Ensure substrate is sufficiently cured to accept polishing application.

B. Grinding and Polishing
   1. Grind the floor to within 1-2 inches of walls, removing floor slab imperfections until there is a uniform scratch pattern and desired concrete aggregate exposure is achieved.
   2. Vacuum the floor thoroughly after each grind, using a squeegee vacuum attachment.
   3. First Pass: Use metal bonded diamond grit of 100.
   4. Second Pass:
      a. Use metal bonded diamond grit of 200.
      b. Grind 90 degrees from previous grind and remove all scratches from the previous grit.
   5. Polish the floor using phenolic resin bonded diamond grits as required to meet sheen level 2 as defined by IPCI; at a distance of 30 to 50 feet, the floor will clearly reflect from side and overhead lighting.
   6. Clean the floor thoroughly using clean water and an autoscrubber or a mop and a wet vacuum.

C. Apply sealer in accordance with Article 3.05.

3.5 SEALER

A. Apply appropriate sealer for new or existing exposed concrete exactly in accordance with manufacturer’s written instructions, using manufacturer’s recommended equipment and method.

B. Apply the number of coats recommended by manufacturer.
3.6 CONCRETE SURFACE REPAIRS

A. Intent of this Specification is to require forms, mixtures of concrete and workmanship so
that concrete surfaces will require no patching, except for plugging of tie holes.

B. Patching Defective Areas: Repair and patch defective areas with cement mortar
immediately after removing forms, when acceptable to the Architect.

C. Mix dry-pack mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate
passing a No. 16 mesh sieve, using only enough water as required for handling and placing.
1. Cut out honeycombs, rock pockets, voids over 1/4-inch in any dimension, and holes
left by tie rods and bolts down to solid concrete but in no case to a depth less than 1
inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean,
dampen with water, and brush-coat the area to be patched with bonding agent. Place
patching mortar before bonding agent has dried.
2. For surfaces exposed to view, blend white portland cement and standard portland
cement so that, when dry, patching mortar will match surrounding color. Provide test
areas at inconspicuous locations to verify mixture and color match before proceeding
with patching. Compact mortar in place and strike-off slightly higher than
surrounding surface.

D. Repairing New Formed Surfaces: Remove and replace concrete having defective surfaces if
defects cannot be repaired to satisfaction of the Architect. Surface defects include color and
texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other
projections on the surface, and stains and other discolorations that cannot be removed by
cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone
plugs secured in place with bonding agent.
1. Repair concealed formed surfaces, where possible, containing defects that affect the
concrete’s durability. If defects cannot be repaired, remove and replace the concrete.

E. Repairing New Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for
smoothness and verify surface tolerances specified for each surface and finish. Correct low
and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and
smoothness by using a template having the required slope.
1. Repair finished unformed surfaces containing defects that affect the concrete’s
durability. Surface defects include crazing and cracks in excess of 0.01-inch wide or
that penetrate to the reinforcement or completely through nonreinforced sections
regardless of width, spalling, popouts, honeycombs, rock pockets, and other
objectionable conditions.
2. Correct high areas in unformed surfaces by grinding after concrete has cured at least
14 days.
3. Correct low areas in unformed surfaces during or immediately after completing
surface finishing operations by cutting out low areas and replacing with patching
mortar. Finish repaired areas to blend into adjacent concrete. Proprietary
underlayment compounds may be used when acceptable to the Architect.
4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in
diameter, by cutting out and replacing with fresh concrete. Remove defective areas
with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all
around. Dampen concrete surfaces in contact with patching concrete and apply
bonding agent. Mix patching concrete of same materials to provide concrete of same
type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

5. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

F. At Existing Floors and Slabs
   1. Crack Repairs
      a. Seal the crack with deep-penetrating concrete sealer to preserve and strengthen concrete against further cracking; sealer may be sufficient to repair fine hairline cracks and cracks that are narrow inside.
      b. Before filling the crack, ensure the inside of the crack is clean and dry; duct tape may be placed on both sides of the crack to make clean-up easier, particularly on rough surfaces.
      c. Basic Repair Steps
         1) Inject the resin into the crack to wet the surfaces and make them tacky.
         2) Push dry silica sand into the crack to fill it.
         3) Thoroughly saturate the sand with resin to fill it to the surface.
         4) In 10 to 15 minutes, scrape off the surface to make it level and use sandpaper for neat appearance.
      d. Hairline cracks which are too narrow for sand are filled and repaired with 2 passes of the resin.
      e. If additional sand is needed, use a completely dry graded sand (no fines) or ideally, sandblasting sand with granulation like table sugar (30 to 40 grit) or similar sand without fines.
      f. To repair wide cracks or cracks with a void underneath, first fill the crack partially with sand to prevent the resin from running out.
      g. To prevent plugging, maintain a steady flow of resin through the mixing nozzle. After a stoppage, purge the mixer into a disposable cup. To minimize stoppages, repair small sections of the crack at a time say, 5-10 feet, or use up the whole cartridge. Fill the crack with sand in 2 to 3 minutes after priming while resin is still tacky. On larger jobs, use a helper to do the scraping.

   2. Floor Leveling: Prepare, mix, and apply repair underlayment and primer according to manufacturer’s written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

G. Perform structural repairs in accordance with Section 03 30 00.

H. Repair methods not specified above may be used, subject to acceptance of the Architect.

3.7 PROTECTION

A. Restore finishes damaged during installation and construction so that no evidence remains of correction work.
SECTION 03 53 00
CONCRETE TOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Lightweight and normal weight concrete topping at interior concrete slab.

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

C. Related Sections
1. Section 03 35 00 - Concrete Finishing: For concrete finishes.
2. Section 09 97 25 - Vapor Emission Treatment Systems: Provision of vapor emission treatment system, as required.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

1.3 SUBMITTALS

A. Product Data: Manufacturer’s literature describing materials and specifications for mixing, placing, curing, and protecting.

B. Certificates: Furnish manufacturer’s certification that applicator is licensed by manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING

A. Ensure storage facilities are weathertight and dry.

B. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Comply with manufacturer’s written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting concrete floor topping performance.
1. Place concrete floor topping only when ambient temperature and temperature of base slabs are between 50 and 86 degrees Fahrenheit.

B. Close areas to traffic during topping application and, after application, for time period recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wood Blocking: As specified on the Structural Drawings.

B. Portland Cement: Conforming to ASTM C150, Type I, white cement.

C. Aggregates: 3/8-inch pea gravel, or aggregate recommended by applicator.

D. Sand: Washed and graded per ASTM C33.

E. Water: Clean and potable, free from impurities detrimental to lightweight and/or normal weight concrete.

F. Admixtures: May be used only for unusual job conditions, and then only as recommended by manufacturer.

2.2 MIXES

A. Mix lightweight and/or normal weight concrete in accordance with manufacturer’s recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate and verify that surfaces are free from debris and are reasonably clean and dry and that conditions are otherwise suitable to receive concrete topping.

B. Verify that concrete floors, regardless of age, comply with the moisture and pH requirements stated by the concrete topping manufacturer.
   1. The moisture conditions of the concrete shall be determined by use of the In Situ probe relative humidity (rH) test method, ASTM F2170, using a moisture testing device manufactured by Wagner or Vasela. The testing device shall be properly maintained and calibrated in accordance with the manufacturer’s specifications and frequency recommendations. Certificates of calibration shall be maintained for test validation.

C. Do not start work until unsatisfactory conditions have been corrected.
3.2 PLACING

A. Interior
   1. All surfaces shall be clean and neat before commencing this work.
   2. Maintain minimum tolerances in the finished surface plane of 3/16-inch maximum variation in 10 feet radius, measured with a 10 feet straightedge. Ponding and “bird baths” will not be acceptable.
   3. Precautions shall be taken to protect the work of other trades from damage.
   4. Place concrete topping over existing concrete in accordance with manufacturer’s recommendations. Topping slab thickness and depressions as indicated on the Drawings.
   5. Install to thickness indicated and properly finished with a trowel finish free of pockets or voids.
   6. Control joints shall be incorporated into the infill to align with existing control joints.
   7. Protection of concrete shall be carried out as required for proper curing.
   8. Coordination with other trades shall be carried out with respect to protection against damage to materials installed by them. Correct any damage arising from work to the satisfaction of the District.
   9. Do not mix or place in temperatures below 40 degrees Fahrenheit.

3.3 CURING

A. Allow concrete topping to harden as recommended by manufacturer. Test for vapor emission by the Calcium Chloride Moisture test method in compliance with ASTM F1869. Emission rate shall not exceed 3 lb/24 hr/1000 sq. ft.

B. Do not allow traffic on concrete topping during hardening period; minimum 24 hours or longer if special conditions exist.
   1. Do not load until concrete topping has cured for at least 5 days.
   2. Any loading shall be distributed and not concentrated.

3.4 ADJUSTMENT

A. Concrete topping damaged after installation, as a result of other trades, shall be repaired at no additional cost to the District.

END OF SECTION
SECTION 04 73 10
MANUFACTURED STONE VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Portland cement-based manufactured stone veneer and trim.

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

C. Related Sections
   1. Section 02 41 14 - Selective Building Demolition: For selective demolition of building elements.
   2. Section 07 62 00 - Sheet Metal Flashing and Trim: Provision of sheet metal flashing.
   3. Section 07 65 00 - Flexible Flashing: Provision of flexible flashing.
   4. Section 07 92 00 - Joint Sealants: Provision of joint sealers.
   5. Section 09 24 00 - Cement Plastering: Provision of weather-resistive barrier, cement plaster scratch and brown coats, and plaster accessories.
   6. Section 09 29 00 - Gypsum Board: Provision of gypsum sheathing.

1.2 REFERENCES

A. ANSI - American National Standards Institute
   1. A118.4 - Specifications for Latex-Portland Cement Mortar.

B. ASTM - American Society for Testing and Materials

C. CBC - California Building Code, 2016 Edition

D. ICBO - International Conference of Building Officials
1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s product data.

B. Samples
   1. Standard sample board consisting of small-scale pieces of veneer units showing full range of textures and colors.
   2. Full range of mortar colors.

C. Quality Assurance/Control Submittals
   1. Qualifications
      a. Proof of manufacturer qualifications.
      b. Proof of installer qualifications.
   3. Veneer manufacturer’s installation reports.
   4. Installation instructions for other materials.

D. Closeout Submittals
   1. Maintenance instructions.
   2. Special warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Experienced mason familiar with installation procedures for manufactured veneer.

B. Field Sample
   1. Prepare 4 by 4 foot sample at a location on the structure as selected by the Architect. Use approved selection sample materials and colors.
   2. Obtain Architect’s approval.
   3. Protect and retain sample as a basis for approval of completed manufactured stone work. Approved sample may be incorporated into completed work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Follow manufacturer’s instructions.

1.6 PROJECT CONDITIONS

A. Environmental Requirements: When air temperature is 40 degrees Fahrenheit or below, consult building code for cold-weather construction requirements.

1.7 WARRANTY

A. Special Warranty: Manufacturer’s standard warranty coverage against defects in materials when installed in accordance with manufacturer’s installation instructions.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Eldorado Stone, LLC, “Meseta Fieldledge”; no known equal.

2.2 MATERIALS

A. Veneer Units: Precast veneer units consisting of portland cement, sand, lightweight aggregates, and mineral oxide pigments; include corner return profiles.
   1. Physical Properties:
      a. Compressive Strength: ASTM C513, 5 sample average, 2,200 psi.
      b. Shear Test: ASTM C482, 50 psi.
      c. Water Absorption: UBCS 32-12, 22 percent.
      d. Freeze-Thaw Test: ASTM C67, 0.67 percent.
      e. Thermal Resistance, ASTM C177: R0.60.
      f. Density: ASTM C567 (Dry Density), 75 pcf.

B. Weather-Resistive Barrier: As specified in Section 09 24 00.

C. Reinforcing: ASTM C847, galvanized self-furring metal lath complying with code agency requirements for the type of substrate over which stone veneer is installed.

D. Mortar
   2. Lime: ASTM C207.

E. Bonding Agent: As manufactured by Grace Construction Products, “Daraweld C”, or equal.

F. Flexible Flashing: As specified in Section 07 65 00.

G. Plaster Accessories: As specified in Section 09 24 00.

H. Joint Sealants: As specified in Section 07 92 00; test for compatibility with the natural stone facings specified.

I. Sealer: Water-based silane or siloxane masonry sealer, clear finish; provide where required for aesthetic match to existing stone veneer.

2.3 MORTAR MIXES

A. Standard Installation (Grouted Joints): Mix mortar in accordance with ASTM C270, Type N or S.
   1. Add color pigment in grout joint mortar in accordance with pigment manufacturer’s instructions and to match existing grout.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates upon which work will be installed.
   1. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.
   2. Commencement of work by installer is acceptance of substrates.

B. Examine existing stone veneer for possible salvage and reuse as recommended by the stone manufacturer; refer to Section 02 41 14 for selective building demolition.

3.2 PREPARATION

A. Protection: Protect adjacent work from contact with mortar.

B. Surface Preparation: Prepare substrate in accordance with manufacturer’s installation instructions for the type of substrate being covered.

C. Installation of Weather-Resistive Barrier
   1. Install weather resistive barrier in accordance with manufacturer’s written instructions and “best practice” recommendations.
   2. Install 2 layers in shingle fashion; lap per manufacturer’s recommendations; lap with existing weather-resistant barrier.

3.3 INSTALLATION

A. Install and clean stone in accordance with manufacturer’s installation instructions for standard grouted joint installation. Mortar joints shall match existing.

3.4 FIELD QUALITY CONTROL

A. Manufacturer’s Field Services: Manufacturer’s field service representative shall make periodic site visits for installation consultation and inspection as requested by the District.

B. Contractor shall verify coverage and perform other field quality control as provided in Section 6.10 of ASTM C1242-18a.

3.5 CLEANING

A. Remove protective coverings from adjacent work.

B. Cleaning Veneer Units
   1. Wash with soft bristle brush and water/granulated detergent solution.
   2. Rinse immediately with clean water.

C. Removing Efflorescence
   1. Allow veneer to dry thoroughly.
   2. Scrub with soft bristle brush and clean water.
   3. Rinse immediately with clean water; allow to dry.
4. If efflorescence is still visible, repeat above procedures using a solution of 1 part household vinegar and 5 parts water.
5. Rinse immediately with clean water.

END OF SECTION
SECTION 05 12 00

STRUCTURAL STEEL

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 SUMMARY

A. Extent of structural steel work is shown on drawings including schedules, notes and details that show size and location of members, typical connections, and type of steel required. Furnish all labor, materials, services, equipment and appliances required in conjunction with or related to the furnishing, fabrication, delivery, and erection of all structural steel defined below. Include all supplementary parts, members and connections necessary to complete the structural steel work, regardless of whether all such items are specifically shown or specified on the drawings.

B. Related Sections

1. Section 03 30 00 – Cast-in-Place Concrete

2. Section 05 50 00 – Metal Fabrications

1.3 DEFINITIONS

A. Structural Steel shall be defined as that work prescribed in Section 2.1 of the AISC “Code of Standard Practice for Steel Buildings and Bridges” and all other structural steel framing shown on the Structural Drawings.

B. Seismic Load Resisting System (SLRS): Seismic Load Resisting System is an assembly of structural elements in the building that resists seismic loads, including struts, collectors, chords, diaphragms, trusses and their connections. These elements and their connections as designated on the structural drawings shall be subject to special toughness, quality, finish, bolting and welding requirements as per the seismic provisions of the code.

C. Protected Zone: Portions of members designated on the structural drawings subject to special quality and repair requirements and to which structural and nonstructural attachments and welds are prohibited.

D. Demand Critical Welds (DCW): Demand Critical Welds are identified in the provisions for each type of Seismic Load Resisting System (SLRS). Demand Critical Welds have special quality and inspection requirements and are subject to special Charpy V-Notch (CVN) toughness and testing requirements to ensure that this notch toughness will be provided.
1.4 QUALIFICATIONS

A. Fabricator:
   1. The structural steel fabricator shall have not less than 5 years experience in the successful fabrication of structural steel similar to this project.
   2. The structural steel fabricator must participate in one of the following certification programs. Program certification must be current at the time of bidding and throughout the duration of the project.
      a. The AISC Quality Certification Program and be designated an AISC Certified Plant in Category STD, Standard for Steel Building Structures.
      b. The Los Angeles Department of Building and Safety (LADBS) certification program.
   3. The structural steel fabricator must be registered and approved by the local building official to perform fabrication work without special inspection.

B. Detailer:
   1. The structural steel detailer shall have not less than 5 years experience in the successful detailing of structural steel similar to this project.

C. Erector:
   1. The structural steel erector shall have not less than 5 years successful experience in the erection of structural steel of a similar nature to this project.
   2. The structural steel erector must participate in one of the following certification programs. Program certification must be current at the time of bidding and throughout the duration of the project.
      a. AISC Erector Certification Program and be designated an AISC Certified Steel Erector.
      b. The Los Angeles Department of Building and Safety (LADBS) certification program.

D. Independent Testing Laboratory: Any testing laboratory retained to perform tests that are required by this specification shall meet the basic requirements of ASTM E329

1.5 QUALITY ASSURANCE

The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

A. Codes and Standards: Comply with provisions of following, except as otherwise indicated. For codes and standards for which no specific version is referenced, the version that is referenced in the applicable building code shall govern, or, if there is no reference in the building code, the latest version of the code or standard shall govern except as otherwise noted in the AISC Steel Construction Manual, 14th edition. Certain sections in this
specification contain requirements that are more restrictive and/or different than contained in the standards listed. In such cases, the requirements of this specification shall control.

1. California Code of Regulations, Title 24, 2016 edition, also known as California Building Code (CBC), with Division of the State Architect (DSA) amendments.

2. 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”.

   a. 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.


5. Research Council on Structural Connections (RCSC) "Specification for Structural Joints using High Strength Bolts".


10. ANSI/AWS D1.8 “Structural Welding Code – Seismic Supplement”


B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Structural Welding Code - Steel". In addition, welding operators working on Demand Critical Welds in Seismic Load Resisting Systems as designated in the Contract Documents shall be qualified in accordance with AWS D1.8, Section 5.

C. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests in the mill, shop, and field by the District's testing laboratory. Such inspections and tests will not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements. The Contractor shall promptly remove and replace materials or fabricated components which do not comply.

D. Questions about Contract Documents: The Contractor shall promptly notify the Architect/Engineer whenever design of members and connections for any portion of the
structure are not clearly indicated or when other questions exist about the Contract Documents. Such questions shall be resolved prior to the submission of shop drawings.

E. District’s Testing Laboratory Services: Inspection or testing by the District does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents

F. Surveyor: The General Contractor shall employ a qualified land surveyor to perform surveys required by this specification.

1.6 SUBMITTALS

A. Product Data: Submit producer's or manufacturer's specifications and installation instructions for following products; include laboratory test reports and other data to show compliance with specifications (including the specified standards):

1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties. For structural steel for which evidence exists that the steel may not conform to ASTM requirements, the contractor, where permitted by the engineer, shall engage the services of an independent testing laboratory to test the material according to ASTM A6 and submit certified test reports that verify conformity to ASTM standards. Tests shall be made for each 10 tons of affected material unless otherwise directed by the Engineer.

2. High-strength bolts (each type), including nuts and washers, including certified copies of mill reports covering physical and chemical properties.

3. Shrinkage-resistant grout.

4. Unfinished bolts and nuts.

5. Welding electrodes (each type).

B. Shop Drawings and Erection Drawings:

1. All drawings submitted for review shall have the approved shop drawing stamp of the Design Team as part of the title block. The approved shop drawing stamp will be provided in electronic format to the successful bidder.

2. Definitions:

a. Shop Drawings: Drawings of the individual structural steel shipping pieces that are to be produced in the fabrication shop.

b. 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.

3. Shop Drawings: Submit for review and approval shop drawings showing complete details and schedules for fabrication and assembly of structural steel members. Structural steel shop drawings shall include the following minimum information:
a. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols, and show size, length, and type of each weld. Indicate 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). 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.

b. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by others.

c. Structural steel shop and erection drawings shall identify:

   1. Members and connections that are part of the seismic load resisting system (SLRS),
   2. Locations and dimensions of protected zones
   3. Demand critical welds
   4. Locations where weld backing is to be removed
   5. Locations where fillet weld reinforcement is to be added to steel backing left in place
   6. Locations where weld tabs are to be removed
   7. Access hole dimensions, surface profile and finish requirements
   8. Locations of pre-tensioned bolts
   9. Connection material specifications and sizes
   10. Gusset Plates drawn to scale when they are detailed to accommodate inelastic rotation
   11. Non Destructive Testing (NDT) to be performed by the fabricator, if any
   12. Indicate joints or groups of joints in which a specific assembly order, welding sequence, welding technique or other special precautions are required
   13. Identification of members and connections, or portions thereof, to be treated as AESR.

4. Erection Drawings: Submit for review and approval complete erection drawings showing field-installation and member-placing instructions for locating and attaching the individual shipping pieces.

5. The fabricator alone shall be responsible for all errors of detailing, fabrication, and for the correct fitting of the structural members.

6. All fabricated material and connections shall fit within architectural constraints.

7. Structural steel members for which shop drawings have not been reviewed and approved shall not be fabricated.

8. 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 and approved.

C. Surveys: Submit the information requested for all surveys required by this specification.
D. Test Reports: Submit certified reports of tests required by this Specification Section. Include data on type(s) of tests conducted and test results.

E. Qualification Data:

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 Districts, and other information specified.

2. 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.

3. 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.

4. 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.

F. Substitutions:

1. Substitutions or any other modifications proposed by the Contractor will be considered by the Architect/Engineer only under the following conditions:

   a. That the request has been made and accepted by the Architect/Engineer and approved by DSA prior to the submission of shop drawings. All substitutions shall be clearly marked and indicated on the shop drawings as a substitute.

   b. That there is a substantial cost advantage or time advantage to the District; 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.

   c. That 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.

   d. The contractor agrees to compensate the Architect and Engineer of Record for all labor and expenses associated with reviewing substitutions, including obtaining approval from DSA.

   e. In no case shall such revisions result in additional cost to the District.

1.7 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.

D. Furnish all fuel, maintenance, and equipment required for hoisting and placement of materials under this contract.

E. Process, pay for and maintain all permits and certificates of on-site inspection required for derricks, cranes and hoisting equipment. No derrick, crane or hoisting equipment shall be operated without a certificate of operation and a certificate of on-site inspection, as required by governing authorities.

1. In addition to the above, all hoisting equipment shall be installed, operated and maintained in accordance with all applicable regulations of authorities having jurisdiction.

2. The Contractor shall furnish street storage and sidewalk crossing permits.

1.8 JOB CONDITIONS

A. The Contractor shall coordinate the fabrication and erection of all structural steel work with the work of other trades.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel: All hot rolled steel plates, shapes, sheet piling, and bars shall be new steel conforming to ASTM A6.

B. Structural steel shall 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:

1. Structural Steel Wide Flange and WT Shapes - High Strength Steel, ASTM A992.


4. Structural Steel Plates and Bars - ASTM A36 typical; ASTM A572 Grade 50 where noted.

5. Steel Pipe - ASTM A53 (Type E or S) Grade B (Fy = 35 ksi).
6. Square and Rectangular HSS – ASTM A500, Grade B/C (Fy = 46 ksi).

7. Round HSS – ASTM A500, Grade B (Fy = 42 ksi)

8. Connection Material: Unless noted otherwise on the drawings, all connection material including bearing plates, gusset plates, stiffener plates, filler plates, angles, etc. shall be A36 steel unless an alternate grade of steel with the members connected is specified.

C. Structural Steel Surfaces: For fabrication of work which will be exposed to view in the completed structure, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.

D. 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 A325 Type I.

2. Alternative Design Fasteners: Fasteners that incorporate a design feature intended to indicate a predetermined tension or torque (load indicator bolts or "twist-off" bolts) shall conform to the requirements of section 2.8 of the RCSC “Specification for Structural Joints Using ASTM A325 or A490 Bolts”.

   a. Bolts that are manufactured to conform to ASTM A325 shall additionally conform to ASTM F1852.

   b. Subject to conformance with specified requirements, acceptable manufacturers include but are not limited to:

   (1) Nucor Fastener, A Division of Nucor Corporation, Conway, AR and St. Joe, IN.

   (2) Lake Erie Screw Corp., Lakewood, OH.

   (3) Vermont Fasteners Manufacturing, Swanton, VT.

   (4) Lohr Structural Fasteners, Humble TX.


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 A563.

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 F436. 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.
6. Zinc-Coated Bolts: ASTM A325 bolts, with their nuts and washers, that are used to connect steel specified as hot-dip galvanized after fabrication shall be zinc-coated either by the hot-dip process in accordance with ASTM A153, Class C or by the mechanical deposition process in accordance with ASTM B695, 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 A325 and ASTM A563 as they relate to zinc-coated materials. ASTM F1852 bolts with their nuts, and washers shall be zinc-coated only by the mechanical deposition process in accordance with ASTM B695, Class 50, Type 1. Do not zinc-coat ASTM A490 bolts.

7. Direct Tension Indicators: Compressible washer-type direct-tension indicators conforming to ASTM F959. Subject to conformance with specified requirements, acceptable manufacturers include but are not limited to:

   Applied Bolting Technology, Ludlow, VT
   Turnasure, LLC, Langhorne, PA

8. Bolt Lubrication: All bolts shall be well lubricated at time of installation. Dry, rusty bolts will not be allowed.

9. New Bolts: All bolts shall be new and shall not be reused.

E. 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. For welds made in members and connections that are a part of the Seismic Load Resisting System as identified on the drawings, provide electrodes that comply with the provisions of ANSI/AWS D1.8, Section 6.3.

3. Electrodes for various welding processes shall be as specified below:

   a. SMAW - E70XX low hydrogen
   b. SAW: - F7X-EXXX
   c. GMAW: - ER70S-X
   d. FCAW: - E7XT-X

4. Electrodes shall be compatible with parent metal joined.

F. Shear Connectors (Headed and Threaded Studs): Shear connectors and their installation shall meet all requirements specified in Section 7, Type B of AWS D1.1 "Structural Welding Code-Steel". Sizes of shear connectors shall be as specified on the drawings.

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 on the drawings:

   a. Grade 36 typical, additionally conforming to Supplementary Requirement S1 of ASTM F 1554. Substitution for Grade 36 anchor rods with Grade 55 anchor rods shall only be permitted provided the Grade 55 anchor rods comply with Supplementary requirements S1 of ASTM F1554.

2. Anchor rods used with galvanized base plates shall be galvanized.

3. Nuts: All nuts with anchor rods shall be heavy hex head conforming to ASTM A563.

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 A36 steel.

H. Structural Steel Primer Paint:

1. Unless noted otherwise, primer paint shall be the following with the indicated surface preparation:

   a. SSPC-Paint 25.1, Type II; zinc oxide, raw linseed oil and alkyd primer, surface prepared according to SSPC-SP-2 (Hand Tool Cleaning) unless noted otherwise in this specification.

2. Refer to Architect's drawings and specifications for final paint finish requirements of structural steel. Primer paint shall be compatible with finish 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 C1107. Provide 8000 psi minimum compressive strength as determined by grout cube test at 28 days.

Subject to conformance with specified requirements, acceptable non-shrink grouts include:

"Crystex" and "Duragroup" as manufactured by L&M Construction Chemicals, Inc.

"Sure Grip High Performance Grout," and "1107 Advantage Grout" as manufactured by Dayton-Superior Corporation.

"Masterflow 555", and "Set Grout" as manufactured by BASF Construction Chemicals.
"Five Star Grout" as manufactured by U.S. Grout Corp.

"NS Grout" as manufactured by The Euclid Chemical Company.

"CG 200 PC", Hilti, Inc.

J. 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-dipped galvanized after fabrication unless indicated on the drawings or in Specification Section 09900 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 shall also be galvanized.
   b. Parapet wall supporting members.
   c. Screen wall supporting members.
   d. Members and connections designated as AESS and permanently exposed to exterior conditions.

   Examine the architectural and structural drawings for other items required to be hot dipped galvanized.

   Zinc-coat all ASTM A307 and A325 bolts nuts, and washers used in the connection of such steel. Field welded connections shall have welds protected with galvanizing repair paint.

2. Surface Preparation: All steel to be hot dip galvanized shall undergo the following surface preparation as specified by the Steel Structures Painting Council (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.

3. Zinc Coating: The zinc coating for steel shapes and plates shall conform to ASTM A123. Weight of zinc coating per square foot of surface for 1/8 inch and 3/16" thick steels shall average not less than 2.0 oz. with no individual thickness less than 1.8 oz. The coating weight shall average not less than 2.3 oz. with no individual thickness less than 2.0 oz. for 1/4" thick and heavier steel.
K. 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.

2.2 FABRICATION

A. 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. Fabricator shall coordinate connection details, joint fit-up procedures, and field adjustment requirements with erector. The General 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. 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.

6. Continuity plates and stiffeners placed in the webs of rolled shapes that are a part of the Seismic Load Resisting System designated on the drawings shall comply with the requirements of Part 1, Section 7.5 of ANSI/AISC 341.

7. Bolted joints in the Seismic Load Resisting Systems shall be pre-tensioned high-strength bolts and shall meet the requirements for slip-critical faying surfaces in accordance with Specification section J3.8 with a Class A faying surface unless noted otherwise. The faying surfaces for end-plate moment connections are permitted to be coated with coatings not tested for slip resistance, or with coatings with a slip coefficient less than that of a Class A faying surface unless noted otherwise.

8. Fabrication of welded members and joints in the Seismic Load Resisting Systems or part of a Demand Critical Weld as indicated on the contract documents shall comply with the requirements of Chapter 6 of AWS D1.8.

B. Dimensional Tolerances: Dimensional tolerances of fabricated structural steel shall conform to Section 6.4 of the AISC Code of Standard Practice.
C. Camber:
   1. Camber of structural steel members is indicated on the drawings.
   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 1200°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.
   6. Specified camber for beams shall be in accordance with the AISC “Code of Standard Practice”.

D. 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.

E. 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.

F. 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.

G. 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.

H. 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.

I. Drainage Holes: Provide 1 inch diameter drainage (weep) holes in all members (trusses, girders, beams, etc.) exposed to weather where rain water could collect (at low points
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). In addition for projects required to meet the AISC Seismic Provisions for Structural Steel Buildings the provisions of AWS D1.8 shall supplement the provisions of AWS D1.1 where specifically modified by AWS D1.8 and shall apply to the design, fabrication, quality control and quality assurance of welded joints designed in accordance with the AISC Seismic provisions for Steel Buildings.

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 approved by the District's Testing Laboratory and 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, DSA approved, 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 testing laboratory shall prepare Welding Procedure Qualification Records (WPQR) documenting the successful qualification of each Welding Procedure Specification.
2. Welding Procedure Specifications for welds designated as Demand Critical Welds shall additionally comply with the requirements of ANSI/AWS D1.8, Section 6.1.

F. Welding Procedures:

1. All welding processes shall comply with the requirements of ANSI/AWS D1.1 unless noted otherwise.

2. Welding requirements for welds that are a part of the Seismic Load Resisting System and also for welds noted as Demand Critical Welds shall additionally comply with the requirements of ANSI/AWS D1.8, chapter 6.

3. Complete joint penetration welds of beam bottom flanges to column, or to continuity plates shall be sequenced to conform to the requirements of AWS D1.8, Section 6.14.

4. Built-up sections assembled by welding shall be free of warpage and all axes shall have true alignment.

5. 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.

6. 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.

7. Before welding is started, the fabricator shall submit for the approval of the District's Testing Laboratory in consultation with the Architect/Engineer, written Welding Procedure Specification for all joints to be welded. After approval, the Welding Procedure Specification shall be followed without deviation unless specific approval for change is obtained from the District's Testing Laboratory and the Architect/Engineer.

8. Before welding, particular attention shall be paid to surface preparation, fit up and cleanliness of surfaces to be welded.

9. Minimum preheat and interpass temperatures for structural steel welding shall be as specified in ANSI/AWS D1.1 and D1.8, 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.

10. 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.

11. 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.
12. Welds shall be free from overlap.

13. Craters shall be filled to the full cross section of the welds.

14. For high-strength low-alloy steels, follow welding procedures as recommended by steel producer for exposed and concealed connections.

15. Fabricator and erector shall coordinate welding responsibility at all welded joints.

G. Stress Relieving: All welding sequences shall be such as to reduce the residual stresses due to welding to a minimum value. If high residual stresses are present, stress relieving of joints shall be required. Welded connections shall be detailed and designed to minimize the accumulation and concentration of through-thickness strains due to weld shrinkage.

H. Exposed welds in AESS shall be ground where noted, dressed smooth, and flush with adjacent surfaces.

2.4 BOLTING

A. Bolt Diameter: Minimum bolt diameter shall be 7/8 inch unless noted otherwise.

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 AISC Specification 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 the AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts."

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.

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 AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts" when all the fasteners of a joint are tight.
   b. Any of the four methods to tighten bolts specified in the AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts" 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 F959.
c. The Contractor shall cooperate with the District’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 Testing and Inspection portion of this specification section.

E. Washers: Washers under the bolt head and/or nut shall be used as required by the AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts."

F. Bolt Lubrication: All bolts shall be well lubricated at time of installation. Dry, rusty bolts will 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. Connection details are indicated on the drawings.

B. 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.

C. The geometry and welding process for complete-joint-penetration-welded-moment connections in Seismic Load Resisting Systems shall comply with the requirements of ANSI/AWS D1.8, chapter 6 and the groove welds of those connections are Demand Critical Welds. Typical examples of Demand Critical Weld (DCW) include but are not limited to the following:
   1. Complete-joint-penetration (CJP) welds between columns and base plates.
   2. Complete-joint penetration welded column splice for a column that is a part of the Seismic Load Resisting System.
   3. Complete-joint penetration welds of beam flanges to column.
   4. Complete-joint penetration welds of single plate shear connections to columns.
   5. Complete-joint penetration welds of beam webs to columns.

D. Column Splices:
   1. A complete-joint penetration welded column splice for a column that is a part of the Seismic Load Resisting System is a Demand Critical Weld.
   2. Remove weld tabs from complete-joint-penetration-weld column splices in Seismic Load Resisting Systems.

E. Base Plates and Bearing Plates:
1. Finish: All baseplates and bearing plates shall be finished in accordance with AISC Specification M2.8.

2. Attachment to Column: Unless shown otherwise on the drawings, all baseplates and bearing plates shall be welded all around to the column with minimum fillet welds as specified in AISC Specification Table J2.4.

3. A complete-joint penetration weld that joins a column that is a part of the Seismic Load Resisting System to a base is a Demand Critical Weld.

4. Anchor Rod Holes in Baseplates: Hole sizes in baseplates for anchor rods shall be made oversize as described in the AISC “Steel Construction Manual”, Table 14-2.

F. Stiffeners: Provide stiffeners finished to bear under load concentrations where shown on the drawings.

G. Limitations on Use of A307 Bolts: ASTM A307 bolts shall not be used in any permanent steel-to-steel or concrete-to-steel connection.

H. 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 prime paint surfaces that are to remain exposed to view in the final construction.

2. Shop prime paint all members designated as AESS.

3. Shop paint any 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.

4. Shop paint any steel that is shown on the drawings to receive a finished paint system as defined in Specification Section 09 90 00.

5. 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. 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.

3. 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.

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.

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.

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. The District’s Testing Laboratory shall:

1. Review ladle analysis and mill test reports. Where certification is questionable, test material to verify compliance per CBC 2203A.1.
2. Visually inspect the seam welds of HSS hollow structural steel sections for visible discontinuities. Include the exterior of the seam weld and the interior at each end of the HSS member.

B. Inspect shop fabrication per CBC Section 1705A.2.

PART 3 - EXECUTION

3.1 ERECTION

A. The Erection work shall comply with the requirements of AISC Specification Section M4.

B. Inspection: 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.

C. Check elevations of concrete and masonry bearing surfaces and anchor bolt locations 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.

D. 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.

E. Temporary Shoring and Bracing:

1. Comply with the provisions of the AISC 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 AISC 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.

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.

F. 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.

G. 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. 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.

H. Base Plates and Bearing Plates: Remove loose latent material from bearing surfaces and base and bearing plates. Set plates to the elevation indicated on the drawings and level using steel shims (plastic shims will not be allowed) or by three leveling screws with weldments at the plate edges. After all protruding plates have been trimmed, grout plates solidly between bearing surfaces using the specified grout, ensuring no voids are present. Finish exposed surfaces, protect installed materials, and allow to wet cure. For proprietary grout materials, comply with manufacturer's instructions. Tighten anchor bolts after supported members have been positioned and plumbed.

I. Splices: Splices will be permitted only where indicated on the DSA approved structural 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.

J. 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 section.

7. Fillers and shims shall not exceed ¼” thick unless approved by the Structural Engineer and DSA.

K. Protected Zones of Seismic Load Resisting Systems: Where a protected zone of any member of a seismic load resisting system is designated on the drawings, or as designated by ANSI/AISC 341 or ANSI/AISC 358, the provisions of Part 1, Section 7.4 of the ANSI/AISC 341 shall apply. Welded attachments of structural and non-structural members, including stud welds and fasteners for the connection of other members is prohibited within the Protected Zone. If erection aids are required to be attached within the Protected Zone, the contractor shall obtain the engineer's approval for the use of such attachments. Gouges, notches and other discontinuities in the Protected Zone shall be repaired in conformance with AWS D1.8 Section 6.15.4. When welds in the protected Zone are required to be removed, removal shall be in conformance with AWS D1.8 Section 6.15.3.

L. 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 District. Do not use cutting torches, reamers, or other devices in the field for unauthorized correction of fabrication errors.

M. 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.

N. Removal of Erection Aids and Devices: The erector shall remove all erection aids and devices that interfere with architectural finish or MEP requirements.

O. 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 specified galvanizing repair paint in accordance with ASTM A780.

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.

P. Clean Up

1. Clean up all debris caused by the Work of this Section, keeping the premises neat and clean at all times.

2. After erection, thoroughly clean surfaces of foreign ore deleterious matter such as dirt, oil or great that would impair the bonding of concrete or other finishes as applicable.

3.2 FIELD QUALITY CONTROL

A. The District will engage a special inspector and qualified testing and inspection agency (the Testing Laboratory) approved by DSA to perform field tests and inspections and prepare test reports.

B. Scope of Work

1. The District’s Testing Laboratory: An independent testing laboratory will sample and test materials as they are being installed for compliance with acceptance criteria as specified and report and interpret the results. The laboratory shall monitor and report on the installation of constructed work and shall perform tests on the completed construction as required to indicate Contractor’s compliance with the various material specifications governing this work. The District shall be responsible for paying the testing laboratory for these services.

2. The District’s Testing Laboratory or a separate agency 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 CBC 2016. 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.

C. Special Inspections:

1. Inspection of Structural Steel, Bolting, and Welding Material

2. Welding of Structural Steel

3. High-Strength Bolting

D. Qualifications
1. Qualifications of Special Inspector: The special inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of DSA, for inspection of the particular type of construction or operation being inspected. The Special Inspector shall meet the legal qualifications of the 2016 California Code of Regulations.

2. Testing Laboratory
   a. The Testing Laboratory shall meet the basic requirements of ASTM E329 and shall submit to the District, 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.
   b. The Testing Laboratory shall be an Approved Agency by the Building Official of the city wherein the project is located to perform Special Inspections and other tests and inspections as outlined in the applicable building code.
   c. 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.

3. Qualifications of Welding Inspectors
   a. Inspectors performing visual weld inspection shall meet the requirements of AWS D1.1 Section 6.1.4. Welding inspection shall be supervised and the inspection reports signed by an inspector with current certification as an AWS Certified Welding Inspector (CWI)
   b. Inspectors performing nondestructive examinations of welds other than visual inspection (MT, PT, UT, RT) shall meet the requirements of AWS D1.1, Section 6.14.6.
   c. Inspectors for welds in a Seismic Load Resisting System shall additionally comply with the requirements of ANSI/AWS D1.8, Chapter 7.

E. Authorities and duties of the District’s Testing Laboratory:

1. Attend Preconstruction Conferences: The District’s Testing Laboratory shall receive from the District and review the project plans and specifications with the Architect and Engineer immediately upon receipt and prior to the start of construction. The Laboratory shall attend preconstruction conferences with the Architect, Engineer, Project Manager, IOR, General Contractor, and Material Suppliers as required to coordinate materials inspection and testing requirements with the planned construction schedule and shall participate in such conferences throughout the course of the project.

2. Cost Proposal: The Testing Laboratory’s proposal to the District 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.
3. Cooperation with Design Team: The Laboratory shall cooperate with the Architect, Engineer, and Contractor and provide qualified personnel promptly on notice.

4. The Laboratory shall perform the required inspections, sampling, and testing of materials as specified under each section and observe methods of construction for compliance with the requirements of the Contract Documents and the 2010 CBC.

5. 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.

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

7. Reports:

   a. Information on Reports: The Laboratory shall submit copies of reports of inspections and tests promptly and directly to the parties named below. The reports shall contain at least the following information:

      (1) Project Name and DSA Application number
      (2) Date report issued
      (3) Testing Laboratory name and address
      (4) Name and signature of inspector
      (5) Date of inspection and sampling
      (6) Date of test
      (7) Identification of product and Specification section
      (8) Location in the project
      (9) Identification of inspection or test
      (10) Record of weather conditions and temperature (if applicable)
      (11) Results of test regarding compliance with Contract Documents

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

      (1) Copies of Reports to the District or his representative
      (2) Copies of Reports to General Contractor
      (3) Copies of Reports to Architect
      (4) Copies of Reports to the Engineer of responsibility
      (5) Copies to the Inspector of Record (IOR)

   c. Certification: Upon completion of the job, the Laboratory shall furnish to the District, 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.

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

9. 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 District, Architect, and Engineer when those submittals are not made in a timely manner.

10. 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

F. Contract Obligations:

1. District Responsibility: The District shall pay for initial shop and field inspections and tests (laboratory services) as required during the fabrication and erection of the structural steel. The Contractor will be liable to the District for the cost for testing and retesting of materials that do not comply with the requirements of the Contract Documents and shall furnish and pay for the testing and inspection of other items as specified in these Specifications.

2. Contractor Responsibility: The Contractor shall provide the Testing Laboratory with the following:
   a. A complete set of shop and erection drawings that have been reviewed by the Architect/Engineer and including all revisions and addenda.
   b. Cutting lists, order sheets, material bills, shipping bills, and mill test reports.
   c. Information as to time and place of all rollings and shipment of material to shop.
   d. Representative sample pieces requested for testing.
   e. Full and ample means and assistance for testing all material
   f. Proper facilities, including scaffolding, temporary work platforms, hoisting facilities, etc, for inspection of work in the mills, shop, and field.

3. 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 experience in structural steel testing and inspection. See "Qualifications of Welding Inspectors" above for special requirements for welding inspectors. The Testing Laboratory shall provide test reports of all inspections. All test reports shall indicate types and locations of all defects found during inspection, the measures required and performed to correct such defects, statements of final approval of all 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. In addition to the parties listed in this Specification the Fabricator and Erector shall receive copies of all test reports.

4. Duties and Responsibilities of the Special Inspector

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

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

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 the discrepancy date, description of the discrepancy, plans or views or specification reference, description of as-built condition, description of any remedial work performed and status of the discrepancy. This log shall be submitted to the contractor and Architect/Engineer on a periodic basis for review and comment. Upon completion this log shall be submitted as an 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.

5. Rejection of Material or Workmanship: The District, 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.

G. Shop Inspections and Tests: The District’s Testing Laboratory shall provide the following inspections at the designated fabrication shops:

1. Shop Inspection Waiver: The requirement to perform fabricating shop inspection 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.

2. An initial shop inspection prior to the start of any fabricating work shall be made to accomplish the following:

a. Verify the fabrication shop’s certification from AISC.

b. Verify 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.
c. Perform steps 1, 2 and 3 of the section "Weld inspection and Testing" described below when shop welding is to be performed.

d. Perform step 1 of the section "High-Strength Bolting Inspection and Testing" described below when shop bolting involving joints that are designated on the plans as Pretensioned or Slip-Critical is to be performed.

e. Provide periodic verification of specified camber of steel beams in the unstressed condition.

f. For seam welds in hollow structural sections (HSS), conduct a thorough visual examination of the seam weld area for visible discontinuities. Visual examination should include, as a minimum, the exterior of the seam weld and the interior at each end.

3. Process Monitoring:

a. Provide continuous monitoring of welding for all CJP, PJP, Plug and Slot welds, Multipass fillet welds and Single-pass fillet welds greater than 5/16 inch as described below in the Weld Inspection and Testing section.

b. Periodically monitor welding of single-pass fillet welds that are less than or equal to 5/16 inch.

c. Periodically monitor welding floor and roof deck welds.

d. Provide continuous 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.

e. Periodically monitor high-strength bolt installation in snug-tight joints and in pre-tensioned or slip-critical joints using turn-of-nut with matchmarking, twist-off-bolt or direct tension indicator methods of installation.

f. Periodically monitor the welding of headed studs to floor beams.

H. Field Inspections: The District's Testing Laboratory shall provide the following inspections in the field:

1. Obtain the planned erection procedure, and review with the Erectors supervisory personnel.

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

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

4. Conduct welding inspection and verification testing per detailed requirement of section on Welding Inspection and Testing below.

5. Conduct high-strength bolting inspection per detailed requirements of Section on High-Strength Bolting and Testing below.

6. 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.
7. Endeavor to guard the District 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 District and Engineer.

8. Visually inspect 100% of the galvanized round, square and rectangular tubes for defects like but not limited to cracks at the tube corners.

I. Weld Inspection and Testing: The District’s Testing Laboratory shall make the following inspections and tests 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. Verify welder qualifications either by certification and/or by retesting. Obtain welder certificates.

3. Verify welding electrodes to be used and other welding consumables as the job progresses.

4. 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.

5. Observe joint preparation and fit up, backing strips, and runout plates for welded moment connections and column splices.

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

7. Visually inspect 100% of welds for proper size, length, location, and weld quality in accordance with AWS D1.1 and D1.8 requirements. Unless specifically noted otherwise, all welding shall be considered statically loaded nontubular connections.

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 joint penetration welds and partial joint penetration welds, Plug and Slot welds, multipass 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 method of attaching the steel floor and roof decking to the structural frame.

d. Periodically monitor the welding of headed studs to steel members.

10. Weld Verification Testing Scope:

a. Perform nondestructive examination services using a qualified technician with the necessary equipment to perform the following:

   (1) 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 and D1.8.

   (2) Interpret, record, and report results of the nondestructive tests.

   (3) Mark for repair, any area not meeting Specification requirements. Correction of rejected welds shall be made in accordance with AWS D1.1.

   (4) Re-examine repair areas and interpret, record, and report the results of examinations of repair welds.

   (5) Verify that quality of welds meet the requirements of AWS D1.1.

b. Fillet welds. provide the following:

   (1) MT test a minimum of 10% of the length of each fillet weld exceeding 5/16".

   (2) Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.

c. Partial joint penetration welds, including flare-bevel groove welds. provide the following:

   (1) MT test a minimum of 25% of the length of each PJP weld exceeding 5/16" effective throat.

   (2) Periodic MT testing of representative PJP welds 5/16" and less but need not exceed 10% of all such welds, except as provided in (3) below.

   (3) Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.

d. Complete joint penetration welds. provide the following:

   (1) All CJP welds exceeding 5/16" thickness shall be 100% UT tested per AWS D1.1 Chapter 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 Chapter 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 K.

   (2) Periodic MT testing of representative CJP welds 5/16" and less not to exceed 10% of all such welds, and 25% of all beam-to-column CJP welds, except as provided in (3) below.
(3) Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.

e. Acceptance Criteria
(1) Visual, MT, PT shall be per AWS D1.1 Table 6.1.
(2) UT testing shall be per AWS D1.1 6.13.1 and Table 6.2.

f. 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 A435 or ASTM A898 (Level 1 criteria) and reported for Engineer disposition.

g. Welds of Anchors to Embedded Plates:
(1) 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.
(2) Deformed Bar Anchors: Perform MT testing on 10% of deformed bar anchors larger than #5 bar.

h. The costs of repairing defective welds and the costs of retesting by the Testing Laboratory providing services for the District 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.

11. Inspection of welds within Seismic Load Resistance Systems shall additionally comply with the requirements of ANSI/AWS D1.8, chapter 7.

a. Weld access holes or beam copes shall be inspected for cracks on the cut surface prior to welding. Inspection shall be performed using magnetic particle testing (MT) or dye penetrant testing (PT) and shall be free of cracks.

b. Inspection of the wide-flange k-area shall be performed using magnetic particle testing (MT). This testing shall include the k-area base metal within 3in of the weld. This magnetic particle testing (MT) shall be performed no sooner than 48 hours following completion of the welding.

c. Base metal shall be ultrasonically tested after welding for laminations and lamellar tearing. Any base metal discontinuities found within t/4 of the steel surface adjacent to the fusion line shall be accepted or rejected on the basis of criteria of AWS D1.1 Table 6.2.

d. Weld Tabs at column splices for columns that are part of the seismic Load Resisting System (SLRS) shall be removed. This removal shall comply with the requirements of AWS D1.8, Section 6.10.

J. High-Strength Bolting Inspection and Testing: The District’s Testing Laboratory shall perform the following inspections and test for connections joined with high-strength bolting. Bolting performed in the shop may be inspected in the field unless continuous monitoring of the bolting operation is herein specified:

1. Observe preinstallation verification testing of the pretensioning method to be used in accordance with the requirements of the “Specification for Structural Joints
Using ASTM A325 and A490 Bolts”. Daily check the calibration of impact wrenches used in field bolted connections.

2. Inspect bolt installation for 100% of high strength bolted connections according to inspection procedures outlined in the "Specification for Structural Joints Using ASTM A325 or A490 Bolts”.

3. Perform Arbitration Testing and Inspection according to procedures outlined in the "Specification for Structural Joints using ASTM A325 or A490 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 above.

4. Monitoring of Bolting Installation:

   a. Continuous Monitoring: The District’s 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 ASTM A325 and A490 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 may be monitored on a periodic basis.

   c. Connections of AESS members: periodic monitoring to verify compliance with AISC 303 and other requirements noted in the construction documents, including orientation of bolt heads.

K. Non-shrink grout for base plates and bearing plates:

1. Compressive Strength Tests (by the District’s Testing Laboratory): Compressive strength of grout shall be determined by testing grout cubes according to the requirements of ASTM C109 - Modified. Test one set of three cubes at 1 day, and one set of three cubes at 28 days.

2. Frequency of Testing: One set of cubes (6 cubes) shall be made for each day's operation of grouting ducts.

END OF SECTION
SECTION 05 40 00

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.

B. Related Sections

1. Section 03 30 00 – Cast-in-Place Concrete
2. Section 05 12 00 – Structural Steel
3. Section 05 45 00 – Metal Support Assemblies
4. Section 05 50 00 – Metal Fabrications
5. Section 09 29 00 – Gypsum Board

1.2 DESCRIPTION OF WORK

A. The work of this section includes all labor, materials and equipment required for the following:

1. Non-load bearing metal stud framing at exterior walls and soffits.
2. Non-load bearing metal stud framing 18 gage and heavier at interior walls and framed ceilings. For metal stud framing lighter than 18 gauge, refer to Section 05 45 00 Metal Support Assemblies

1.3 QUALITY ASSURANCE

A. Codes and Standards

1. California Code of Regulations, Title 24, 2016 edition, also known as California Building Code (CBC), with Division of the State Architect (DSA) amendments.
2. AISI "North American Specification for the Design of Cold-Formed Steel Structural Members" as published by the American Iron & Steel Institute (AISI).
3. AISI “Standard for Cold-Formed Steel Framing – General Provisions” as published by the American Iron & Steel Institute (AISI).
SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

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A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

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1. Non-load bearing metal stud framing at exterior walls and soffits.
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2. AISI "North American Specification for the Design of Cold-Formed Steel Structural Members" as published by the American Iron & Steel Institute (AISI).

3. AISI “Standard for Cold-Formed Steel Framing – General Provisions” as published by the American Iron & Steel Institute (AISI).

B. Product Certification: Manufacturer’s material certification or data from an independent testing agency that is qualified according to ASTM E329 indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

C. Fire-Rated Assemblies: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

D. Installer: Company specializing in performing the work of this Section with minimum 3 years documented experience.

E. Welders: Qualified in accordance with AWS D1.3 for welding process, position, type of weld and type of steel.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s ICC-ESR report, 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 anchors, framing connectors and fasteners used.

B. Welding certificates shall be submitted to the District Testing Agency.

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. Acceptable Manufacturers: Subject to compliance with requirements, cold-formed steel framing manufacturers shall be members of the Steel Stud Manufacturer’s Association (ICC ER-4943P).

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 for cold formed shapes: ASTM A653 or ASTM A1003, Structural Grade, Type H, grades as indicated, and coated with G60 galvanized coating.
   1. 16 gage and heavier studs, tracks and plate: Grade 50 steel.
   2. 18 gage studs, tracks and plate: Grade 33 steel.

B. Steel sheet for miscellaneous clips, bent plate, flat plate and backing plates: ASTM A653
   1. 16 gage and heavier: Grade 50 steel.
   2. 18 gage: Grade 33 steel.

C. Minimum Base Metal Thickness: 18 gage unless noted otherwise.

2.4 TYPES

A. Structural Stud/Joist (S-Section): steel studs with punched web, of size, thickness and properties as required by the DSA approved Drawings.
   1. Built-up headers and diagonal braces shall be fabricated from unpunched stud sections.
   2. Tracks shall be unpunched.

B. Track (T-Section): Standard tracks of size, shape, and thickness as required by the DSA approved drawings.

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 A1003, 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
11. Backing plates

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Hot-rolled Steel Shapes and Clips: ASTM A36, zinc coated by hot-dip process according to ASTM A123.

B. Cold-formed light gage metal clips: by Simpson Strong-Tie Company or The Steel Network unless shown otherwise on the DSA approved drawings.

C. Vertical Deflection Clips (non-load-bearing framing): Manufacturer’s standard bypass and head clips as shown on the DSA approved drawings, capable of isolating wall stud from upward and downward vertical displacement of primary structure using mechanical fasteners. Connections shall be tested in accordance with ICC AC261 criteria and hold a valid ICC-ES evaluation service report to be accepted, such as ICC-ESR-1903, or equivalent. Provide clips with attached bushing and screw of the series, size and configuration as shown on the DSA approved drawings.

1. VertiClip® or VertiTrack® series or equal, unless noted otherwise on the DSA approved drawings. Mechanical attachment to structure and screw attachment to stud web using step-bushings to permit frictionless vertical movement.

D. Anchor Rods: ASTM F1554, Grade 36, threaded carbon-steel, hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153, Class C.

E. Anchoring to Concrete: See Cast-In-Place Concrete Section for acceptable anchoring processes and products.

F. Expansion Bolts: Hilti Fastening Systems “Kwik Bolt TZ Concrete Anchors” (ICC ESR-1917), or equal product substituted per Section 01630.

G. Power-Actuated Fasteners: Hilti Fastening Systems DS (0.177” dia. x 1 ½” embedment) (ICC ER-1663).

H. Screws: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws; No. 8 pan head and larger as noted on the Drawings.

I. 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. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, non-corrosive, non-staining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C1107, with fluid consistency and 30-minute working time. The grout strength shall be twice the
Compressive strength of the supporting concrete but need not be greater than 8000 psi nor shall it be less than 5000 psi.

C. Shims: Load bearing, high-density multi-monomer plastic, non-leaching.

D. 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 compressed to eliminate gaps at ends of studs.

B. 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. Where fastening to framing with sprayed fire-resistant materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistant materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistant materials from damage.

D. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

E. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.
3.2 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 and as shown on the DSA approved drawings.

B. Coordinate framing sizes and layouts with the work of the various trades. Where ductwork, conduit, piping, casework, and other such items exceed indicated available space, increase stud sizes or make other minor modifications as necessary to accommodate the work at no change in cost of to the District. Coordinate details and requirements of other trades which adjoin and fasten to studs and requires backing or special support framing.

C. Runner Tracks: Install continuous tracks sized to match studs as shown in the DSA approved drawings. Align tracks accurately to layout at base and tops of studs. Complete, uniform level bearing support shall be provided for the bottom track, using high strength grout as needed.

D. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements. Splices in studs shall not be permitted. Splices in other work shall not be permitted unless the splice has been engineered and detailed on the structural drawings.

E. Provide four (4) studs at each intersecting wall and three (3) studs at each corner minimum.

F. Where stud system abuts structural columns or walls, anchor ends of stiffeners to supporting structure.

G. 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.

H. Installation of Wall Stud System:

1. Wall studs shall sit squarely in tracks a maximum 1/8” gap to track web. Connect studs to top and bottom runner tracks by screw fastening as specified at both inside and outside flanges. Install studs at spacing required on Drawings. Do not cut or notch stud flanges or cut additional openings in web.

I. Isolate non-load-bearing steel framing from building structure where detailed on the DSA approved drawings using drift clips, vertical deflection clips, or deflection tracks.

J. Frame both sides of expansion and control joints, with separate studs; do not bridge the joint with components of stud system.

K. Framed wall openings shall include a header and multiple studs at each edge of openings as indicated on the DSA approved drawings.

L. Horizontal Bridging:
1. Horizontal bridging shall consist of a channel (U-section) attached to each stud using a manufacturer’s clip angle. See DSA approved drawings for bridging detail and approved alternate.

2. Install horizontal bridging in all non-loadbearing stud walls systems, spaced (vertical distance) at not more than 4'-0" o.c.

3. Install horizontal bridging in all framed ceilings and soffits, spaced at midspan, but not more than 8'-0" o.c.

4. Provide stud bracing during construction as required for studs to carry construction loads.

M. Sheathing Attachment: Provide attachment of interior and exterior sheathing and wall material to each stud in accordance with architectural drawings.

N. Installation of Ceiling Joists: Install level and plumb, complete with bracing and reinforcing as indicated on DSA approved drawings. Provide not less than 1-1/2" end bearing.

1. Reinforce ends with end clips, steel hangers, steel angle clips, steel stud section, or as otherwise recommended by joist manufacturer and as indicated on the DSA approved drawings.

2. Provide web stiffening of joists at points of reaction or concentrated loads when center of web punch-out is less than 12" from edge of bearing.

3. Secure ceiling joists to interior support systems to prevent lateral movement of bottom flange.

4. Provide additional ceiling joist parallel to each opening that interrupts one or more normal joist spacings unless shown otherwise on the drawings. These ceiling openings shall be framed with headers of same size as the typical joist, unless shown otherwise on the drawings.

O. Welded connections shall be made by resistance spot fusion welding, fillet welding, or plug welding and shall be performed in accordance AWS D1.3.

P. 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.

Q. Tolerance: install members to provide surface plane with maximum variation of ¼ inch in 10 feet in any direction.

3.3 FIELD QUALITY CONTROL

A. District’s Testing Agency shall provide inspection of welding, including fit-up, welding equipment, weld quality, and welder certifications in accordance with CBC Section 1704A.3 and AWS D1.3.

B. The Project Inspector shall provide periodic inspection during installation as required to establish the installed Work is in conformance with the Contract Documents.
END OF SECTION
SECTION 05 45 00
METAL SUPPORT ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
1. Interior metal studs and furring for support of gypsum board.
2. Backing for interior items to be attached to gypsum board and metal studs.

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

C. Related Sections
1. Section 05 40 00 - Cold-Formed Metal Framing: Provision of heavy interior cold-formed metal framing.
2. Section 07 92 00 - Joint Sealants: Provision of acoustical sealant.
3. Section 09 29 00 - Gypsum Board: Provision of gypsum board.
4. Section 10 11 00 - Visual Display Surfaces: Provision of visual display surfaces.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials
2. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. C645 - Standard Specification for Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.

B. AWS - American Welding Society
1. D1.3 - Structural Welding Code - Sheet Steel

C. CBC - California Building Code, 2016 Edition

D. GA - Gypsum Association
1. 203 - Installation of Screw-Type Steel Framing Members to Receive Gypsum Board.

E. ICC - International Code Council

F. SSMA - Steel Stud Manufacturers Association
G. USG - United States Gypsum Company
   1. Drywall/Steel Framed Systems, SA923/rev. 3-02.

1.3 SYSTEM DESCRIPTION

A. Design Requirements
   1. Plumb, true, straight and rigid framing for support of attached materials.
   2. Design system to accommodate construction tolerances, deflection of building structural members, support of attached materials and clearances of intended openings in accordance with CBC.

1.4 SUBMITTALS

A. Product Data: For each type of metal framing product and accessory indicated, including manufacturer’s typical details, ICC report, specifications and installation instructions.

1.5 QUALITY ASSURANCE

A. Welder Qualifications: Qualified in accordance with AWS D1.3 for welding process, position, type of weld and type of steel.

B. Regulatory Requirements
   1. Comply with fire resistance ratings as indicated and as required by governing authorities and codes.
   2. Provide materials, accessories, and application procedures that have been listed by an approved testing agency or tested according to ASTM E119 for the type of construction shown.

C. Perform work in accordance with GA 203 and ASTM C754, governing laws, building code requirements, manufacturer’s printed recommendations and USG’s “Drywall/Steel Framed Systems, SA923/rev. 3-02.”

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection
   1. Deliver materials to job site and store in ventilated dry locations. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather.
   2. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Acceptable Manufacturers
   1. Steel Framing and Furring: Member of SSMA (ICC ER-4943P).
   2. Grid Suspension Assemblies: Chicago Metallic Corp.; USG Interiors, Inc.; National Rolling Mills Co., or equal.
2.2 STEEL FRAMING FOR STUDS AND FURRING

A. Studs: C-shaped, ASTM C645, with galvanized coating ASTM A653, G-90; non-load bearing rolled steel, channel shaped, punched for utility access.
   1. Depth and Flange Width: As indicated on the Drawings.
   2. Gauge: As indicated on the Drawings.
   3. Tracks: Match stud gauge and depth. 1-1/4 inch flange width unless noted otherwise.
   4. Spacing: 16 inches on center throughout.

B. Deflection Tracks: Manufacturer’s standard top runner designed to prevent cracking of gypsum board applied to interior studs resulting from deflection of the structure above fabricated from steel sheet complying with ASTM A568 or ASTM A653, 16 gauge minimum. Width to accommodate depth of studs and of the following configuration:
   1. Top Runner with Slotted Flanges: 2-1/2 inch deep flanges with slots 1 inch on center.
   2. Product: SlipTrack, Inc. (ICC ESR-2049), or equal.

C. Stiffeners or Bridging: Unpunched channel shape, formed of 16 gauge steel to required dimensions.

D. Furring and Bracing Members: Same material and finish as studs, thickness to suit purpose.

E. Steel Rigid Furring Channels: ASTM C645, hat shaped, depth of 7/8-inch, and minimum thickness of base (uncoated) metal as follows:
   1. Thickness: 0.0179-inch, unless otherwise indicated.

F. Z-Furring Members: Manufacturer’s standard Z-shaped furring members with slotted or nonslotted web, fabricated from steel sheet complying with ASTM A568 or ASTM A653; with a minimum base metal (uncoated) thickness of 0.0179-inch, face flange of 1-1/4 inch, wall-attachment flange of 7/8-inch, and of depth required to fit insulation thickness indicated.


H. Hat Channels: Hat-shaped, corrosion-resistant rigid furring channels, ASTM C645, 7/8-inch deep unless otherwise indicated, base metal thickness as required, as manufactured by Dietrich Metal Framing, Inc., “FC-Series”, or equal.

I. Sheet Steel: ASTM A653.

J. Metal Screws: Self-drilling and self-tapping; No. 8 and larger as noted on the Drawings; ITW Buildex, “TEKS (ICC ESR-1976)”, or equal; screws shall penetrate substrate by a minimum of 3 full threads exposed; use low profile heads as required by architectural finish.

K. Powder Driven Fasteners
   1. Tempered steel pins with special corrosive resistant plating or coating.
   2. Pins shall have guide washers to accurately control penetration.
   3. Fastening shall be accomplished by low-velocity, piston-driven, powder accentuated tool.
   4. Pins and tool shall be Hilti, “X-U Fasteners (ICC ESR 1385)”, or equal.
L. Expansion Bolts: Hilti Fastening Systems, “Kwik Bolt TZ Concrete Anchors (ICC ESR-1917)”, or equal.

M. Metal Backing Plates: As indicated on the Drawings.

N. Bracing: Provide cross diagonal straps, attached as indicated on the Drawings and per stud manufacturer’s specifications for frame stability.

O. Welding Electrodes: AWS low hydrogen; rod number and diameter as approved by District’s Testing Agency.

2.3 MISCELLANEOUS MATERIALS

A. Acoustical Sealant: As specified in Section 07 92 00.

B. Galvanized Finish Touch-Up Coating: Liquid zinc compound that bonds electrochemically to iron, steel and aluminum, as manufactured by ZRC Chemical Products, “ZRC Cold Galvanizing Compound”, or equal.

C. Resilient Sound Isolation Clip
   1. Isolation clip shall consist of a rubber element into which a standard galvanized steel furring channel, 7/8-inch by minimum 25 gauge, is captured. The channel legs snap fit into the rubber element without any metal-to-metal or other rigid contact with building elements.
   2. Clips shall have sufficient capacity to support wall weights as constructed. Design load capacity shall be based on a safety factor where the load to failure, defined as pullout of the channel from the clip, is a minimum 2.5 times the allowable maximum design load. Anchors for attachment of the clips to the substructure shall be selected to support wall weights at each clip.
   3. The isolation clip is attached to the wall framing or other structural substrate through galvanized steel brackets on each side of the rubber isolation element. The brackets shall be of sufficient strength to carry the wall weight without bending or failure.

2.4 FINISHES

A. Galvanized Surfaces: Where galvanizing is removed by welding or other assembly procedures, clean area of any foreign matter by wire brushing and metal conditioner recommended by galvanized finish touch-up manufacturer. Apply galvanized touch-up coating by brush or spray with minimum coverage of 1.4 mils, dry film.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive metal support framing systems and verify the following:
   1. Installation of building components located in walls is complete.
   2. Backing plates are properly located for support of wall hung items.

B. Beginning of installation means installer accepts existing conditions.
3.2 INSTALLING STEEL FRAMING FOR STUDS AND FURRING

A. Studs - Typical
   1. Align and secure top and bottom tracks. Place 2 beads of acoustic sealant between tracks and substrate. Tracks shall be securely anchored to supporting structure, with fasteners specified at no more than 32 inches on center.
   2. Fit tracks under and above openings; secure intermediate studs at spacing of wall studs.
   3. Abutting or intersecting pieces or track shall be securely anchored to a common structural element or spliced together. Do not splice studs.
   4. Install studs vertically at spacing as indicated. Place 2 beads of acoustic sealant between studs and adjacent vertical surfaces.
   5. Connect studs to tracks using fastener method.
   6. Construct corners using minimum 3 studs.
   7. Double studs vertically at wall openings, door and window jambs and not more than 2 inches each side of openings, unless otherwise specified. Provide track and stud horizontally at wall, window head and sill openings.
   8. Brace stud framing system and make rigid.
      a. Diagonal bracing shall be installed at locations indicated for frame stability.
      b. Install bridging as indicated on the Drawings.
      c. Wire tying of framing members shall not be permitted.
   9. Coordinate erection of studs with requirements of door and window frame supports and attachments.
   10. Align stud web openings.
   11. Coordinate installation of jamb anchors and metal backing plates with electrical and mechanical work to be placed in or behind stud framing.
   12. Welded connections shall be made by resistance spot fusion welding, fillet welding, or plug welding and shall be done in accordance with the latest recommended procedures and practices of AWS.
   13. Do not cut or notch stud flanges or cut additional opening in stud web.
   15. Provide all angles, clips and other miscellaneous pieces necessary to attach light gauge framing to building structure or to attach other materials to light gauge framing.

B. Backing in Studs or Furring
   1. Verify that any pre-drilling of backing and attachment of spacers to prevent crushing of attached material is done prior to application of attached material.
   2. Securely weld or screw cut sections of unpunched stud to at least 3 studs or furring supports, leaving flat surface of backing stud web to receive attachment of object to be secured.
   3. If it is determined by the Architect that backing was not provided for any items as required, the Contractor shall remove the finish materials; install backing and shall patch and refinish surface to match adjacent area and surface at no additional cost to the District.

C. Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8-inch from plane of faces of adjacent framing.
D. Resilient Sound Isolation Clip
   1. General: Install work in accordance with the manufacturer’s approved product
      installation procedures.
   2. Spacing and location of sound isolation clips shall be determined by the manufacturer
      based on wall type. Installation drawing details shall be provided by the manufacturer
      to assure optimum sound control and structural integrity of the system.

3.3 FIELD QUALITY CONTROL

A. The District’s Testing Agency will provide periodic inspection of welding, including prior
   fit-up welding equipment, weld quality, and welder certification in accordance with AWS
   and CBC.

END OF SECTION
SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Painted steel canopy with Cedar wood members as indicated on the Drawings.
   2. Stainless steel surface-mounted low wall air return at Cadaver Lab.
   3. Stainless steel countertops.
   4. Countertop supports.
   5. Partition post at cantilever wall at Bookstore service desk.
   6. Non-structural miscellaneous metal channels, angle imbeds, backing and mounting plates, and other shapes as required.
   7. Rough hardware.

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

C. Related Sections
   1. Section 06 20 00 - Finish Carpentry: Provision of Cedar wood members at steel canopy.
   2. Section 06 41 10 - Custom Carpentry: Provision of plastic laminate and epoxy countertops.
   3. Section 07 62 00 - Sheet Metal Flashing and Trim: Provision of sheet metal flashing and trim.
   4. Section 09 90 00 - Painting and Coating: For finish painting of items not specified to have factory finish.
   5. Section 12 36 61.16 - Solid Surfacing Countertops: Provision of solid surfacing countertops.

1.2 REFERENCES

A. ADA - Americans with Disabilities Act

B. AGA - American Galvanizers Association
   1. Inspection Manual for Hot Dip Galvanized Products.

C. AISC - American Institute of Steel Construction Inc.

D. ANSI - American National Standards Institute
   1. B18.2.1 - Square and Hex Bolts and Screws - Inch Series.
   4. B18.6.4 - Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws (Inch).
E. ASTM - American Society for Testing and Materials
10. A384 - Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
12. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
16. A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
F. AWS - American Welding Society
   1. D1.1 - Structural Welding Code - Steel.
   2. D1.3 - Structural Welding Code - Sheet Steel.
   3. D1.6 - Structural Welding Code - Stainless Steel.

G. CBC - California Building Code, 2016 Edition

H. NAAMM - National Association of Architectural Metal Manufacturers
   1. MFM - Metal Finishes Manual for Architectural and Metal Products.

I. SSPC - The Society for Protective Coatings
   1. PA 1 - Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel.
   2. SP 2 - Surface Preparation Specification No. 2: Hand Tool Cleaning.
   3. SP 3 - Surface Preparation Specification No. 3: Power Tool Cleaning.

1.3 SYSTEM DESCRIPTION

A. Performance Requirements
   1. Wind Load Requirements for Exterior Items: Members shall withstand dead and live loads caused by pressure and suction of wind in accordance with CBC.
   2. Work shall support normally imposed loads in conformity with AISC requirements.
   3. Provide for expansion and contraction.
   4. Exterior items shall exclude water.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s product data for paint products and grout.

B. Shop Drawings: Submit shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections.
   1. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.
   2. Where welded connections and concrete inserts are required, show size and locations required.

C. Quality Control Submittals: Welder certificates signed by Contractor certifying that welders comply with requirements specified under the “Quality Assurance” Article.

D. Samples: Only as requested by the Architect.

1.5 QUALITY ASSURANCE

A. Welding Standards: Comply with applicable provisions of AWS D1.1 and AWS D1.3.
   1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
B. Design Criteria
   1. Work shall be designed to support normally imposed loads and conform to AISC requirements.
   2. Built-up parts shall not exhibit warp.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle packaged materials in original containers with seals unbroken and labels intact until time of use.

B. Discharge materials carefully and store on clean concrete surface or raised platform in safe, dry area.

1.7 JOB CONDITIONS

A. Scheduling and Sequencing
   1. Ensure timely fabrication of items to be embedded or enclosed by other work.
   2. Furnish information and assistance required for locating embedded items and be responsible for proper locations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

B. Steel and Iron
   1. Steel Plates, Shapes, and Bars: ASTM A36.
   2. Rolled Steel Floor Plate: ASTM A786, rolled from plate complying with ASTM A36 or ASTM A283, Grade C or D.
   3. Cold-Formed Steel Tubing: ASTM A500.
      a. For exterior installations and, where indicated, provide metalized-tubing.
   5. Steel Pipe: ASTM A53, Type S, Grade B, Schedule 40, unless otherwise indicated, or another weight required by structural loads.
      a. Black finish, unless otherwise indicated.
      b. Prime with red oxide primer at locations detailed to receive paint.
   6. Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 316L.
   7. Stainless Steel Tubing: ASTM A554, Grade MT 316L.
   10. Concrete Inserts: Anchors of type indicated below, fabricated from corrosion resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E488, conducted by a qualified independent testing agency.
a. Threaded or wedge type; galvanized ferrous castings, either ASTM A47 malleable iron or ASTM A27 cast steel. Provide bolts, washers, and shims as required, hot-dip galvanized in accordance with ASTM A153.
b. Provide weld plate imbedded in concrete as detailed in the Drawings. Coordinate location with other imbedded materials.

C. Fasteners: Provide plated fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating, for exterior use or where built into exterior walls, concrete slabs, or ceilings. Select fasteners for the type, grade, and class required.
1. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A, with hex nuts, ASTM A563, and, where indicated, flat washers.
8. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in concrete and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E488 conducted by a qualified independent testing agency.
   b. Material: Group 1 alloy 304 or 316 stainless steel bolts and nuts complying with ASTM F593 and ASTM F594.
9. Epoxy Cement: As manufactured by Simpson Strong-Tie, “SET/ET/AT High Strength Anchoring Adhesives”; The QUIKRETE Companies; Rust-Oleum, or equal.

D. Welding Materials: AWS D1.1 and AWS D1.3, type required for materials being welded.
1. Electrodes: E = 70XX.

2.2 STANDARD CATALOG PRODUCTS

A. Non-Shrink Grout
1. Premixed; containing no metallic particles, requiring only addition of water.
2. Shall have minimum working time of 15 minutes and initial set time of 30 to 45 minutes in accordance with ASTM C191.

B. Expansion Cement
1. Non-metallic, non-corrosive, pourable hydraulic type cement that is quick-setting, high strength, and non-shrinking, with the following properties
   a. Compressive Strength: 58,400 psi at 7 days in accordance with ASTM C109.
   b. Volume Change: Plus 0.31 at 7 days in accordance with ASTM C157.

C. Coatings
1. Coatings for Protection of Dissimilar Materials
   a. Dissimilar Metals: Bituminous type materials in accordance with ASTM D1187.
   b. Aluminum in Contact with Concrete, Metal, Wood, or other Absorptive Material.
2. Shop Primer for Ferrous Metal: VOC compliant, fast-curing, lead and chromate free, universal modified alkyd primer with good resistance to corrosion, compatible with finish paint systems.
4. Galvanizing Repair Paint: High zinc dust content paint, with dry film containing not less than 94 percent zinc dust by weight, as manufactured by Parker Amchem, “Galvaprep SG”; Sherwin Williams, “Zinc Clad I”; Rust-Oleum, or equal.
5. Exterior metal components/fabrications that are intended to be exposed at the completion of construction and their attachments shall be shop treated with galvanic “metalized” process; then shop primed, and painted as indicated herewith.

D. Partition Post at Cantilever Wall at Bookstore Service Desk: 1-1/2 inch round stainless steel post with full length channels for 1/4-inch thick glass; flat cap and welded base plate; brushed stainless steel finish.
1. Configuration: Provide end, center posts as required and as indicated on the Drawings.
2. Height: 24 inches.

2.3 FABRICATION, GENERAL

A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on Construction Drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

B. Preparation
1. Coordinate with other work supporting or adjoining miscellaneous metal and verify requirements of cutting out, fitting, and attaching.
2. Verify sizes, designs, and locations of items; do so at site whenever construction progress permits.

C. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
D. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the fabrication and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
   1. Temperature Change (Range): 100 degrees Fahrenheit.

E. Shear and punch metals cleanly and accurately. Remove burrs.

F. Ease exposed edges to a radius of approximately 1/32-inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

G. Remove sharp or rough areas on exposed traffic surfaces.

H. 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. Use electric shielded-arc process in accordance with AWS.
   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 that no roughness shows after finishing and contour of welded surface matches those adjacent.
   5. Miter corners and angles of frames unless otherwise indicated.
   6. Make welds normally exposed to view in finished work uniform and grind smooth.

I. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

J. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

K. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. 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.

L. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

M. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

N. Bolted and Screwd Connections
   1. Use bolts for field connections only, and then only as noted. Countersink heads; finish smooth and flush.
   a. Provide washers under heads and nuts bearing on wood.
b. Draw nuts tight and prevent loosening of permanent connections by nicking threads.
c. Use beveled washers where bearing is on sloped surfaces.

2. Where necessary to use screws for permanent connections in ferrous metal, use flat head type, countersink, fill screw slots, and finish smooth and flush.
3. Evenly space exposed heads.

2.4 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports for applications indicated that are not a part of structural steel framework as required to complete the Work.

B. Fabricate units to sizes, shapes, and profiles indicated and required to receive other adjacent construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
1. Equip units with integrally welded anchors for casting into concrete. Furnish inserts if units must be installed after concrete is placed.
   a. Except as otherwise indicated, space anchors 24 inches on center and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4-inch thick by 8 inches long.

C. Galvanize miscellaneous interior and exterior framing and supports.

2.5 STAINLESS STEEL COUNTERTOPS

A. Countertops, General: Provide smooth, clean exposed tops, integrated backsplashes, and edges in uniform plane free of defects. Roll exposed edges and corners. Provide front and end overhang of 1 inch over base cabinets.

B. Stainless Steel Tops: Made from 14 gauge stainless steel sheet, ASTM A666, Type 316L, with No. 6 satin finish, and complying with the following:
1. Weld shop-made joints and grind and polish surfaces to produce uniform, directional, textured, polished finish indicated, free of cross scratches. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
2. Where field-made joints are permitted, provide welded joints.
3. Extend top down to provide a 1 inch thickness and 1/2-inch return flange under frame. Sound deaden entire undersurface with heavy-build mastic coating.
4. Provide hemmed edges, unless otherwise indicated.

2.6 STEEL FINISHES, GENERAL

A. Comply with NAAMM’s MFM for recommendations relative to applying finishes. Finish metal fabrications after assembly.
2.7 STEEL AND IRON FINISHES

A. Exterior metal components/fabrications that are intended to be exposed at the completion of construction and their attachments shall be shop treated with galvanic “metalized” process; then shop primed and painted as indicated herewith.

B. Galvanizing
   1. Galvanize items after fabrication in largest sections practicable unless otherwise permitted or recommended by ASTM A384 and ASTM A385.
   2. Where galvanizing is removed by welding or other assembly procedures, touch up abraded areas with molten zinc or zinc-rich paint.
   3. Where ferrous metal item is noted to be galvanized, perform galvanizing in accordance with following standards as applicable to item:
      b. Other Fabricated Items: ASTM A123.

C. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
   1. Typical: SSPC SP 2, SSPC SP 3, as required.

D. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes or to be embedded in concrete, unless otherwise indicated. Comply with requirements of SSPC PA 1 for shop painting.

E. Stainless Steel
   1. Remove or blend tool and die marks and stretch lines into finish.
   2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
   3. Satin, Directional Polish: No. 6 finish.
   4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

F. Finish Painting: As specified in Section 09 90 00.

2.8 SOURCE QUALITY CONTROL

A. Test and Inspections: The District will employ testing laboratory to test welds per CBC, Section 1705A.2.2.5.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction. Include threaded fasteners for concrete inserts, through-bolts, lag bolts, wood screws, and other connectors as required. Fasteners not installed but required after pour shall be submitted to the Architect for approval. Fastener shall not be installed until the Architect approval is received.
B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or similar construction.

D. 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 the surfaces of exterior units that have been galvanized after fabrication and are intended for bolted or screwed field connections.

E. Field Welding
   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 that no roughness shows after finishing and contour of welded surface matches those adjacent.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 SETTING

A. Set item shown or required to be installed in sleeves with quick-setting anchor cement unless otherwise noted.

B. Use non-shrink grout mixed in accordance with manufacturer's directions for setting plates, bolts, and similar items.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and prime and paint exposed areas with same material as used for shop painting to comply with SSPC PA 1 requirements for touching up shop-painted surfaces.
   1. Apply by brush or spray to provide a 2.0-mil minimum dry film thickness.

B. For galvanized surfaces, clean welds, bolted connections, and abraded areas, and apply galvanizing repair paint to comply with ASTM A780.

END OF SECTION
SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Plywood sheathing.
   2. Miscellaneous blocking and nailers.
   3. Rough hardware.

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

C. Related Sections
   1. Section 07 18 13 - Pedestrian Traffic Coatings: Provision of pedestrian traffic coating at canopy.
   2. Section 07 32 16 - Concrete Roof Tiles: Provision of concrete tile roofing system.
   3. Section 09 90 00 - Painting and Coating: For finish painting.

1.2 REFERENCES

A. AISI - American Iron and Steel Institute

B. ANSI - American National Standards Institute
   1. B18.2.1 - Square and Hex Bolts and Screws.

C. APA - American Plywood Association (APA)

D. ASTM - American Society for Testing and Materials

E. CALGreen - California Green Building Standards, 2016 Edition

F. FS - Federal Specifications
   1. FF-N-105 - Nails, Brads, Staples and Spikes: Wire, Cut and Wrought.

G. FSC - Forest Stewardship Council
   1. STD-01-001 - FSC Principles and Criteria for Forest Stewardship.

H. WCLIB - West Coast Lumber Inspection Bureau
1.3 SYSTEM DESCRIPTION

A. Composite wood used on the Project shall comply with CALGreen Code Nonresidential Mandatory Measures, Chapter 5, Division 5.5, Section 5.504, Articles 5.504.4.5 and 5.504.4.5.3.

1.4 SUBMITTALS

A. Product Data: Submit for each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.5 QUALITY ASSURANCE

A. Plywood shall bear grade-trade marks of appropriate grading agency.

B. Forest Certification: Provide wood products made with not less than 70 percent of wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, “FSC Principles and Criteria for Forest Stewardship”.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS LUMBER AND PLYWOOD

A. General: Provide lumber for support or attachment of other construction including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, battens, stripping and similar members.

B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

D. Grade: “Standard” grade, light framing size lumber of any species or board-size lumber as required. “No. 3 Common” or “Standard” grade boards per WCLIB rules.

E. Plywood Sheathing: APA rated sheathing, thickness as indicated. Panel rating 40/20, Exposure 1, Grade B,B with exterior glue; provide fire retardant treated sheathing.

2.2 ROUGH HARDWARE

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, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A153 or of AISI Type 304 stainless steel.


D. Lag Bolts and Screws: ANSI B18.2.1.

E. Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and where indicated, flat washers.

2.3 FINISHES

A. Finish Painting: As specified in Section 09 90 00.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Plywood Sheathing
   1. 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.
   2. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
   3. Securely attach to substrate by fastening as indicated.
   4. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
   5. Coordinate 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.
   6. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
   7. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed when rain is forecast.

B. Wood Nailer and Blocking
   1. Install wood battens, nailers and blocking where shown and where required for attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
   2. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

END OF SECTION
SECTION 06 20 00

FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Exterior wood members at tube steel canopy.
   2. Interior standing and running trim.

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

C. Related Sections
   1. Section 05 50 00 - Metal Fabrications: Provision of steel canopy.
   2. Section 09 90 00 - Painting and Coating: For field finish painting.

1.2 REFERENCES

A. APA - APA-The Engineered Wood Association

B. ASTM - American Society for Testing and Materials

C. CALGreen - California Green Building Standards, 2016 Edition

D. CFR - Code of Federal Regulations

E. EPA - Environmental Protection Agency

F. WI - Woodwork Institute

G. WRCLA - Western Red Cedar Lumber Association

H. WWPA - Western Wood Products Association

1.3 SYSTEM DESCRIPTION

A. Composite wood used on the Project shall comply with CALGreen Code Nonresidential Mandatory Measures, Chapter 5, Division 5.5, Section 5.504, Articles 5.504.4.5 and 5.504.4.5.3.
1.4 SUBMITTALS

A. Product Data: Submit for all items.

B. Samples: Provide finished samples of wood slats attached backer board.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site: Do not deliver interior finish carpentry until environmental conditions meet requirements specified for installation areas. If finish carpentry must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

B. Storage and Protection: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack plywood. Provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber shall bear the grade and trademark of the association under whose rules it is produced and a mark of mill identification. Lumber shall be of sound stock, thoroughly seasoned, kiln-dried to a moisture content not exceeding 19 percent, and surfaced 4 sides, except as specifically designated for items hereinafter.

1. Species
   a. Exterior at Steel Canopy: Western Red Cedar, WRCLA, clear grade; kiln dried; laid plank side; intended for transparent finish.
   b. Interior Intended for Transparent Finish: Maple at 4-inch bases.

B. Plywood: APA, A-B Grade Exterior, 3/4-inch thick, with plain sliced veneer as selected by the Architect.

C. Fasteners
   1. Provide fasteners and anchorages with hot-dip galvanized coating complying with ASTM A153, length of fastener embed into wood substrate to equal 1-1/2 times thickness of items fastened.
   2. Countersink nails and fill surface where nailing is unavoidable. Sand smooth and flush for clear finish.

D. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
   1. Use wood glue that has a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Multipurpose Construction Adhesive: Formulation complying with ASTM D3498 that is recommended for indicated use by adhesive manufacturer.
   1. Use adhesive that has a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
F. Putty: Linseed oil type, tinted to match surface finish color.

G. Steel Fabrications at Canopy: As specified in Section 05 50 00.

H. Back Priming: As specified in Section 09 90 00.

2.2 FABRICATION

A. Preparation
   1. Verify measurements at job site.
   2. Verify details and dimensions of fixtures integral with finish carpentry for proper fit and accurate alignment.

B. General Fabrication Requirements
   1. Factory-fabricate and assemble work in complete units insofar as dimensions permit shipment and installation.
   2. Kerf backs of solid members more than 5 inches wide or more than 1 inch nominal thickness.
   3. Conceal nailing where possible and set nail heads for putty in exposed portions.
   4. Perform corrective measures necessitated by non-conformance with WI standards. The Architect’s opinion shall govern discrepancies.
   5. Preprime wood and field prime end cuts.

C. Exterior Wood Members at Steel Canopy: Wood slats shall be nailed to backer boards; backer boards shall be painted black and fastened to steel structure as indicated.
   1. Dimensions: As indicated on the Drawings.

2.3 FINISHES

A. Shop Finishing: Provide items specified in this Section to be fabricated in accordance with WI standards, shop finished in accordance with the following requirements

B. Preparation For Site Finishing
   1. Touch-Up: Touch-up items specified to be shop finished in accordance with requirements of WI.
   2. Items Other Than Those Specified to Be Shop Finished
      b. Finish paint in accordance with requirements of Section 09 90 00.
      3. Finish MDF smooth with no visible wart or paint wicking at fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General
   1. Set work square, level, plumb with edges scribed, accurate, and secure in place with fastenings, clips, braces, brackets, anchors, shims, and blocks.
2. Conceal nailing and screwing where possible and set nail heads for putty in exposed portion and conceal screws as indicated.
3. Miter inside and outside corners of running trim; bevel end joints together.

B. Wood Surfaces
1. Thoroughly hand sand. Take care that cross sanding is removed by final sanding in direction of grain; ease “knife-edge” corners by sanding.
2. Ensure free from dust, glue, stains, and other foreign matter and in proper condition to receive finish.

3.2 ADJUSTING

A. Repair damaged or defective finish carpentry where possible to eliminate functional or visual defects. Where not possible to repair, replace finish carpentry. Adjust joinery for uniform appearance.

END OF SECTION
SECTION 06 41 10
CUSTOM CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Plastic laminate faced casework and shelving.
   2. Wood veneer slatwall panels.

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

C. Related Sections
   1. Section 05 50 00 - Metal Fabrications: Provision of stainless steel countertops and countertop supports.
   2. Section 08 80 00 - Glazing: Provision of glass and glazing.
   3. Section 09 90 00 - Painting and Coating: For back priming.
   5. Section 12 36 61.16 - Solid Surfacing Countertops: Provision of solid surfacing countertops.
   6. Division 22 - Plumbing: Provision of sinks and other plumbing fixtures and fittings for elements located in countertops including rough-in and connection to such fixtures.
   7. Division 26 - Electrical: Provision of electrical fixtures and fittings for elements located in casework including rough-in and connection to such fixtures.

1.2 REFERENCES

A. ANSI - American National Standards Institute
   1. A208.2 - Medium Density Fiberboard (MDF) for Interior Applications.

B. CALGreen - California Green Building Standards, 2016 Edition

C. CFR - Code of Federal Regulations

D. EPA - Environmental Protection Agency

E. FS - Federal Specifications
   1. FF-N-105 - Nails, Brads, Staples and Spikes: Wire, Cut and Wrought.

F. NEMA - National Electric Manufacturers Association
   1. LD3 - High Pressure Decorative Laminates.
G. WI - Woodwork Institute

1.3 DEFINITIONS

A. Exposed Portions - All Grades: Surfaces visible when doors and drawers are closed; underside of bottoms of cabinets over 4 feet above finished floor; cabinet tops under 6 feet above finished floor; visible front edges of web frames, ends, divisions, tops, shelves, and hanging stiles.
   1. Where open shelves are indicated, tops and bottoms of adjustable shelves and inside surfaces of shelving units shall be considered as exposed.

B. Semi-Exposed Portions: Shelves behind cabinet doors; divisions; interior face of ends, backs, and bottoms; drawer sides, subfronts, backs, and bottoms; underside of bottoms of cabinets between 2-1/2 and 4 feet above finished floor; interior faces of hinged doors; and all rooms designated as storage, janitor, closet, or utility.

C. Concealed Portions: Toe space; sleepers, web frames, stretchers, and solid sub-tops; security panels; underside of bottoms of cabinets less than 2-1/2 feet above finished floor; flat tops of cabinets 6 feet or more above finished floor except if visible from upper building level; 3 non-visible edges of adjustable shelves; underside of countertops, knee spaces, and drawer aprons; faces of cabinet ends of adjoining units that butt together.

1.4 SYSTEM DESCRIPTION

A. Composite wood used on the Project shall comply with CALGreen Code Nonresidential Mandatory Measures, Chapter 5, Division 5.5, Section 5.504, Articles 5.504.4.5 and 5.504.4.5.3.

1.5 SUBMITTALS

A. Product Data
   1. Submit manufacturer’s product data for each type of product and process specified and incorporated into items of architectural casework during fabrication, finishing, and installation, including hardware.
   2. Submit manufacturer’s written installation instructions for pre-fabricated casework items.

B. Shop Drawings: Submit shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, seismic anchorage and other components.
   1. Show details full size.
   2. Show locations and sizes of furring and blocking, including concealed backing and reinforcing specified in other Sections.
   3. Show locations and sizes of cutouts and holes for plumbing fixtures, electrical devices, faucets, soap dispensers, grommets, and other items installed in casework.

C. Samples
   1. Submit proposed finish panel with edge details, colors, patterns, finishes, and textures.
   2. Resubmit panel sample with finishes adjusted as directed, until material and finish are accepted.
D. Quality Control Submittals
   1. Certificates: Submit WI compliance certificates indicating that casework meets requirements of grades specified.
   2. Qualification data for firms and persons specified in the “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and Cities, and other information specified.

1.6 QUALITY ASSURANCE

A. Qualifications
   1. Fabricator: Firm experienced in producing architectural casework similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units without delaying the Work.
   2. Installer: Arrange for interior architectural casework installation by a firm that can demonstrate successful experience in installing architectural casework items similar in type and quality to those required for this Project.

B. Quality Standard: Except as otherwise indicated, comply with WI for grades of interior architectural casework, construction, finishes and other requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site: Do not deliver casework until painting and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas.

1.8 PROJECT CONDITIONS

A. Environmental Requirements: Do not deliver or install casework until wet-work is completed and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where casework is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Verify locations of concealed framing, backing, reinforcements, and furring that support casework by accurate field measurements before being enclosed. Record measurements on final shop drawings.
   2. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating casework without field measurements. Provide allowance for trimming at site and coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions.
PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of the WI quality standard for each type of casework and quality grade indicated, unless otherwise indicated.

B. Plywood at Wet Area Countertops: Marine type, 3/4-inch thick.

C. Medium Density Fiberboard (MDF): ANSI A208.2, 3/4-inch thick, water-resistant, paint grade, with low VOC/formaldehyde-free, as manufactured by SierraPine, “Medex”, or equal.

D. Plastic Laminate
   1. Typical: High pressure general purpose grade, solid colors with textured surfaces.
      a. Plastic Thickness and Grade: Meet requirements of NEMA LD3.
      b. Adhesive: As recommended by plastic laminate manufacturer.
   2. Product: As manufactured by Formica; Wilsonart, or equal.
   3. Colors: To be selected from available range.

E. Wood Veneer Slatwall Panels: At 3-inches or 4-inches on-center, as indicated on the Drawings.

F. Glass and Glazing: As specified in Section 08 80 00.

G. Stainless Steel Countertops: As specified in Section 05 50 00.

H. Solid Surfacing Countertops: As specified in Section 12 36 61.16.

I. Hardware - General Requirements
   1. Furnish necessary screws, staples, bolts or other fastenings of proper size and type to secure items in position and, where exposed, to match finish of hardware item fastened.
   2. Keying: Key groups of locks the same in accordance with the Architect’s directions.
   3. Typical hardware except where specifically noted otherwise.
      a. Drawer/Door Pulls: Stainless steel wire with satin finish; as manufactured by Hafele; Blum, or equal.
      b. Hinges: 5 knuckle projecting barrel, stainless steel mortise with 5/8-inch round corners in satin finish; as manufactured by Hafele; Blum, or equal.
      c. Locks: As indicated on the Drawings.
      d. Drawer Slides: Concealed full extension, 150 pounds load capacity, stainless steel with satin finish; as manufactured by Accuride; Blum, or equal.
      e. Catches: Elbow type, chrome-plated brass finish; as manufactured by Hafele; Blum, or equal.
      f. Shelf Hardware: Standards and supports, steel, zinc plated, satin finish; as manufactured by Knape and Vogt Mfg. Co.; Blum, or equal.
      g. Door and Drawer Silencers: Black rubber; as manufactured by Builders Brass Works; Ives, or equal.
2.2 INSTALLATION MATERIALS

A. Screws: Select material, type, size, and finish required for each use. Comply with ANSI B18.6.1 for applicable requirements.

B. Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N105 for applicable requirements.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors.

D. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

E. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Wood Glues: 30 g/L.
   2. Contact Adhesive: 250 g/L.

F. Adhesive for Bonding Plastic Laminate: Resorcinol.
   1. Adhesive for Bonding Edges: Hot melt adhesive.

2.3 PLASTIC LAMINATE FACED CASEWORK

A. Quality Standard: Comply with WI Section 15.
   1. Grades
      a. Typical: Custom.

B. WI Construction Style: Style A, Frameless.

C. WI Construction Type: Type I, multiple self-supporting units rigidly joined together.

D. WI Door and Drawer Front Style: Flush overlay.

E. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
   1. Horizontal Surfaces Other Than Tops: HGL.
   2. Post-Formed Surfaces: HGP.
   3. Vertical Surfaces: HGS.
   4. Edges: PVC edge band, color as selected by the Architect from manufacturer’s full range.
F. Materials for Semi-Exposed Surfaces: Provide surface materials indicated below:
1. Drawer Sides and Backs: Solid hardwood lumber.
3. At semi-exposed backs of panels with exposed plastic laminate surfaces, provide plastic laminate.
4. At concealed backs of panels with exposed plastic laminate surfaces, provide plastic laminate.

G. Colors, Patterns, and Finishes: As selected by the Architect from laminate manufacturer’s full range of colors and finishes.
1. Backprimer: As specified in Section 09 90 00.

H. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

I. Shelving: Plastic laminate faced where indicated on the Drawings.
   1. Edges: PVC edge band, color as selected by the Architect from manufacturer’s full range.

2.4 FINISHING

A. Quality Standard: Comply with WI Section 5, unless otherwise indicated.
   1. Grade: Provide finishes of same grades as items to be finished.

B. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural casework, as applicable to each unit of work.
   1. Backpriming: Sand and apply 1 coat of sealer or primer compatible with finish coats to concealed surfaces of casework, including backs of cabinets and underside of countertops. Concealed surfaces of plastic laminate-clad casework do not require backpriming when surfaced with plastic laminate.

C. Backprime surfaces to be set against concrete or plaster, as specified in Section 09 90 00.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition casework to average prevailing humidity conditions in installation areas before installing.

B. Before installing architectural casework, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.

3.2 INSTALLATION

A. Quality Standard: Install casework to comply with WI for the same grade specified in Part 2 of this Section for type of casework involved.
B. Install casework plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8-inch in 96 inches for plumb and level (including tops).

C. Scribe and cut casework to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

D. Anchor casework to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed nailing, countersunk and filled flush with casework and matching final finish where transparent finish is indicated.

E. Cabinets: Install without distortion so that 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 the 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.

F. Countertops: Anchor securely to base units and other support systems as indicated. Caulk space between backsplash and wall with specified sealant.
   1. Install countertops with no more than 1/8-inch in 96 inch sag, bow, or other variation from a straight line.
   2. Secure backsplashes to tops with concealed metal brackets at 16 inches on center.

G. Complete the finishing work specified in this Section to the extent not completed at shop or before installation of casework.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective casework where possible to eliminate functional and visual defects; where not possible to repair, replace casework. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust concealed hardware

C. Clean casework on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION
SECTION 07 18 13

PEDESTRIAN TRAFFIC COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   2. Pedestrian traffic coatings for exterior applications over plywood substrates.

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

C. Related Sections
   1. Section 06 10 00 - Rough Carpentry: Provision of exterior grade fire-retardant treated plywood sheathing.
   2. Section 07 21 01 - Building Insulation: Provision of tapered insulation.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

1.3 DEFINITIONS

A. Traffic coatings are defined to include cold liquid-applied elastomeric membranes with integral wearing surfaces for application to building decks that are not subject to hydrostatic pressure in areas housing equipment or that are subject to pedestrian or vehicular traffic.

1.4 SYSTEM DESCRIPTION

A. Performance Requirements
   1. General: Provide traffic coatings that are watertight and that will not deteriorate upon exposure to normal sun, weather, normal traffic, and manufacturer-recommended cleaning procedures.
   2. Non-compliant performance of traffic coatings includes but is not limited to:
      a. Adhesive or cohesive failures.
      b. Abrasion or tearing failure resulting from normal traffic.
      c. Surface crazing or spalling.
      d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
   3. Provide traffic coatings that comply with ASTM C957 and that meet or exceed the following physical requirements.
      a. Low-Temperature Flexibility and Crack Bridging (ASTM C957): No cracking.

c. Chemical Resistance (ASTM C957): Tensile retention of base, intermediate, and top coats; minimum 70 percent in water, 70 percent in ethylene glycol, and 45 percent in mineral spirits.

d. Weathering Resistance and Recovery from Elongation (ASTM C957): Average recovery from elongation not less than 90 percent; average tensile retention not less than 80 percent; average elongation retention not less than 90 percent.

e. Abrasion Resistance (ASTM C957): Weight loss no greater than 50 mg.

1.5 SUBMITTALS

A. Product Data: Product data including of manufacturer’s most current printed instructions for evaluating, preparing, and treating the substrate, technical data, and tested physical and performance properties of traffic coatings.

B. Certification by traffic coating manufacturer that products comply with local regulations controlling use of volatile organic compounds (VOC’s).

C. Samples: Submit 24 inch square samples for verification purposes on a rigid backing, in color, texture, and finish required for traffic coatings.

1.6 QUALITY ASSURANCE

A. Qualifications: Installer certified in writing by traffic coating manufacturer as a licensed or approved applicator.

B. Preinstallation Conference: Conduct conference at Project site.

1.7 WARRANTY

A. General: Warranties specified in this Article shall not deprive the District of other rights the District may have under other provisions of the Contract Documents and are in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

B. Warranty: Submit written warranty signed by traffic coatings manufacturer and installer agreeing to repair or replace traffic coatings that do not meet requirements or that deteriorate as defined in this Section within the warranty period indicated below:

1. Warranty Period: 5 years after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 COATING MATERIALS

A. General
1. Material Compatibility: Provide primers, base, intermediate, and top coats, and miscellaneous materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.
2. Color: As selected by the Architect from the manufacturer’s full range.

B. Traffic Coating
1. Primer: Concrete and metal primers as required by the manufacturer.
2. Flashing Tape: Minimum thickness of 30 mils, manufacturer’s standard.
4. Aggregate: Silica (quartz) sand or other aggregate approved by the manufacturer.
5. Elastomeric Base Coat: Polyurethane coating, gray in color.
6. Elastomeric Topcoat: Polyurethane coating, with color as selected by the Architect.

2.3 MISCELLANEOUS MATERIALS

A. Plywood Sheathing: As specified in Section 06 10 00.

B. Tapered Insulation: Rigid extruded-polystyrene board as specified in Section 07 21 01.

C. Cover Board: Glass mat-faced gypsum panel with water resistant core, mold-resistant, 4 thickness as indicated, as manufactured by Georgia Pacific, “DensDeck Prime Roof Board”, or equal.

D. Adhesive for Insulation and Cover Board: As manufactured by Sika Sarnafil, “Sarnacol AD Board Adhesive”, or equal; or as recommended by the manufacturer.

E. Joint Sealants: Multicomponent urethane sealant complying with ASTM C920 as recommended by manufacturer for substrate and joint conditions, and for compatibility with the following traffic coatings: Type M, Class 25, Grade NS for sloping and vertical applications or Grade P for deck applications, and Use T where subject to traffic or Use NT elsewhere.

F. Sheet Metal Flashing: As required by traffic coating manufacturer, or as indicated on Drawings.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Clean and prepare substrate according to manufacturer’s recommendations and as specified. Provide clean, dust-free, and dry substrate for traffic coating application.

B. Mask off adjoining surfaces not receiving traffic coatings and close off deck drains and other deck penetrations to prevent spillage and migration of liquid coatings.

C. Install plywood sheathing as specified in Section 06 10 00.
D. Install tapered insulation as specified in Section 07 21 01.

E. Install cover board in accordance with manufacturer’s written instructions.

3.2 PREPARATION AT TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C1127 and manufacturer’s recommendations.

B. Provide sealant cants at penetrations and reinforced and nonreinforced deck-to-wall butt joints.

C. Prime substrates and apply preparatory base coat. Embed joint reinforcing strip in coating when recommended by traffic coating manufacturer.

D. Terminate edges of deck-to-deck expansion joints with preparatory base coat strip.

3.3 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C1127 and traffic coating manufacturer’s requirements.

3.4 SHEET METAL FLASHING

A. Deck-to-Wall Joints and Dynamic Joints: Install sheet metal flashing and attach to deck and wall substrates according to manufacturer’s requirements.

3.5 TRAFFIC COATINGS APPLICATION

A. General: Apply each traffic coating material according to manufacturer’s recommendations.

B. Pedestrian Traffic Coating: Apply base, intermediate, and top coats and aggregate according to manufacturers recommendations and as follows.
   1. Normal Duty: Apply a minimum dry film thickness (DFT) of 32 mils, excluding substrate primer and aggregate.

C. Wall Terminations and Vertical Surfaces: Apply traffic coatings to prepared wall terminations and vertical surfaces to height as indicated on Drawings or as required by manufacturer.

D. Cure traffic coatings according to manufacturer’s recommendations taking care to prevent contamination and damage during application stages and curing.

END OF SECTION
SECTION 07 21 01
BUILDING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Thermal and acoustical insulation.

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

C. Related Sections
   1. Section 07 18 13 - Pedestrian Traffic Coatings: Provision of pedestrian traffic coating at canopy.
   2. Section 07 84 00 - Firestopping: Provision of firestopping.
   3. Section 09 29 00 - Gypsum Board: Provision of gypsum board.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

B. CALGreen - California Green Building Standards, 2016 Edition

C. CBC - California Building Code, 2016 Edition

1.3 DEFINITIONS

A. Thermal Resistivity: Where the thermal resistivity of insulation products are designated by "r-values", they represent the reciprocal of thermal conductivity (k-values). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees Fahrenheit between the 2 exposed faces required to cause 1 BTU to flow through 1 square foot per hour at mean temperatures indicated.

1.4 SYSTEM DESCRIPTION

A. Insulation used on the Project shall comply with CALGreen Code Nonresidential Voluntary Measures Appendix A5, Division A5.5, Section A5.504, Articles A5.504.4.8 and A5.504.4.8.2.
1.5 SUBMITTALS

A. Product Data: Submit manufacturer’s product data for insulation products specified.

B. Certifications: Submit certification that insulation was furnished and installed in accordance with CBC requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: 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 recommendations for handling, storage, and protection during installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Thermal Insulation at Exterior Walls
   1. Kraft-faced, friction-fit, flexible batt or blanket of fiberglass, width to fit stud space, formaldehyde-free, 25 percent recycled content, conforming to ASTM C665, Type II, Class C, non-combustible when tested in accordance with ASTM E136, having thermal resistance rating of R-19, unless otherwise indicated, and the following fire resistive requirements when tested in accordance with ASTM E84:
      a. Flame Spread: Not rated.
      b. Smoke Developed: Not rated.
   2. Product: As manufactured by Johns Manville; Certainteed Corporation; Owens Corning, or equal.

B. Thermal Insulation at Interior Walls
   1. Unfaced, friction-fit, flexible batt or blanket of fiberglass, width to fit stud space, formaldehyde-free, 25 percent recycled content, conforming to ASTM C665, Type I, non-combustible when tested in accordance with ASTM E136, having thermal resistance rating of R-13 or thickness as required to fill stud cavity, unless otherwise indicated, and the following fire resistive requirements when tested in accordance with ASTM E84:
      a. Flame Spread: 25 or less.
      b. Smoke Developed: 50 or less.
   2. Provide batts to full depth and width of stud cavities.
   3. Product: As manufactured by Johns Manville; Certainteed Corporation; Owens Corning, or equal.

C. Tapered Insulation at Canopy
   1. Extruded Polystyrene Board Insulation: Rigid, cellular polystyrene thermal insulation formed from polystyrene base resin by an extrusion process using hydrochlorofluorocarbons as blowing agent to comply with ASTM C578 for type and with other requirements indicated below:
      a. Type IV, 1.60-lb/ft. minimum density, unless otherwise indicated.
      b. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 75 and 450, respectively.
c. Thickness: 1/2-inch, unless otherwise indicated.
d. Edge: Square.


D. Acoustical Insulation
   1. Unfaced, minimum 3-1/2 inches thick or as required to fill stud cavity, friction-fit, formaldehyde-free, flexible batt or blanket of fiberglass, width to fit wall stud or ceiling joist space, and conforming to ASTM C665, Type I, non-combustible when tested in accordance with ASTM E136 and having the following fire resistive requirements when tested in accordance with ASTM E84.
      a. Flame Spread: 25 or less.
      b. Smoke Developed: 50 or less.
   2. Provide batts to full depth and width of stud cavities.
   3. Product: As manufactured by Johns Manville; Certainteed Corporation; Owens Corning, or equal.

E. Accessories
   1. Insulation Tape: Pressure-sensitive tape of type recommended by insulation manufacturer for sealing joints and penetrations in insulation.
   2. Insulation Support: Galvanized springwire as required and as recommended by insulation manufacturer.
   3. Primers and Sealers: As recommended by the insulation manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions with installer present, for compliance with requirements of the Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer’s instructions applicable to products and application indicated. If printed instructions are not available or do not apply to project conditions, consult manufacturer’s technical representative for specific recommendations before proceeding with installation of insulation.

B. Extend insulation full thickness as 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.

C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

D. Tape joints and ruptures in insulation, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
3.3 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrate by method indicated, complying with manufacturer’s recommendations. If no specific method is indicated, use mechanical anchorage to provide permanent placement and support of units.

B. Maintain required separations from electric fixtures and appliances.

C. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.

D. Repairs to Existing Thermal Insulation: Where existing thermal insulation is adversely affected by work of this Project, maintain thermal barrier R-value by repairing with insulation materials of equal or greater thermal resistance rating.

3.4 ACOUSTICAL INSULATION

A. Install at all sound-rated construction including walls and floor/ceiling assemblies where indicated.

3.5 PROTECTION

A. General: Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION
SECTION 07 32 16

CONCRETE ROOF TILES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Patching of existing concrete roofing tiles as indicated on the Drawings.

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

C. Related Sections
   1. Section 06 10 00 - Rough Carpentry: Provision of exterior grade fire-retardant treated plywood sheathing.
   2. Section 07 62 00 - Sheet Metal Flashing and Trim: Provision of sheet metal items associated with concrete roofing tiles.
   3. Division 23 - Heating, Ventilating, and Air Conditioning (HVAC): Provision of HVAC work to be performed above and penetrating roof.
   4. Division 26 - Electrical: Provision of electrical work to be performed above and penetrating roof.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

B. CBC - California Building Code, 2016 Edition

C. FMA - Factory Mutual Associates

D. ICBO - International Conference of Building Officials
   1. UBCS - Uniform Building Code Standards
      a. 15-5 - Roof Tile.

E. NRCA - National Roofing Contractors Association

F. TRI - Tile Roofing Institute

G. WSRCA - Western States Roofing Contractors Association
1.3 SYSTEM DESCRIPTION


B. Performance Requirements: Provide anchorage system of roofing tiles that is designed to comply with requirements as specified in Article title “Regulatory Requirements” in this Section.

1.4 SUBMITTALS

A. Product Data: Submit manufacture’s literature completely describing products.

B. Shop Drawings: Submit drawings showing methods of installation, including details of methods of attachment of insulation, plywood, underlayment, and tile to adjacent materials and substrates.

C. Samples: Submit 2 typical tiles for acceptance of color and surface.

D. Quality Control Submittals
   1. Certificates of Compliance: Submit certificate certifying that materials conform to cited standards.
   2. Manufacturer’s Instructions: Submit manufacturer’s installation instructions.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements
   1. Wind Loading: Dead loads and live loads caused by pressure and suction of wind for design pressure in pounds per square foot shall be in accordance with CBC and the following:
      a. Exposure: B.
      b. Design Wind Pressure: P = 55.8584.
   2. Seismic Requirements: Comply with lateral displacement requirements of CBC.
   3. Roofing Construction
      a. Securing and Fastening: Provide roofing construction that is secured and fastened with requirements of CBC.
      b. Roof Covering Requirements: Provide roof covering that complies with requirements of CBC.
      c. Roof Covering Classification: Provide roof covering that is rated Class A in accordance with CBC.
      d. Roof Covering Materials and Application: Provide concrete tile roofing system that complies with CBC.
      e. Fasteners and Wire: Comply with requirements of CBC.

B. Mockups
   1. Build mockups as directed by the Architect to demonstrate aesthetic effects and qualities of materials and execution.
      a. Provide mockup to observe color and texture of new concrete roof tiles next to existing concrete roof tiles.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
1.6 WARRANTY

A. Special Concrete Roof Tile Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace tile that fails in materials within specified warranty period. Material failures include manufacturing defects that result in leaks.
   1. Warranty Period: 50 years from date of Substantial Completion.

B. Special Roofing Installer's Warranty: Roofing Installer's warranty, signed by roofing Installer, covering Work of this Section, in which roofing Installer agrees to repair or replace components of concrete tile roofing that fail in materials or workmanship.
   1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Roofing Tiles: Contractor shall field verify and match existing tiles.
   1. Type: Concrete tile.
   2. Dimensions: Match existing.
   3. Color: Match existing.
   4. Product: As manufactured by Eagle Roofing, or equal to match existing.

B. Plywood Sheathing: Match existing if required for repair; provide fire-retardant pressure treated sheathing as specified in Section 06 10 00.


D. Flexible Flashing: Self-adhering, 30 mil thick composite of aggressive butyl rubber based adhesive backed by a layer of high density cross laminated polyethylene with a service temperature of up to 300 degrees Fahrenheit.

E. Cements, Sealants and Mastic
   2. Sealant: Silicone type complying with ASTM D1002.
   3. Mastic: Type as recommended by tile manufacturer.
   4. Adhesive: Concrete tile adhesive shall be identified by manufacturer as specifically formulated as a concrete roof tile adhesive, if used.

F. Batten Strips: As specified on the Structural Drawings.

G. Fasteners
   1. At Plywood: Type as recommended by tile manufacturer that is FMA approved for Wind-Storm Resistance Classification I-90.
   2. At Underlayment and Tiles: Stainless steel screws, sizes as recommended by tile manufacturer for substrate indicated.
   3. Wire Ties: Stainless steel, Type 304, 0.083-inch minimum diameter.
H. Tile Vents and Eave Closures: Manufacturer’s recommended non-corroding screen vents and solid eave closures as required for application.

2.2 FABRICATION

A. Factory Fabrication
   1. Fabricated to sizes and shapes as indicated.
   2. Provide tiles having 3 inch headlap.

B. Factory Finishing: Color as selected by the Architect.

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.
   1. Examine roof sheathing to verify that rotten wood is not present.
   2. Prior to installation of new concrete tiles, prepare written survey of existing concrete tiles to remain; record broken tiles that need to be replaced.
      a. Prepare additional written survey at the end of installation to record any tiles that were broken during the course of the work.

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

3.2 PREPARATION

A. Sheet Metal Installer: Supervise installation of sheet metal flashings and coordinate installation of other sheet metal work that is integrated or adjacent to tile installation.

B. Surface Preparation
   1. Plywood: Secure plywood in accordance with approved fastening pattern as required to comply with requirements of FMA Wind-Storm Resistance Classification I-90.
   2. Underlayment
      a. Apply 1 layer of underlayment side lapped minimum 2 inches and end lapped minimum 6 inches.
      b. Secure underlayment with roofing cement to hold underlayment in place until roofing tile application.
      c. Seal edges of underlayment with roofing cement.
   3. Flashings: Supervise installation of sheet metal flashings at roof valleys and other areas as indicated.

3.3 INSTALLATION

A. General
   1. Install tiles in accordance with manufacturer’s installation instructions and CBC.
   2. Ensure that both horizontal and vertical alignment is maintained.
   3. Do not install cracked or broken tile.
   4. Penetrations: Cut tiles neatly to fit to or around roof penetrations and other vertical surfaces.
5. At Hips and Valleys: Exercise care when cutting hip or valley tile to ensure integrity of finished installation.
6. Upon completion, ensure sound, whole, clean and water-tight installation.

B. Chalk Lines
1. Chalk horizontal and vertical guide lines on membrane to assure watertightness and proper appearance.
2. Space chalk lines by measuring delivered tiles for average length and width exposures.
3. Do not exceed exposure length of 1/4-inch beyond average.

C. Batten Strips: Apply in accordance with roof tile manufacturer’s written instructions.

D. Roofing Tile
1. Eave Closures
   a. At eave end of tiles, install closures at each tile.
   b. Seal space between closures and tile completely with sealant.
   c. Install manufacturer’s closures, such that tiles are raised 1 inch above substrate.

2. Tiles
   a. Install first row 13 inches from eave, leaving 1 inch overhang; length exposure shall not exceed 16 inch centers, and width exposure shall not exceed 12 inch centers.
   b. Install tile in rows from left to right, beginning at lower left corner of roof.
      1) Start at lower left corner with gable tile.
      2) Secure each row of field tile with screws.
      3) Install ridge, hip and valley tile with screws for tile, with minimum of 2 fasteners per tile.

3. Avoid Color Patterning, Checkerboarding, Spotting and Stairstepping: Comply with the following:
   a. After installation of each 80 roofing tiles, make visual inspection from ground level and at distance from building of about 40 feet.
   b. Verify that tile courses follow straight and true lines.
   c. Verify that color range is smooth with no abrupt changes.
   d. Make necessary corrections before proceeding with further installation.

3.4 ADJUSTING

A. Replace, rework, or otherwise make good as required tiles found defective as follows:
   1. Items broken, damaged or defaced.
   2. Incomplete, misaligned or incorrectly located items.

END OF SECTION
SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Prefinished aluminum gutters and downspouts.
   2. Sheet metal flashing and counterflashing.
   3. Exposed metal trim.
   4. Miscellaneous sheet metal accessories, including accessories required for concrete tile roofing.

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

C. Related Sections
   2. Section 05 50 00 - Metal Fabrications: For protection of dissimilar metals.
   3. Section 07 32 16 - Concrete Roof Tiles: Provision of concrete tile roofing system.
   4. Section 07 65 00 - Flexible Flashing: Provision of flexible flashing.
   5. Section 07 92 00 - Joint Sealants: Provision of joint sealants.
   6. Section 09 90 00 - Painting and Coating: For field painting and touch-up painting of factory finished materials.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials
   1. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. AWS - American Welding Society

C. SMACNA - Sheet Metal and Air Conditioning Contractors’ National Association

D. SSPC - The Society for Protective Coatings
1.3 SYSTEM DESCRIPTION

A. Performance Requirements
   1. Work of this Section shall physically protect concrete tile roofing, exterior plaster penetrations, wall and door openings, and joints to dissimilar materials and other items as indicated from damage that would permit water leakage to building interior.
   2. Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.
      a. Contractor is responsible for the design of sheet metal profiles not indicated on the Drawings and for determining the maximum lengths of segments.
   3. Flashing to be Installed: Provide complete flashing system for full extent of locations where flashing is shown to occur.

1.4 SUBMITTALS

A. Shop Drawings: Submit drawings showing material profile, jointing pattern, jointing details, intersections, fastening methods, flashings, terminations, and installation details prior to fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sheet Materials
   1. Aluminum: ASTM B209, Alloy 3003, 3004, 3105, or 5005, temper suitable for forming and structural performance required, but not less than H14, pre-finished as indicated.
   2. Prepainted, Metallic-Coated Steel: Sheet steel metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755.
   3. Zinc-Coated Steel Where Needed: Commercial quality with 0.20 percent copper, ASTM A653, G90 hot-dip galvanized, mill phosphatized where indicated for painting; 20 gauge except as otherwise indicated.

B. Miscellaneous Materials and Accessories
   1. Solder and Flux: For use with steel, provide 50 - 50 tin/lead solder, ASTM B32, with rosin flux. Re-melted or reworked solder will not be permitted.
   2. Fasteners: Same metal as flashing/sheet metal or other noncorrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.
   3. Bituminous Coating: SSPC Paint 12, solvent type bituminous mastic, nominally free of sulfur, compounded for 15 mil dry film thickness per coat.
   4. Reglets: Metal of type and profile indicated, compatible with flashing indicated, noncorrosive, as manufactured by Fry Reglet; Springlok, or equal.
   5. Metal Accessories: Provide sheet metal clips, cleats, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size, and gauge required for performance.
   7. Joint Sealant: As specified in Section 07 92 00.

C. Materials for Permanent Protection of Dissimilar Materials: As specified in Section 05 50 00.
2.2 FABRICATION

A. Shop Assembly
1. Design and fabricate work in accordance with SMACNA, unless otherwise indicated.
2. As far as practicable, form and fabricate sheet metal in shop. Where on-site fabrication is required, provide work equal to shop quality. Additionally, identify bulk materials from which items are field fabricated by manufacturer’s trademark printed or embossed at frequent intervals.
3. Reproduce accurately profiles and bends indicated.
4. Provide profiles with interactions that are sharp, even, and true; with plane surfaces free from buckles and waves; and seams that follow direction of water flow.
5. Reinforce correctly for strength and appearance.
6. Cut, fit, and drill sheet metal as required to accommodate related, adjacent, or adjoining work.
7. Exposed Edges of Sheet Metal: Fold, bend, or return exposed edges of sheet metal. Raw edges will not be permitted.
8. Form pieces in longest practical lengths.

B. Sheet Metal Joints
1. In general, provide lock joints; where impractical, lap, rivet, solder, or weld joints, or join as otherwise recommended by a system manufacturer.
2. Join joints and miters as recommended by a system manufacturer.
3. Where positive joining is required, weld in accordance with applicable AWS standards.
4. Turn lock joints on exposed surfaces in direction of flow.

C. Soldering
1. Neatly solder exposed surfaces.
2. Pre-tin edges minimum 1-1/2 inches both sides prior to soldering.

D. Expansion and Contraction of Sheet Metal Runs: Provide loose locking slip joint of maximum 8 feet from external and internal corners, maximum 10 feet length for valley flashing and other skyward-facing pieces, maximum 24 feet length of straight runs, unless manufacturer recommends more frequent interval, and 1 at center of runs less than 20 feet, but more than 8 feet, unless specified otherwise following herein.

E. Gutters: Fabricate to cross section indicated, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required. Fabricate in minimum 96-inch long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.

F. Downspouts: Fabricate downspouts, as indicated on the Drawings, complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Provide custom aluminum downspout bracket as manufactured by Copper Shoppe Solutions, “TORRES”, or equal.
G. Provide the following items of materials and minimum gauges as indicated:
   1. Cleats: Formed of same metal as that being anchored, with size, shape, and quantity
      as required to secure flashing and sheet metal work in place.
   2. Base Flashing, Counterflashings, and Roof Penetration Flashing
      a. Formed with 3/4-inch locked and soldered seams, assembled into units not
         longer than 16 feet.
      b. Join units with 3/4-inch wide loose locked seams filled with soft grade butyl
         base compound, before units are assembled.
      c. Mitre corners and joints by riveted or locked and soldered joints.
   3. Counterflashings at Reglets: Form counterflashings at walls to extend into installed,
      prefilled metal reglets. Form metal in a manner which will provide spring action
      against the roof flashings.

H. Finishing
   1. Galvanized Sheet Metal
      a. Finish: G90, conforming to ASTM A653 and ASTM A924.
      b. After Fabrication: Touch-up abraded surfaces in accordance with Section 09 90 00.
   2. Prefinished Sheet Metal: Where indicated, sheet metal shall be coil coated with
      organic coating as manufactured by Kynar 500 or Hylar 5000.
      a. Color: As selected by the Architect.
   3. Field Finish Painting Where Needed: As specified in Section 09 90 00.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Conform with SMACNA procedures and methods of installation.

B. Where installation requires fabrication at the Project site, conform to applicable
   requirements of Article titled “Fabrication” in this Section.

C. Coordinate flashing finishes with waterproof products that will be in contact with flashing.
   Provide bonderized, acid wash, grip-lock, etc., flashings as required by adjoining product
   manufacturers. Flashings requiring a chemical wash will be prepared at site and prior to
   installation.

D. Install standard catalog products in accordance with manufacturer’s instructions, unless
   otherwise indicated.

E. Install work watertight; ensure that items are installed in true and accurate alignment with
   other items and related work, that joints are accurately fitted, that corners are reinforced and
   that exposed surfaces are free of dents.

F. Apply flashing compound at slip joints or wherever metal-to-metal contact occurs and
   movement may be anticipated to occur.

G. Gutters: Join sections with riveted and soldered or lapped joints sealed with sealant.
   Provide for thermal expansion. Slope to downspouts. Provide end closures and seal
   watertight with sealant.
1. Install felt underlayment layer in built-in gutter trough and extend to drip edge at eaves and under felt underlayment on roof sheathing. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with roofing nails. Install slip sheet over felt underlayment.
2. Anchor and loosely lock back edge of gutter to continuous cleat.
3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
4. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.

H. Downspouts: Join sections with 1-1/2 inch telescoping joints.
   1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.
   2. Provide elbows at base of downspout to direct water away from building.

I. Flashings
   1. Fasten sheet metal runs to underlaying material by nailing through slotted holes in flange at 3 inches on center, unless otherwise indicated or required by manufacturer.
   2. Provide waterproof washers wherever fasteners penetrate flashings.
   3. Flashings at horizontal and vertical intersections to shop fabricated heels with full solder seams. Flashings will lap onto all intersecting planes 4-inch or to a minimum beyond 4-inch to allow for the weatherboard lap of flashings with surround building moisture resistant/proof sheathing.

J. Cleaning Metal Surface Primer Ready: Cleaning products shall not contaminate adjacent materials. Factory clean where possible. Notify paint applicator when paint ready so as not to allow any oxidization to occur.

3.2 ADJUSTING

A. Replace damaged material with new.

END OF SECTION
SECTION 07 65 00

FLEXIBLE FLASHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Flexible membrane flashing at all window openings, exterior wall openings, wall caps and at other conditions as detailed in the Drawings.

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

C. Related Sections
   2. Section 07 62 00 - Sheet Metal Flashing and Trim: Provision of sheet metal flashing and trim.
   4. Section 09 24 00 - Cement Plastering: Provision of portland cement plaster system.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer’s most current product data and installation instructions, including manufacturer’s written instructions for evaluating, preparing, and treating substrate, technical data, and data for physical and performance properties.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer approved by flexible flashing membrane manufacturer.

B. Mockup: Apply flexible flashing to typical window opening, recessed window opening, door opening and wall cap to demonstrate surface preparation, crack and joint treatment, corner treatment, and execution quality for approval by the Architect and the District.
   1. If the Architect determines mockups do not comply with requirements, reapply flexible flashing until mockups are approved.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection
   1. Store materials in their original undamaged packages in clean, dry protected location and within temperature range required by flexible flashing membrane manufacturer.
   2. Protect stored materials from direct sunlight.
1.5 PROJECT CONDITIONS

A. Environmental Requirements: Do not apply to moist or damp surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS


2.2 MATERIALS

A. Weather-Resistive Barrier: As specified in Section 09 24 00.

B. Flexible Flashing: Self-sealing, self-healing, fully adhered, composite flexible flashing. Flashing shall be 40 mil minimum thickness sheet consisting of rubberized asphalt integrally bonded to a high density, cross-laminated polyethylene film. The rolls shall be interwound with a disposable silicone-coated release sheet. Flashing shall be from rolls of 12 inch width.

C. Flexible Mastic or Flashing Compound: Compatible with flashing product, approved for use by manufacturer.

D. Primer: Manufacturer’s standard, water-based, excellent adhesion and aggressive tack, VOC-compliant, as manufactured by Grace Construction Products, “Perm-A-Barrier WB”, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions under which flexible flashing will be applied, with installer present, for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Installation constitutes acceptance of substrate condition.

3.2 INSTALLATION

A. Install flexible flashing in strict accordance with manufacturer’s written instructions.

B. Use elastomeric flashing compound compatible with rubberized asphalt at exposed lap joints where water intrusion could occur.

C. Surface shall be smooth, clean, dry and free of voids or other conditions hindering adhesion or regularity of flashing installation. Clean loose dust or dirt from the surface wherever wall flashing is to be applied by wiping with a clean dry cloth or brush.
D. Test surfaces for proper adhesion. Use manufacturer’s recommended surface conditioner if substrate or conditions hinder proper adhesion of flashing membrane. Prime substrates where recommended by the flashing manufacturer.

E. Cut membrane to size and peel release paper from roll to expose rubberized asphalt and position against surface. Press firmly into place with a steel hand roller or the back of a utility knife, fully adhering the flashing to the substrate.

F. Overlap adjacent pieces minimum 3 inches and roll overlap with a steel hand roller.

G. Rubberized asphalt flashing shall not be applied in areas where it will be exposed to direct sunlight. In all cases, flashing shall be covered within 30 days after installation.

H. Install flashing at wall in openings in accordance with approved field mockup and in accordance with details.

I. Ensure that flexible flashing adheres continuously to substrate, and is free from bubbles, fishmouths, creases and other irregularities that affect monolithic adhesion.

J. Carefully notch and fold flexible flashing at corners and returns. Provide additional overlapping pieces as required for watertight installation.

K. Provide flexible flashing over weather-resistive barrier at all wall caps and elsewhere as detailed.

END OF SECTION
SECTION 07 84 00

FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Firesafing, firestopping and smoke seal materials.

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

C. Related Section
   1. Section 07 21 01 - Building Insulation: Provision of building insulation.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

B. CBC - California Building Code, 2016 Edition

1.3 SYSTEM DESCRIPTION

A. Performance Requirements: Through penetration firestopping systems or designs shall be the types tested in accordance with ASTM E814 or UL 1479 and listed by UL FRD or approved by FM P7825.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Conform to CBC for fire resistance ratings and surface burning characteristics.

B. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through penetration firestop systems are installed per specified requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: 3M; Bio Fireshield; Hilti; General Electric; Specified Technologies Inc., or equal.

2.2 MATERIALS

A. Provide asbestos free firestopping material capable of maintaining an effective barrier against flame, gases, and temperature. Provide noncombustible firestopping that is nontoxic to human beings during installation or during fire conditions. Devices and equipment for
firestopping service shall be UL FRD listed or FM P7825 approved for use with applicable construction, and penetrating items.

B. Fire Hazard Classification: Material shall have a flame spread of 25 or less, a smoke developed rating of 50 or less when tested in accordance with UL 723 or UL listed and accepted.

C. Firestopping Rating: Firestopping materials shall be UL FRD listed or FM-7825 approved for “F” and “T” ratings at least equal to fire rating of fire wall or floor in which penetrated openings are to be protected.


E. Firesafing: SAFB mineral wool as manufactured by USG, or equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to application, remove from surfaces dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting or required fire resistance of firestopping materials. Prepare surface as recommended by manufacturer.

3.2 APPLICATION

A. General
   1. Provide firestopping for conditions specified whether or not firestopping is indicated, and, if indicated, whether such material is designated as insulation, safing, or sealant.
   2. Do not install insulation specified in Section 07 21 01 in place of firestopping materials specified in this Section.

B. Install firestopping in accordance with UL FRD systems or FM P7825 designs, and as recommended by manufacturer. printed instructions of the UL BMD, manufacturer’s instructions, or architectural detail as indicated on the Systems and Applications Schedule.

C. Apply firestopping material in sufficient thickness to achieve rating to uniform density and texture.

D. Install material at the following locations:
   1. Around duct, cable, conduit, piping, and their supports that penetrate fire rated above grade floor slabs, interior partitions and exterior walls.
   2. Around openings and penetrations through firr rated ceiling assemblies.
   3. Around penetration of vertical fire rated service shafts.
   4. Around openings and penetrations through fire rated enclosures.
   5. Slip joints at construction of rated walls to floor ceilings.
   6. At other locations as indicated and/or required by building Code.

E. Install firestop with sufficient pressure to properly fill and seal openings to ensure effective smoke seal.
F. Insulated Pipes and Ducts: Cut and remove thermal insulation where pipes and ducts pass through firestoppings. Replace thermal insulation with material having equal thermal insulation characteristics and equal firestopping characteristics.

3.3 FIELD QUALITY CONTROL

A. Immediately notify the Architect if the specified firestopping systems cannot meet the requirements of the Specification.

B. All areas of work must be accessible until inspected by the Architect and the District’s applicable fire protection representative. Correct unacceptable firestops and provide additional inspection to verify compliance with this Specification at no additional cost.

END OF SECTION
SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Joint sealants and backing systems for the following locations:
   1. Exterior and interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:
      a. Perimeter joints of exterior and interior openings where indicated.
      b. Other joints as indicated.
   2. Interior joints in horizontal traffic surfaces as indicated below:
      a. Control and expansion joints in cast-in-place concrete slabs.
      b. Other joints as indicated.
   3. Acoustical sealant for concealed joints.

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

C. Related Sections
   2. Section 05 45 00 - Metal Support Assemblies: Provision of metal support assemblies.
   3. Section 07 62 00 - Sheet Metal Flashing and Trim: Provision of sheet metal flashing and trim.
   5. Section 09 29 00 - Gypsum Board: Provision of gypsum board.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

B. CALGreen - California Green Building Standards, 2016 Edition
C. CFR - Code of Federal Regulations

D. EPA - Environmental Protection Agency

E. FS - Federal Specifications
   1. TT-S-001657 - Interim Federal Specification, Sealing Compound—Single Component, Butyl Rubber Based, Solvent Release Type (For Buildings and Other Types of Construction).
   2. TT-S-1543B - Sealing Compound, Silicone Rubber Base.

1.3 SYSTEM DESCRIPTION

A. Performance Requirements: Provide joint sealers that have been manufactured to establish and maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

B. Sealants used on the Project shall comply with CALGreen Code Nonresidential Mandatory Measures, Chapter 5, Division 5.5, Section 5.504, Article 5.504.4.1.

1.4 SUBMITTALS

A. Product Data: Submit product data from manufacturers for each joint sealant product required.

B. Samples for verification purposes of each type and color of joint sealant required. Install joint sealant samples 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.
   1. Submit samples of all standard colors of sealant which is not paintable.

1.5 QUALITY ASSURANCE

A. Field Adhesion Testing: Before installing sealants, field test their adhesion to project joint substrates with the sealant manufacturer’s technical representative present. Perform 10 tests in the first 1,000 feet of each sealant type and substrate, followed by 1 test every 1,000 feet thereafter. Include the following:
   1. Locate test joints where indicated on project or, if not indicated, as direct by the Architect.
      a. Conduct field tests for each application and for each kind of sealant and joint substrate indicated.
   2. Notify the Architect 7 days in advance of dates and times when test joints will be erected.
   3. Arrange for tests to take place with joint sealant manufacturer’s technical representative present.
a. Test joint sealants by hand-pull method described as follows:
   1) Install joint sealants in 60-inch long joints using same materials and methods for joint preparation and joint sealant installation required for the completed work. Allow sealants to cure fully before testing.
   2) Make knife cuts from one side of joint to the other, followed by 2 cuts approximately 2 inches long at sides of joint and meeting cross cut at one end. Place a mark 1 inch from cross-cut end of 2-inch piece.
   3) Use fingers to grasp 2-inch piece of sealant between cross-cut end and 1-inch mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
   4) For joints with dissimilar substrates, verify adhesion to each substrate separately. Do this by extending cut along one side, verifying adhesion to the opposite side, and then repeating this procedure for opposite side.

b. Refer to ASTM C1521 for Test Procedure.

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.

1.6 WARRANTY

A. Special Manufacturer’s Warranty: Manufacturer’s standard form in which silicone sealant manufacturer agrees to furnish silicone 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: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General Requirements
   1. Provide joint sealers compatible with one another and with substrates.
   2. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
      a. Sealants: 250 g/L.
      b. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Manufacturer’s standard color range shall permit matching sealants to color of contacting surfaces and future ability to paint.
B. Sealants and Caulks

1. Type A - One Part Neutral Cure Silicone Sealant
   a. ASTM C920, non-sag, one part, low modulus, elastomeric sealant.
   b. Color: As selected by the Architect.

2. Type B - Polyurethane Sealant, Two Component
   a. ASTM C920, Type M; Grade P; Class 25; Use T having minimum ASTM D2240 Shore A hardness of 30 plus or minus 5.
   b. Color: As selected by the Architect.

3. Type C - Silicone Sealant, Single Component
   a. FS TT-S-1543B, mildew resistant, chemical curing, non-sagging, non-staining, nonbleeding.
   b. Color: As selected by the Architect.

4. Type D - Acrylic Emulsion Sealant
   a. ASTM C834 that accommodates joint movement of not more than 5 percent in both extension and compression for a total of 10 percent.
   b. Color: As selected by the Architect.

5. Type E - Acoustical Sealant
   a. Non-hardening, non-skinning, for use in conjunction with gypsum board.

6. Type F - Sheet Metal Lap Sealant
   a. 1-part butyl conforming to FS TT-S-001657, Type 1.

2.2 ACCESSORIES

A. Primer: Non-staining type recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: Bi-cellular, ASTM C1330, Type B.

D. Backer Rod at Acoustical Sealant: Flexible closed cell, neoprene rod or polyethylene foam suitable for use as a backer to the acoustic sealant. Width of backer rod shall be a minimum of 30 percent greater and a maximum of 50 percent greater than the joint width.

E. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
PART 3 - EXECUTION

3.1 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer’s printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Installation of Sealant Joint Backings: Install sealant joint backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   a. Do not leave gaps between ends of joint fillers.
   b. Do not stretch, twist, puncture, or tear joint fillers.
   c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.

2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints for 2 opposing side adhesion only.

E. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

F. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

1. Provide concave joint configuration per Figure 5A in ASTM C1193, unless otherwise indicated.

G. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, and to comply with sealant manufacturer’s directions for installation methods, materials, and tools that produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer’s recommendations.
3.2 SCHEDULE

A. Type A, Non-Sag
   1. Exterior and interior control and expansion joints in vertical surfaces of cast-in-place concrete.
   2. Between metal and concrete.
   3. Interior and exterior perimeter joints between cast-in-place concrete and frames of doors and windows.
   4. Control and expansion joints in exterior soffits and overhead surfaces.
   5. All other exterior joints not specified.

B. Type B: Exterior control, expansion, and isolation joints in cast-in-place concrete slabs.

C. Type C: Not Used.

D. Type D: All other interior joints not indicated otherwise.

E. Type E: Concealed acoustical conditions.

F. Type F: Lap joints and other moving joints in sheet metal.

END OF SECTION
SECTION 080671

DOOR HARDWARE SETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section references specification sections relating to commercial door hardware for the following:

1. Swinging doors.
2. Sliding Doors.
3. Other doors to the extent indicated.

B. Commercial door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical and access control door hardware.
3. Electromechanical and access control door hardware power supplies, back-ups and surge protection.
4. Automatic operators.
5. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Sections “Flush and Clad Wood Doors”.
3. Division 08 Section “Door Hardware”.
4. Division 08 Section “Automatic Door Operators”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI’s "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.
D. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in the Related Sections.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum [5] years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum [3] years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum [5] years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

D. Source Limitations: Obtain each type and variety of Door Hardware specified in the Related Sections from a single source, qualified supplier unless otherwise indicated.

E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the applicable model building code.

F. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.8 MAINTENANCE SERVICE

A. 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 door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Refer to “PART 3 – EXECUTION” for required specification sections.
PART 3 - EXECUTION

3.1 DOOR HARDWARE SETS

A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. The supplier is responsible for handing and sizing all products as listed in the door hardware sets. Quantities listed are for each pair of doors, or for each single door.

C. Products listed in the Door Hardware Sets must meet the requirements described in the specification sections noted.

1. Section 08 41 26 – All Glass Entrances.
2. Section 08 71 00 – Door Hardware.
3. Section 08 74 13 – Card Key Access Control Hardware.
4. Section 28 13 00 – Access Control.
5. Section 28 13 10 – Multi-Family Access Control.

D. Manufacturer’s Abbreviations:

1. MK - McKinney
2. RO - Rockwood
3. VD - Von Duprin
4. RU - Corbin Russwin
5. SA - Sargent
6. RF - Rixson
7. NO - Norton
8. PE - Pemko
9. SU - Securitron
10. HD - HID

Hardware Sets
Set: 2.0

Doors: 164A, 164C

1 Continuous Hinge  MCK-12HD PT  CL MK 087100
1 Retrofit Kit  IN220-231 BIPS MW EK1P  US26D SA 281300
1 Rim Exit Device  RX AX 98EO  US32D VD 087100
1 Cylinder  1788-114- CT6AHB  630 RU 087100
1 Concealed Closer  91N  626 RF 087100
1 Door Stop  463-RKW  US32D RO 087100
1 Threshold  ___A FHS14 as detailed  PE 087100
1 Gasketing  by door mfg.
1 Sweep  315CN  PE 087100
1 Electric Power Transfer  EL-CEPT  SU 087100 ❄
1 ElectroLynx Harness Frame  PoE-C___PRJ  MK 087100 ❄
1 ElectroLynx Harness Door  PoE-C___PRJ  MK 087100 ❄

Set: 4.0

Doors: 232A

3 Hinge  TA2714 4,5 x 4.5  US26D MK 087100
1 Storeroom Lock  ML2057 PSA ACHS CT6B  626 RU 087100
1 Surf Overhead Stop  55-X36  652 RF 087100
1 Kick Plate  K1050 10X2LDW BEV CSK  US32D RO 087100
1 Gasketing  S44GR  PE 087100
1 Door Bottom  PDB411AE  PE 087100

Set: 9.0


1 Retrofit Kit  IN120-231 BIPS MW EK1MI  US32D SA 281300
1 Cylinder  3788-178- CT6AHB  626 RU 087100
1 Balance of Hardware existing
Set: 11.0

Doors: 148A

2 Hinge (heavy weight)  T4A3386 x NRP 4.5 x 4.5  US32D MK 087100
1 Hinge (heavy weight)  T4A3386 PoE 4-1/2" x 4-1/2"  US32D MK 087100
1 Access Control Mort Lock  IN220-ML20134 MW PSA BIPS CHS CT6B  626  RU 281300
1 Surface Closer  DC8210 A3  689  RU 087100
1 Kick Plate  K1050 10X2LDW BEV CSK  US32D RO 087100
1 Door Stop  463-RKW  US32D RO 087100
1 Threshold  ___A FHS14 as detailed  PE 087100
1 Gasketing  S773GR  PE 087100
1 Sweep  315CN  PE 087100
1 ElectroLynx Harness Frame  PoE-C__ PRJ  MK 087100
1 ElectroLynx Harness Door  PoE-C__ PRJ  MK 087100
1 Power Supply provided by access control.

Set: 12.0

Doors: 105A, 162B, 164B, 180A, 189A, 233A

1 Access Control Mort Lock  IN120-ML20134 W PSA BIPS CHS CT6B  626  RU 281300
1 Balance of Hardware existing

Set: 13.0

Doors: 165A

1 Storeroom Lock  ML2057 PSA ACHS CT6B  626  RU 087100
1 Balance of Hardware existing

Set: 14.0

Doors: 181B

1 Cylinder  1788-114- CT6AHB  630  RU 087100
1 Alarm  98 ALK  US32D VD 087100
Set: 16.0

Doors: 181BA

3 Hinge (heavy weight) T4A3786 4.5 x 4.5 US26D MK 087100
1 Storeroom Lock ML2057 PSA ACHS CT6B  626 RU 087100
1 Kick Plate K1050 10X2LDW BEV CSK US32D RO 087100
1 Door Stop 441CU/409 as required US26D RO 087100
1 Gasketing S773GR PE 087100

Set: 17.0

Doors: 229C

2 Hinge (heavy weight) T4A3786 4.5 x 4.5 US26D MK 087100
1 Hinge (heavy weight) T4A3786 PoE 4-1/2" x 4-1/2" US26D MK 087100
1 Access Control Mort Lock IN220-ML20134 MW PSA BIPS CHS CT6B 626 RU 281300
1 Surface Closer DC8210  689 RU 087100
1 Kick Plate K1050 10X2LDW BEV CSK US32D RO 087100
1 Door Stop 441CU/409 as required US26D RO 087100
1 Threshold ___A FHS1L14 as detailed PE 087100
1 Gasketing S773GR PE 087100
1 Door Bottom 222APK PE 087100
1 ElectroLynx Harness Frame PoE-C___PRJ MK 087100
1 ElectroLynx Harness Door PoE-C___PRJ MK 087100
1 Power Supply provided by access control.

Set: 18.0

Doors: 230B

1 Rim Exit Device AX 98EO ALK US32D VD 087100
1 Cylinder 1788-114- CT6AHB  630 RU 087100
1 Threshold ___A FHS1L14 as detailed PE 087100
1 Gasketing S773GR PE 087100
1 Door Bottom PDB411AE PE 087100
1 Balance of Hardware existing
Set: 19.0

Doors: 228A

2 Continuous Hinge MCK-12HD PT CL MK 087100
1 Mullion 4954-XP SP28 VD 087100
1 Retrofit Kit IN220-231 BIPS MW EK1P US26D SA 281300
2 Rim Exit Device RX AX 98EO US32D VD 087100
1 Cylinder 3788-178-CT6AHB 626 RU 087100
2 Concealed Closer 91N 626 RF 087100
2 Door Stop 463-RKW US32D RO 087100
1 Threshold --- A FHS1L14 as detailed PE 087100
1 Gasketing by door mfg.
2 Electric Power Transfer EL-CEPT SU 087100
1 ElectroLynx Harness QC-C1500P MK 087100
1 ElectroLynx Harness QC-C306P MK 087100
1 ElectroLynx Harness Frame PoE-C---PRJ MK 087100
1 ElectroLynx Harness Door PoE-C---PRJ MK 087100
1 Power Supply provided by access control.

Set: 22.0

Doors: 181A

1 Continuous Hinge MCK-12HD PT CL MK 087100
1 Rim Exit Device QEL RX AX 98EO US32D VD 087100
1 Retrofit Kit IN220-231 BIPS MW EK1P US26D SA 281300
1 Cylinder 1788-114-CT6AHB 630 RU 087100
1 Cylinder 3788-178-CT6AHB 626 RU 087100
1 Automatic Opener 6330/10 as required 689 NO 087113
1 Door Stop 463-RKW US32D RO 087100
1 Threshold --- A FHS1L14 as detailed PE 087100
1 Gasketing by door mfg.
1 Sweep 315CN PE 087100
1 Electric Power Transfer EL-CEPT SU 087100
1 ElectroLynx Harness Frame PoE-C---PRJ MK 087100
1 ElectroLynx Harness Door PoE-C---PRJ MK 087100
2 Push Plate 639 NO 087100

Contra Costa Community College District
Diablo Valley College
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Door Hardware Sets
10/25/2018
<table>
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<tr>
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<td>MKAN</td>
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<tr>
<td>Power Supply</td>
<td>BPS-24-2</td>
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**Set: 23.0**

Doors: 181AB

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<tr>
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<td>T4A3386 x NRP 4.5 x 4.5</td>
<td>US32D MK 087100</td>
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<tr>
<td>1 Rim Exit Device</td>
<td>AX 98L-NL ALK 996L-NL</td>
<td>US32D VD 087100</td>
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<tr>
<td>1 Cylinder</td>
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<tr>
<td>1 Cylinder</td>
<td>3788-178-CT6AHB</td>
<td>RU 087100</td>
</tr>
<tr>
<td>1 Surface Closer</td>
<td>DC8210 A3</td>
<td>RU 087100</td>
</tr>
<tr>
<td>1 Door Stop</td>
<td>463-RKW</td>
<td>US32D RO 087100</td>
</tr>
<tr>
<td>1 Threshold</td>
<td>A FHSL14 as detailed</td>
<td>PE 087100</td>
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<tr>
<td>1 Gasketing</td>
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<td>PE 087100</td>
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<tr>
<td>1 Sweep</td>
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Notes: Local alarm by security.

**Set: 24.0**

Doors: 182A

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<td>1 Access Control Mort Lock</td>
<td>IN120-ML20134 W PSA BIPS CHS CT6B</td>
<td>RU 281300</td>
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<td>1 Viewer</td>
<td>622</td>
<td>DCRM RO 087100</td>
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<td>1 Balance of Hardware existing</td>
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**Set: 25.0**

Doors: 181C

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<td>1 Dble Act Gate Pivot Hinge</td>
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<td>MCKINNEY</td>
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**END OF SECTION**
SECTION 08 11 15

STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Non-fire rated exterior steel doors and frames, with and without transoms and
      sidelites.
   2. Fire resistance rated and non-fire rated interior steel door and window frames.

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

C. Related Sections
   1. Section 08 14 16 - Flush Wood Doors: Provision of flush wood doors.
   2. Section 08 71 00 - Door Hardware: Provision of door hardware.
   3. Section 08 80 00 - Glazing: Provision of glass and glazing.
   4. Section 09 90 00 - Painting and Coating: For field painting primed doors and frames.

1.2 REFERENCES

A. ANSI - American National Standards Institute
   1. A115 - Specifications for Steel Door and Frame Preparation for Hardware.
   2. A224.1 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for
      Steel Doors and Frames.
   3. A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel
      Doors, Frames, Frame Anchors and Hardware Reinforcements.

B. ASTM - American Society for Testing and Materials
   1. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel
      Hardware.
   2. A568 - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength,
      Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
   3. A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-
      Coated by the Hot-Dip Process.
      Transmission Loss of Building Partitions and Elements.
   6. E413 - Classification for Rating Sound Insulation.

C. DHI - Door and Hardware Institute
   1. A115 - Specifications for Steel Door and Frame Preparation for Hardware.

D. Intertek Testing Agency
E. NFPA - National Fire Protection Association
   1. 80 - Fire Doors and Windows.

F. SDI - Steel Door Institute
   2. 105 - Recommended Erection Instructions for Steel Frames.
   3. 112 - Galvanized Standard Steel Doors and Frames.

G. UL - Underwriters Laboratories Inc.

1.3 SUBMITTALS

A. Product Data: Submit product data for each type of door and frame specified, including
details of construction, materials, dimensions, hardware preparation, core, label compliance,
sound ratings, profiles, and finishes.

B. Shop Drawings: Submit shop drawings showing fabrication and installation of standard steel
doors and frames referenced to the Architect’s door mark and hardware group. Include details
of each frame type, elevations of door design types, conditions at openings, details of
construction, location and installation requirements of door and frame hardware and
reinforcements, and details of joints and connections. Show anchorage and accessory items.
   1. Provide schedule of doors and frames using same reference numbers for details and
      openings as those on the Drawings.

1.4 QUALITY ASSURANCE

A. Where indicated, provide fire rated frame assemblies that comply with NFPA 80, are
   identical to frame assemblies whose fire resistance characteristics have been determined in
   accordance with ASTM E152, and which are labeled and listed by UL or Intertek Testing
   Agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Republic Builders Products; Steelcraft Manufacturing Co.;
   Kewanee; Stiles Hollow Metal; Curries, or equal.

2.2 MATERIALS

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled,
   complying with ASTM A568.

B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A568.

C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, hot dipped
galvanized in accordance with ASTM A924 with A60 or G60 coating designation, mil
phosphatized.
D. Supports and Anchors: Fabricate of not less than 18 gauge sheet steel; galvanized wherever used with galvanized frames.

E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built in at exterior walls, hot-dip galvanize in compliance with ASTM A153, Class C or D as applicable.

F. Shop Applied Paint: Apply after fabrication.
   1. Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints complying with ANSI A224.1.

G. Finish: As specified in Section 09 90 00.

2.3 DOORS

A. Doors: Provide metal doors of ANSI grades and models specified below or as indicated on the Drawings or schedules:
   1. Exterior Doors: Provide doors with insulated core and complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
      a. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).
   2. Door Louvers: Provide sightproof stationary louvers where indicated, constructed of inverted V-shaped or Y-shaped blades formed of 24 gauge cold-rolled steel set into minimum 20 gauge steel frame.

B. Door Cores
   1. Core Stiffeners: Vertical steel stiffeners or steel channel grid.
   2. Core Filler: Sound deadening mineral composition, incombustible, moisture resistant, chemically inert in accordance with reviewed manufacturer's recommendations.

2.4 FRAMES

A. Provide metal frames for doors and windows of types and styles as indicated on the Drawings and schedules. Conceal fastenings, unless otherwise indicated.
   2. Interior: Fabricate fully welded frames of minimum 18 gauge cold-rolled steel.
   3. Provide fire resistance frames with ratings as required and as indicated on the Drawings.

B. Door Silencers: Except on weatherstripped and smoke gasketed frames, drill stops to receive 3 silencers on strike jambs of single door frames and 2 silencers on heads of double door frames.

C. Door Hardware: As specified in Section 08 71 00.

2.5 FABRICATION

A. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant.
Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at Project site. Comply with ANSI A250.8 requirements.

1. Internal Construction: Manufacturer’s standard vertical steel stiffeners or unitized steel grid with internal sound deadener on inside of face sheets where appropriate in accordance with ANSI standards.

2. Clearances: Not more than 1/8-inch at jamb s and heads except between non-fire resistance rated pairs of doors not more than 1/4-inch. Not more than 3/4-inch at bottom.

B. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel.

C. Tolerances: Comply with SDI 117.

D. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold-rolled or hot-rolled steel.

E. Fabricate exterior doors, panels, and frames from galvanized sheet steel in accordance with SDI 112. Close top and bottom edges of exterior doors as integral part of door construction or by addition of minimum 14 gauge inverted steel channels.

F. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

G. Sound-Rated (Acoustical) Assemblies: Where shown or scheduled, provide door and frame assemblies fabricated as sound-reducing type, tested in accordance with ASTM E90, and classified in accordance with ASTM E413.

1. Unless otherwise indicated, provide acoustical assemblies with sound ratings of STC 33 or better.

H. Glazing: As specified in Section 08 80 00.

I. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware in accordance with final Door Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI/DHI A115 Series Specifications for door and frame preparation for hardware.

1. For concealed overhead door closers, provide space, cutouts, reinforcing, and provisions for fastening in top rail of doors or head of frames, as applicable.

J. Reinforce doors and frames to receive surface applied hardware. Drilling and tapping for surface applied hardware may be done at Project site.

K. Locate hardware as indicated on final shop drawings or, if not indicated, in accordance with DHI.

L. Shop Painting: Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.

1. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.
2. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

2.6 FINISHES

A. Finish Painting: As specified in Section 09 90 00.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install steel doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.

B. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated.
   1. Except for frames located at existing concrete, masonry or drywall installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
   2. Install fire rated frames in accordance with NFPA 80.

C. Door Installation: Fit hollow metal doors accurately in frames, within clearances specified in ANSI A250.8.

3.2 ADJUST AND CLEAN

A. Prime Coat Touch-Up: Immediately after erection, fill with compatible material, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Final Adjustments: Check and readjust operating hardware items, leaving steel frames undamaged and in complete and proper operating condition.

END OF SECTION
SECTION 08 14 16

FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Non-fire resistance rated flush solid core doors, with and without glazing.

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

C. Related Sections
   2. Section 08 71 00 - Door Hardware: For furnishing of finish hardware.
   3. Section 08 80 00 - Glazing: Provision of glass and glazing.
   4. Section 09 90 00 - Painting and Coating: For finish painting.

1.2 REFERENCES

A. AWI - Architectural Woodwork Institute

B. CALGreen - California Green Building Standards, 2016 Edition

C. DHI - Door and Hardware Institute
   2. WDHS-3 - Recommended Hardware Locations for Wood Flush Doors.

D. FSC - Forest Stewardship Council
   1. STD-01-001 - FSC Principles and Criteria for Forest Stewardship.

E. WDMA - Window and Door Manufacturers Association

F. UL - Underwriters Laboratories, Inc.

1.3 SYSTEM DESCRIPTION

A. Composite wood used on the Project shall comply with CALGreen Code Nonresidential Mandatory Measures, Chapter 5, Division 5.5, Section 5.504, Articles 5.504.4.5 and 5.504.4.5.3.

1.4 SUBMITTALS

A. Product Data: Submit product data for each type of door, including details of core and edge construction and factory-finishing specifications.
B. Shop Drawings: Submit shop drawings indicating location and size of each door referenced to the Architect’s door mark and hardware group, elevation of each kind of door, details of construction, location and extent of hardware blocking, requirements for factory finishing and other pertinent data.

1. For factory machined doors, indicate dimensions and locations of cutouts for locksets.

C. Samples for Verification: Corner sections of doors approximately 12 inches square with door faces and edgings representing the typical range of color and grain for each species of veneer and solid lumber required.

1.5 QUALITY ASSURANCE

A. Quality Standard: WDMA I.S.1-A.

B. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

C. Forest Certification: Provide doors made with not less than 70 percent of wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, “FSC Principles and Criteria for Forest Stewardship”.

1.6 WARRANTY

A. General Warranty: Door manufacturer’s warranty specified in this Article shall not deprive the District of other rights the District may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Door Manufacturer’s Warranty: Submit written agreement on door manufacturer’s standard form signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup, or twist) more than 1/4-inch in a 42 inch by 84 inch section or that show telegraphing of core construction in face veneers exceeding 0.01-inch in a 3 inch span, or do not conform to tolerance limitations of referenced quality standards.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors where defect was not apparent prior to hanging.

2. Warranty shall be in effect during the following period of time after date of Final Completion.


PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Algoma Hardwoods, Inc.; Eggers Industries, Architectural Door Division; Marshfield DoorSystems, Inc., or equal.
2.2 MATERIALS

A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.

B. Interior Solid Core Doors for Transparent Finish
   1. Faces: Maple, quarter sliced to match existing as verified in the field.
   2. Grade: Premium with Grade AA faces.
   3. Construction: 5 plies.
   5. Core: Structural composite lumber.
   7. Assembly of Veneer Leaves on Door Faces: Center balance.
   8. Bonding: Stiles and rails bonded to core; then entire unit abrasive planed before veneering.

C. Glazing: As specified in Section 08 80 00.

D. Steel Door Frames at Existing Building: As specified in Section 08 11 15.

E. Hardware: As specified in Section 08 71 00.

2.3 FABRICATION

A. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI WDHS-3. Comply with final hardware schedules, door frame shop drawings, DHI A115-W series standards, and hardware templates.
   1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory machining.

2.4 FINISHES

A. Field Painting: Transparent finish, as specified in Section 09 90 00.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware: See Section 08 71 00.

B. Manufacturer’s Instructions: Install wood doors to comply with manufacturer’s instructions and referenced quality standard and as indicated.

C. Job-Fit 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. Seal cut surfaces after fitting.
   1. Fitting Clearances for Non-Fire Resistance Rated Doors: Provide 1/8-inch at jambs and heads; 1/16-inch per leaf at meeting stiles for pairs of doors, and 1/8-inch from bottom of door to top of decorative floor finish or covering. Where threshold is
shown or scheduled, provide 1/4-inch clearance from bottom of door to top of threshold.
2. Bevel non-fire resistance rated doors 1/8-inch in 2 inches at lock and hinge edges.

D. Finishing
1. Before finishing doors, remove handling marks or effects of exposure to moisture with a complete, thorough final sanding over all surfaces of the door.
   a. Deep scratches shall be steamed out before sanding.
   b. Sharp edges shall be eased by sanding.
2. Clean sanded doors before applying sealer or finish.
3. Seal around all cutouts with 2 coats of varnish or sealer before hardware is set into place.

E. Field Finished Doors: See Section 09 90 00.

3.2 ADJUSTING AND PROTECTION

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Refinish or replace doors damaged during installation.

END OF SECTION
SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART I - GENERAL

1.1 SUMMARY

A. Section Includes: Aluminum-framed storefronts and entrances.

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

B. Related Sections
1. Section 07 65 00 - Flexible Flashing: Provision of flexible flashing.
2. Section 07 92 00 - Joint Sealants: Provision of sealants.
3. Section 08 71 00 - Door Hardware: Provision of door hardware.
4. Section 08 80 00 - Glazing: Provision of glass and glazing.

1.2 REFERENCES

A. AA - Aluminum Association

B. ASCE - American Society of Civil Engineers

C. ASTM - American Society for Testing and Materials

D. CBC - California Building Code, 2016 Edition

E. CCR - California Code of Regulations

F. DSA - Department of the State Architect

G. NAAMM - National Association of Mirror Manufacturers
1. MFM - Metal Finishes Manual for Architectural and Metal Products.

H. SSPC - The Society for Protective Coatings
1.3 SYSTEM DESCRIPTION

A. Design Requirements: Provide aluminum storefront systems that comply with structural performance requirements indicated.
   1. Seismic Loads: Provide storefront systems, including anchorage, capable of withstanding the effects of earthquake motions calculated according to CBC.
   2. Wind Loads: Wind pressures are based on the provisions of ASCE 7.10, the all height method of CBC 1609A.6 and the following criteria:
      c. Wind Exposure Category: C.
      d. Wind Importance Factor: I_w = 1.0.
   3. Deflection Normal to the Plane of the Wall: Test pressure required to measure deflection of framing members normal to the plane of the wall shall be equivalent to the wind load specified above. Deflection shall not exceed 1/360 of the clear span, when subjected to uniform load deflection test.
   4. Deflection Parallel to the Plane of the Wall: Test pressures required to measure deflection parallel to the plane of the wall shall be equal to 1.5 times the wind pressures specified above. Deflection of any member carrying its full dead load shall not exceed an amount that will reduce glass bite below 75 percent of the design dimension and shall not reduce the edge clearance between the member and the fixed panel, glass or other 1 fixed member above to less than 1/8-inch. The clearance between the member and an operable door or window shall be at least 1/16-inch.
   5. Seismic Drift: 2 percent of the height between relative stories above and below.
   7. Glazing to Glazing Joints: Provide glazing to glazing joints that accommodate thermal and mechanical movements of glazing and system, prevent glazing to glazing contact and maintain required edge clearances.
   8. 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 E331 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.

B. Performance Requirements: Finish hardware supplier shall be responsible for furnishing physical hardware to the entrance manufacturer prior to fabrication and for coordinating hardware delivery requirements with the hardware manufacturer, the General Contractor, and the entrance manufacturer to ensure the Project is not delayed.

1.4 SUBMITTALS

A. Product Data: Submit product data for each aluminum storefront system required, including:
   1. Manufacturer’s standard details and fabrication methods.
   2. Data on finishing, hardware and accessories.
   3. Recommendations for maintenance and cleaning of surfaces.
   4. Profiles and dimension of components.

B. Shop Drawings: Submit shop drawings for aluminum storefront system required, including:
   1. Layout and installation details, including relationship to adjacent work.
   2. Elevations at 1/4-inch scale.
3. Detail sections of typical composite members.
4. Anchors and reinforcement.
7. Entry door details, flashing details and other special conditions.
8. Structural calculation for seismic and gravity loads on structural components of system. Drawings and calculations shall be by licensed engineer in the State of California and engineer shall be fully familiar with glazing systems.

C. Deferred Submittals (CCR Title 24, Part 1, Sec. 4-317(g)): Only where a portion of the construction cannot be adequately detailed on the approved plans because of variations in product design and/or manufacturer, the approval of plans for such portion, when specifically accepted by DSA, may be deferred until the material suppliers are selected, provided the following conditions are met:
1. The project plans clearly indicate that DSA approval of the deferred submittal is required for the indicated portions of the work prior to fabrication and installation.
2. The project plans and specifications adequately describe the performance and loading criteria for such work.
3. A California licensed architect or California registered engineer stamps and signs the plans and specifications for the deferred submittal item. The architect or engineer in general responsible charge of the design of the project shall submit the plans and specifications for the deferred submittal item to DSA, with notation indicating that the deferred submittal documents have been found to be in general conformance with the design of the building.
4. Fabrication of deferred submittal items shall not begin without first obtaining the approval of plans and specifications by DSA.

D. Samples
1. For Initial Color Selection: Submit pairs of samples of specified finish on 12 inch long sections of extrusions or formed shapes.
2. For Verification Purposes: The Architect reserves the right to require additional samples, that show fabrication techniques and workmanship, and design of hardware and accessories.

E. Quality Control Submittals: Provide certified test reports from a qualified independent testing laboratory showing that aluminum storefront systems have been tested in accordance with specified test procedures and comply with performance characteristics indicated.

1.5 WARRANTY

A. Warranty: Submit a written warranty, executed by the manufacturer, agreeing to repair or replace units that fail in materials or workmanship within the specified warranty period. Failures include, but are not necessarily limited to:
1. Structural failures including excessive deflection, excessive leakage or air infiltration.
2. Faulty operation.
3. Deterioration of metals, metal finishes and other materials beyond normal weathering.

B. Warranty Period: 2 years after the date of Final Completion.
C. The warranty shall not deprive the District of other rights or remedies the District may have under other provisions of the Contract Documents, and is in addition to and runs concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers
   2. Entrances

2.2 MATERIALS

A. Aluminum Extrusions: Alloy and temper recommended by aluminum storefront manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070-inch wall thickness at any location for the main frame and complying with ASTM B221; 6063-T6 alloy and temper.

B. Fasteners: Aluminum, nonmagnetic stainless steel, or other materials to be non-corrosive and compatible with aluminum window members, trim hardware, anchors, and other components.

C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B633; provide sufficient strength to withstand design pressure indicated.

D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B456 or zinc-coated steel or iron complying with ASTM B633; provide sufficient strength to withstand design pressure indicated.

E. Sealant: For sealants required within fabricated storefront system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement as specified in Section 07 92 00.

F. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC Paint 12 requirements, except containing no asbestos, formulated for 30-mil thickness per coat.

2.3 STOREFRONT FRAMING SYSTEM

A. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

B. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed, fasteners shall be stainless steel.
C. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

D. Glazing: As specified in Section 08 80 00.
   1. Provide center glazed system to match existing.

E. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.

F. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

G. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.4 ENTRANCES

A. Type 1: Manufacturer’s standard glazed doors for manual swing and slide operation.
   1. Door Construction: Minimum 0.125-inch thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.
   2. Door Design: Medium stile.
   3. Dimensions: 3-1/2 inch vertical stile; 3-1/2 inch top rail; 10-inch bottom rail.
   4. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets; provide nonremovable glazing stops on outside of door.
   5. At sliding door, provide break-away function on moving pane.

B. Type 2: Manufacturer’s standard glazed, insulated panel doors.
   1. Door Face: Architectural quality aluminum sheet, 0.090-inch thick, plain unpatterened.
   2. Dimensions: 5-inch vertical stile; 5-inch top rail; 5-inch bottom rail.
   4. Glazing: Insulated glass, as indicated in Section 08 80 00.

C. Hardware, General: As specified in Section 08 71 00.

2.5 FABRICATION

A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
   2. Profiles that are sharp, straight, and free of defects or deformations.
   3. Accurately fit joints; make joints flush, hairline and weatherproof.
   4. Physical isolation of glazing from framing members.
   5. Accommodations for 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.
B. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

C. Storefront Framing: Fabricate components for assembly using manufacturer’s standard installation instructions.

D. After fabrication, clearly mark components to identify their locations in Project according to shop drawings.

2.6 ALUMINUM FINISH

A. General: Comply with NAAMM’s MFM for recommendations relative to applying and designating finishes.

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 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.

C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

D. Aluminum Finish: Match existing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas with the installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of storefront and entrance system. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer’s written instructions for protecting, handling, and installing storefront and entrance system. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.

B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install framing components plumb and true in alignment with established lines and grades without warp or rack of framing members.

D. Install glazing to comply with requirements of Section 08 80 00.
E. Erection Tolerances: Install storefront system to comply with the following maximum tolerances.
   1. Variation from Plane: Limit variation from plane or location shown to 1/8-inch in 12 feet; 1/4-inch over total length.
   2. Diagonal Measurements: Limit difference between diagonal measurements to 1/8-inch.

3.3 FIELD QUALITY CONTROL

A. Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

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 stages as indicated on the Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
   1. Water Penetration: Areas shall be tested according to ASTM E1105 at a minimum uniform and cyclic static-air-pressure difference of 0.67 times the static-air-pressure difference specified for laboratory testing under Article 1.3, but not less than 4.18 lbf/sq. ft. and shall not evidence water penetration.

C. Repair or remove work where 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.

3.4 CLEANING

A. Remove excess sealant and glazing compounds, and dirt from surfaces.

END OF SECTION
SECTION 087100

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Automatic operators.
4. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Door Hardware Schedule”.
2. Division 08 Section “Hollow Metal Doors and Frames”.
3. Division 08 Section “Interior Aluminum Doors and Frames”.
4. Division 08 Section “Flush Wood Doors”.
5. Division 08 Section “Automatic Door Operators”.
6. Division 08 Section “Access Control Hardware”.
7. Division 28 Section “Access Control”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

6. NFPA 105 - Installation of Smoke Door Assemblies.
7. UL/ULC and CSA C22.2 – Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
8. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:
   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
   h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
   a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
   b. Complete (risers, point-to-point) access control system block wiring diagrams.
   c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the
manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

E. California Building Code: Provide hardware that complies with CBC Section 11B.

1. All openings as a part of an accessible route shall comply with CBC Section 11B-404.

2. The clear opening width for a door shall be 32” minimum. For a swinging door it shall be measured between the face of the door and the stop, with the door open 90 degrees. There shall be no projections into it below 34” and 4” maximum projections into it between 34” and 80” above the finish floor or ground. Door closers and stops shall be permitted to be 78” minimum above the finish floor or ground. CBC Section 11B-404.2.3.

3. Operable hardware on accessible doors shall comply with CBC Section 11B-309.4 and shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. Operable parts of such hardware shall be 34” minimum and 44” maximum above finish floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usable from both sides. Applicable for lever-type hardware; panic bars, push-pull activating or U shaped handles, lever handle for thumb turn deadbolt.

4. Hardware (including panic hardware) shall not be provided with “nightlatch” function for any accessible doors or gates unless the following conditions are met:
   a. Such hardware has a ‘dogging’ feature and is dogged during the time the facility is open.
   b. All ‘dogging’ operation is performed only by employees as their job function (non-public use).

5. The force for pushing or pulling open a door shall be in accordance with CBC Section 11B-404.2.9.
   a. Interior hinged doors, sliding or folding doors, and exterior hinged doors: 5 pounds (22.2 N) maximum. Required fire doors: the minimum opening force allowable by the Authority having Jurisdiction, may increase the maximum effort to operate fire doors to achieve positive latching, but not to exceed 15 pounds (66.7N). These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position.
b. The force required for activating any operable parts, such as lever hardware, or disengaging other devices shall be 5 pounds (22.2N) maximum to comply with CBC Section 11B-309.4.

6. Door closing speed shall comply with CBC Section 11B-404.2.8. Closers shall be adjusted so that the required time to move a door from an open position of 90 degrees to a position of 12 degrees from the latch is 5 seconds minimum. Spring hinges shall be adjusted so that the required time to move a door from an open position of 70 degrees to the closed position is 1.5 seconds minimum.

7. Floor stops shall not be located in the path of travel and 4” maximum from walls.

8. Thresholds shall comply with CBC Section 11B-404.2.5.

9. Where flush bolts occur in accessible route of travel, provide accessible flush bolt (automatic).

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.
1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.
C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Five years for exit hardware.
3. Twenty five years for manual surface door closer bodies.
4. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

A. 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 door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

   a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
   a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
   b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
   a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:
   a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:
   a. Hager Companies (HA).
   b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
   c. Stanley Hardware (ST).

B. Concealed Hinges: Hinges mortised into door and frame so that they are concealed when the door is closed. Hinges shall be adjustable three ways; vertically, horizontally and compression (in/out) capable of a 180 degree swing. Hinges are to be non-handed. Provide fastener type, size, and quantity as recommended by hinge manufacturer for properly installing concealed hinges in the door and frame type application. Provide steel receiver for metal door and frame cutouts for receiving concealed hinges.

1. Manufacturers:
   a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
   b. Soss Door Hardware.
   c. Tectus by Simonswerk.

C. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge, with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cutouts.
1. Manufacturers:
   a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
   b. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.3 POWER TRANSFER DEVICES

A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:
   a. Securitron (SU) - EL-CEPT Series.

B. Electrified Quick Connect Data Transfer Hinges: Provide combined electrified power and Ethernet data transfer hinges with Molex™ standardized plug connectors to accommodate Electrified Quick Connect Data Transfer Hinges: Provide combined electrified power and Ethernet data transfer hinges with Molex™ standardized plug connectors to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Data transfer hinges feature two 6-position and two 4-position Molex connectors, 9 multi-strand wires; 2 twisted pairs (26 AWG), 4 straight conductors (28 gauge) and 1 straight conductor (22 AWG) with concealed plug connectors eliminating the need for separate or exposed wiring. Rated 350 mA continuous @ 48 volts DC nominal, the hinge is capable of two PoE wiring configurations:
   a. Power over Data (5 wire): Power and Data supplied together over the 2 twisted 26 AWG pairs. The 22 AWG conductor is used for the earth ground connection.
   b. Data with Power over Spares (9 wire): Data over 2 twisted (26 AWG) pairs with Power over spare pairs 94 straight 28 AWG conductors. The 22 Awg conductor is used for earth ground connection.

2. Manufacturers:
2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.
   1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
   2. Furnish dust proof strikes for bottom bolts.
   3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
   4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
   5. Manufacturers:
      a. Door Controls International (DC).
      b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
      c. Trimeco (TC).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
   1. Manufacturers:
      a. Corbin Russwin Hardware (RU).

C. Cylinders: Original manufacturer cylinders complying with the following:
   1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
   2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
   3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
   4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
   1. Removable Cores: Core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware. Provide removable core (small or large format) as specified in Hardware Sets.
E. Security Cylinders: ANSI/BHMA A156.5, Grade 1, patterned security cylinders and keys able to be used together under the same facility master or grandmaster key system. Cylinders are to be factory keyed.

1. Manufacturers:
   a. Corbin Russwin (RU) - Pyramid PS Series.
   b. No Substitution.

F. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified cylinders employing a utility patented and restricted keyway requiring the use of patented controlled keys. Provide bump resistant, fixed core cylinders as standard with solid recessed cylinder collars. Cylinders are to be factory keyed where permanent keying records will be established and maintained.

1. Provide a 6 pin multi-level master key system comprised of patented controlled keys and security and high security cylinders operated by one (1) key of the highest level. Geographical exclusivity to be provided for all security and high security cylinders and UL437 certification where specified.
   a. Level 1 Cylinders: Provide utility patented controlled keyway cylinders that are furnished with patented keys available only from authorized distribution.
   b. Level 2 Cylinders: Provide utility patented controlled keyway and side bar locking incorporating unique angled bottom pins for geographical exclusivity. Cylinders constructed to provide protection against bumping and picking.
   c. Level 3 Cylinders: Provide utility patented controlled keyway and side bar locking incorporating unique angled bottom pins for geographical exclusivity. Cylinders to be UL437 certified and constructed to provide protection against bumping, picking, and drilling.
   d. Refer to hardware sets for specified levels.

2. Manufacturers:
   a. Corbin Russwin (RU) – Access 3 Series.

G. Keying System: Each type of lock and cylinders to be factory keyed.

1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Key locks to Owner's existing system.

H. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).

I. Construction Keying: Provide construction master keyed cylinders.
J. Key Registration List (Biting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

K. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with
self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent
markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of
150% of the number of locks required for the project.

1. Manufacturers:
   a. Lund Equipment (LU).
   b. MMF Industries (MM).
   c. Telkee (TK).

L. Key Control Software: Provide one network version of "Key Wizard" branded key management
software package that includes one year of technical support and upgrades to software at no
charge. Provide factory key system formatted for importing into “Key Wizard” software.

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational
Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be
field-reversible for handling without disassembly of the lock body.

1. Manufacturers:
   b. No Substitution.

B. Multi-Point Locksets, FEMA: Three-point locking system device engineered for in-swinging
and out-swinging door applications on windstorm safe shelter rooms. Extra heavy duty steel
component construction securing the door to the frame at top, bottom and center latch positions.
All three latching points are automatically activated when the device is locked. Multi-Point
Deadlocking System shall be used only with doors, frames and associated hardware that have
been engineered, tested and approved for a complete opening assembly system.

1. ANSI-BHMA listed to A156.37 Grade 1 for multi-point locks:
   a. Lever torque to retract all bolts less than 28 in.lb.
   b. Cycle tested to 800,000 cycles.

2. NFPA 80 and NFPA 101 life safety requirements.

3. UL10B or UL10C, 3-hour fire rated openings.
4. **Latchbolt Construction:**
   a. Center Bolt to be one piece, ¾” throw anti-friction stainless steel latch and one piece, 1” throw, hardened stainless steel deadbolt; 2-3/4” standard backset.
   b. Top and Bottom Bolts to be ¾” x ¾” stainless steel square latchbolt with ¾” projection.

5. **Independent top and bottom bolt projection shall be field adjustable:**
   a. From the center mortise pocket.
   b. Ability to make field adjustments while the door is in the hung position without the removal of the door.
   c. Top and Bottom Bolts and the Center Mortise Case shall be factory installed into the door assembly.

6. **Bottom strike shall be offset and reversible to accommodate alignment issues due to rough opening tolerances.**

7. **Devices must be able to accommodate sectional rose and lever trim to match the design style and architectural finishes of the balance of the lockset and latches as specified.**

8. **Devices must be available with electronic access control options for higher or everyday use and traceability.**

9. **Devices must be available with rod-dogging indicator options:**
   a. Operated by single-point latching for non-emergency or normal use of the space.
   b. Ability to hold rods in a retracted state.
   c. Day-to-day operations with mortise lock only.
   d. Indicator to show status.

10. **Manufacturers:**
    a. Corbin Russwin Hardware (RU) - FE6600 Series.
    b. Sargent Manufacturing (SA) - FM7300 Series.
    c. No Substitution.

C. **Residential Pivot Locking Devices**

1. **Pivot mechanism devices for push to open operation designed to fit ANSI standard door preps and ADA compliant.**

2. **Manufacturers:**
   a. Yale Residential (YR) – PV Series.
   b. No Substitution.
2.7 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.8 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.

b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

6. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.


9. Rail Sizing: Provide exit device rails factory sized for proper door width application.

10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:
   a. Detex (DE) - Advantex Series
   b. Von Duprin (VD) - 35A/98 XP Series.
   c. No Substitution.

C. Conventional Push Rail Exit Devices (Commercial Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Fabricate latchbolts from cast stainless steel, Pullman type, incorporating a deadlocking feature.

1. Manufacturers:
   a. Adams Rite (AD) - EX Series.
   b. Cal Royal (CA) - 7700 Series.
   c. Falcon Hardware (FA) - 24/25 Series.
   d. Hager (HA) - 4500 Series.
   e. PDQ (PQ) - 6200 Series.
   f. Stanley Commercial (ST) - QED110 Series.
   g. Yale Locks and Hardware (YA) - 2100 Series.
   h. Yale Locks and Hardware (YA) - 6000 Series.

D. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed paint finish.

1. Provide keyed removable feature where specified in the Hardware Sets.
2. Provide stabilizers and mounting brackets as required.

3. Provide electrical quick connection wiring options as specified in the hardware sets.

4. Manufacturers:
   a. Von Duprin (VD) - 9954 Series.

2.9 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.

4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Manufacturers:
   a. Corbin Russwin Hardware (RU) - DC8000 Series.
   b. No Substitution.
C. Door Closers, Overhead Concealed (Narrow Profile): ANSI/BHMA 156.4 certified Grade 1
door closers designed for narrow profile frames and doors. Closers to have fully concealed body
in the frame head for offset hung applications, with separate and independent valves for closing
speed and backcheck adjustments.

1. Manufacturers:
   a. Rixson Door Controls (RF) - 91 Series.

2.10 ELECTROMECHANICAL DOOR OPERATORS

A. General: Provide low energy operators of size recommended by manufacturer for door size,
weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate
operator mechanisms with door operation, hinges, and activation devices.

1. 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.

B. Standard: Certified ANSI/BHMA A156.19.

C. Performance Requirements:

1. Opening Force if Power Fails: Not more than 15 lbf required to release a 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 Protection: Not more than 15 lbf required to prevent stopped door from
closing or opening.

D. Configuration: Surface mounted or in-ground as required. Door operators to control single
swinging and pair of swinging doors.

E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1
accessibility guideline. Provide time delay for door to remain open before initiating closing
cycle as required by ANSI/BHMA A156.19.

F. Features: Operator units to have full feature adjustments for door opening and closing force and
speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface
delay, obstruction recycle, and hold open time from 0 up to 30 seconds.

G. Provide outputs and relays on board the operator to allow for coordination of exit device latch
retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified
auxiliary contacts.

H. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with
nonferrous shims for aligning system components.
I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Norton Door Controls (NO) - 6300 Series.

2.11 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.

4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
   a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

6. Manufacturers:
   a. Hiawatha, Inc. (HI).
   b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
   c. Trimco (TC).

2.12 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Floor stops shall be at 4" max from wall. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:
a. Hiawatha, Inc. (HI).
b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

   a. Rixson Door Controls (RF).
   b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
   c. Sargent Manufacturing (SA).

2.13 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: 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, based on testing according to UL-10C.


D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).
2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
2.14 Fabrication
A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.15 Finishes
A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 Examination
A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 Preparation
A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

3.3 Installation
A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
   1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.
C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. The supplier is responsible for handing and sizing all products as listed in the door hardware sets. Quantities listed are for each pair of doors, or for each single door.

C. Refer to Section 080671, Door Hardware Sets, for hardware sets.

END OF SECTION
SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Glass and glazing.

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

C. Related Sections
   1. Section 06 41 10 - Custom Casework: Provision of custom casework.
   2. Section 08 11 15 - Steel Doors and Frames: Provision of steel doors and frames.

1.2 REFERENCES

A. ANSI - American National Standards Institute

B. ASTM - American Society for Testing and Materials

C. CBC - California Building Code, 2016 Edition

D. CPSC - Consumer Product Safety Commission

E. GANA - Glass Association of North America

F. IGCC - Insulating Glass Certification Council

G. SIGMA - Sealed Insulating Glass Manufacturers Association
   1. TM-3000 - Vertical Glazing Guidelines.

H. UL - Underwriters Laboratories Inc.
1.3 SYSTEM DESCRIPTION

A. Design Requirements
1. Provide glass and glazing that has been produced, fabricated, and installed to withstand movement without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials, and other defects in the work.
2. Glass Design: Glass thicknesses indicated on the Drawings are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for the various size openings in the thicknesses and strengths (annealed or heat-treated) to meet or exceed the following criteria:
   a. Minimum glass thickness, nominally, of lites in exterior walls is 0.23-inches.
   b. Minimum glass thicknesses of lites, whether composed of annealed or heat-treated glass, are selected so the worst-case probability of failure does not exceed the following: 8 lites per 1000 for lites set vertically or not over 15 degrees off vertical and under wind action. Determine minimum thickness of monolithic annealed glass according to ASTM E1300. For other than monolithic annealed glass, determine thickness per glass manufacturer’s standard method of analysis including applying adjustment factors to ASTM E1300 based on type of glass.
3. Normal thermal movement results from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on materials’ actual surface temperatures due to both solar heat gain and nighttime sky heat loss.
   a. Temperature Change (Range): 120 degrees Fahrenheit ambient; 180 degrees Fahrenheit material surfaces.
4. Verify locations where safety glazing is required by CBC. Bring to the Architect’s attention locations not noted as such in the Drawings. Do not proceed until directed by the Architect.
5. Energy Requirements: As indicated on the Drawings.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s product data for each glass product and glazing material indicated.

B. Samples: Submit samples for verification purposes of 12 inch square samples of each type of glass indicated except for clear monolithic glass products, and 12 inch long samples of each color required for each type of sealant or gasket exposed to view. Install sealant or gasket sample between 2 strips of material representative in color of the adjoining framing system.

C. Quality Control Submittals
1. Test Reports
   a. Compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants. Include sealant manufacturer’s interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.
b. Compatibility test report from manufacturer of insulating glass edge sealant indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, glazing tape, gaskets, setting blocks, and edge blocks.
c. Product test reports for each type of glazing sealant and gasket indicated, evidencing compliance with requirements specified.

2. Certificates
   a. Product certificates signed by glazing materials manufacturers certifying that their products comply with specified requirements.
   b. Separate certifications are not required for glazing materials bearing manufacturer’s permanent labels designating type and thickness of glass, provided labels represent a quality control program of a recognized certification agency or independent testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

   A. Regulatory Requirements
      1. Glass and glazing shall meet requirements of CBC Chapter 24.
      2. Safety Requirements: Provide glass and glazing complying with ANSI Z97.1 and CBC Chapter 24 and testing requirements of CPSC 16 CFR Part 1201 for Category II materials.
      3. Fire Resistive Glazing Products: Products identical to those tested in accordance with ASTM E2074 for doors and ASTM E2010 for window assemblies; both labeled and listed by UL.
      4. Insulating Glass Certification Program: Provide insulation glass units permanently marked with appropriate label of IGCC.

   B. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
      1. GANA Publication: “Glazing Manual”.

   C. Single-Source Responsibility for Glass: Obtain glass from 1 source for each product indicated below:
      1. Heat-treated glass of each condition indicated, ASTM C1048.
      2. Insulating glass of each construction indicated.

   D. Preconstruction Compatibility and Adhesion Testing: Submit to sealant manufacturers, samples of each glass, gasket, glazing accessory, and glass framing member that will contact or affect glazing sealants for compatibility and adhesion testing as indicated below
      1. Use test methods standard with sealant manufacturer to determine if priming and other specific preparation techniques are required for rapid, optimum glazing sealants adhesion to glass and glazing channel substrates.
      2. Submit not less than 9 pieces of each type and finish of glass-framing members and each type, class, kind, condition, and form of glass (monolithic, laminated, insulating units) for adhesion testing, as well as one sample of each glazing accessory (gaskets, setting blocks, and spacers) for compatibility testing.
3. Schedule sufficient time to test and analyze results to prevent delay in the Work.
4. Investigate materials failing compatibility or adhesion tests and get sealant manufacturer's written recommendations for corrective measures, including using special primers.
5. Testing is not required when glazing sealant manufacturer can submit required preparation data that is acceptable to the Architect and is based on previous testing of current sealant products for adhesion to and compatibility with submitted glazing materials.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials to comply with manufacturer's directions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing materials manufacturer or when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.8 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive the District of other rights the District may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer's Special Warranty on Insulating Glass: Written warranty, made out to the District and signed by insulating-glass manufacturer agreeing to furnish replacements for insulating-glass units that deteriorate, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Viracon; Ford Glass Division; PPG Industries, Inc.; AFG Industries, Inc., or equal.

2.2 MATERIALS

A. Glass Types
1. Type 1 - Float Glass: ASTM C1036, Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), 1/4-inch thick, unless otherwise noted or where recommended by manufacturer to meet wind load requirements.
2. Type 2 - Float Glass: ASTM C1048, Kind FT (fully tempered) Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), 1/4-inch thick, unless otherwise noted or where recommended by manufacturer to meet wind load requirements.
3. Type 3 - Float Glass: Low-E, ASTM C1036, Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), 1/4-inch thick, unless otherwise noted or where recommended by manufacturer to meet wind load requirements.
   a. Product: As manufactured by Viracon, “VE3 2M Grey”, or equal to match existing.
4. Type 4 - Float Glass: Low-E, ASTM C1048, Kind FT (fully tempered) Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), 1/4-inch thick, unless otherwise noted or where recommended by manufacturer to meet wind load requirements.
   a. Product: As manufactured by Viracon, “VE3 2M Grey”, or equal to match existing.
5. Type 5 - Spandrel Glass: ASTM C1048, Kind FT (fully tempered), Condition B (spandrel glass, one-surface ceramic coated), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select).
   a. Location of Ceramic Coating: Second surface.
   c. Thickness: 1/4-inch.
   d. Product: As manufactured by Viracon, or equal to match existing.
6. Type 6 - Fire Rated Safety Glass: Proprietary Category II safety glazing product in the form of 2 lites of clear ceramic glazing material laminated together to produce a laminated lite of 5/16-inch nominal thickness; polished on both surfaces; weighing 4 lb/sq. ft.; and as follows:
   a. Fire-Protection Rating: As indicated for the assembly in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
   b. Polished on both surfaces, transparent.
   c. Logo: Each piece of fire rated glazing shall be labeled with a permanent logo including name of product, manufacturer, testing laboratory (UL), fire rating period, safety glazing standards, and date of manufacture.
7. Types 7 Through 9: Not used.
8. Type 10 - Laminated Glass Unit
   a. ASTM C1172, safety, 2 ply factory laminated glass, 1/2-inch total thickness of the following:
      1. Outboard Layer: Glass Type 1.
      2. Interlayer
         a. Polyvinyl butyral sheet, 0.030-inch thick, clear color.
         b. Product: As manufactured by Saflex, Monsanto Co., or equal.
      3. Inboard Layer: Glass Type 1.
   b. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets. Laminate in autoclave with heat plus pressure.
10. Type 20 - Sealed Insulating Glass: Preassembled units composed of the following:
    a. Outboard Lite: Glass Type 3.
    b. Air Space: 1/2-inch.
    c. Inboard Lite: Glass Type 1.
11. Type 21 - Sealed Insulating Glass: Preassembled units composed of the following:
    a. Outboard Lite: Glass Type 4.
    b. Air Space: 1/2-inch.
    c. Inboard Lite: Glass Type 2.
12. Type 22 - Sealed Insulating Glass: Preassembled units composed of the following:
   a. Outboard Lite: Glass Type 4.
   b. Air Space: 1/2-inch.
   c. Inboard Lite: Glass Type 5.

2.3 GLAZING ACCESSORIES

A. Provide the following accessories as required.
   1. Setting Blocks, Spacers, and Edge Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.
      a. Provide black spacers at sealed insulating glass; do not use silver.
   3. Glazing Tape: Provide manufacturer’s standard solvent free butyl-polyisobutylene formulation with solids content of 100 percent; in extruded tape form; non-staining and non-migrating in contact with nonporous surfaces; packaged on rolls with release paper on 1 side; with or without continuous spacer rod as recommended by manufacturers of tape and glass for application indicated.

2.4 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for the Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine glass framing, with glazier 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 glass-framing members.

B. Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.
B. Glazing channel dimensions as indicated on Drawings provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass from edge damage during handling and installation as follows
   1. Use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass lites with flares or bevels on bottom horizontal edges so edges are located at top of opening, unless otherwise indicated by manufacturer’s label.
   2. Remove damaged glass from Project site and legally dispose of off site. Damaged glass is glass with edge damage or other imperfections that, when installed, weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install elastomeric setting blocks in sill rabbets, sized and located to comply with referenced glazing standard, 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 sizes larger than 50 united inches (length plus height) as follows:
   1. Locate spacers inside, outside, and directly opposite each other. Install correct size and spacing to preserve required face clearances, except where gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and comply with system performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required by glass manufacturer.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

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 in one continuous length. Do not stretch tapes to make them fit opening.

C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these 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 lite 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. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

B. Secure compression gaskets in place with joints located at corners to compress gaskets producing a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

C. Install gaskets so they protrude past face of glazing stops.

3.6 PROTECTION AND CLEANING

A. Protect exterior glass from breakage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended 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 build-up of dirt, scum, alkali deposits, or stains, and remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both faces in each area of Project not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION
SECTION 09 24 00
CEMENT PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Exterior portland cement plasterwork (stucco) with integral color finish on metal lath
      over weather-resistant barrier over continuous sheathing.
   2. Installation of finish coat only over existing cement plaster where indicated on the
      Drawings.

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

C. Related Sections
   1. Section 04 73 10 - Manufactured Stone Veneer: Provision of manufactured stone
      veneer.
   2. Section 07 65 00 - Flexible Flashing: Provision of self-adhering flashing sheet.
   3. Section 07 92 00 - Joint Sealants: Provision of joint sealants.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials
   1. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron
      Alloy-Coated (Galvannealed) by the Hot-Dip Process.
      Plasters.
      Veneer Base.
      Interior and Exterior Portland Cement-Based Plaster.

B. ICC - International Code Council

C. NAAMM - National Association of Architectural Metal Manufacturers

D. PCA - Portland Cement Association
1.3 SYSTEM DESCRIPTION

A. Design Requirement: Cement plaster system includes components listed herein; system thickness 7/8-inch.

B. Performance Requirements
   1. Provide exposed plaster finish surfaces that are true and even without waves, cracks or other imperfections. Cracks, blisters, pits or discoloration will not be acceptable.
   2. Sheathing, lath and related accessories shall provide proper, secure base and reinforcement for plaster systems. Unless specifically noted otherwise, conform to NAAMM Standard Manual/SFA 920.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s product data completely describing products.

B. Samples: Minimum 24 by 24 inch sample panels for review of finish texture by the Architect. Should sample panel be rejected, continue to submit until satisfactory texture is achieved. Sample passing review shall serve as standard of quality for the Project.

1.5 QUALITY ASSURANCE

A. Mockups: Before plastering, install mockups of at least 10 sq. ft. in surface area of square edge casing bead installation at splice joints and at corners to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Install mockups for each type of finish indicated.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 LATH MATERIALS

A. Weather-Resistive Barrier: 2-ply polymeric housewrap/asphalt saturated kraft Grade D breather type sheathing paper; complies with ASTM E2273, as manufactured by Fortifiber Building Systems Group, “Hydro Tex”, or equal.

B. Self-Adhering Flashing Sheet: 25 mils, as specified in Section 07 65 00.


D. Accessories
   1. Casing Beads: As manufactured by Cemco, “#66”, or equal.
   2. Vertical Control Joint: As manufactured by Cemco, “#XJ15”, or equal.
   3. Horizontal Control Joint: Solid leg, as manufactured by Cemco, “#15”, or equal.
   4. External Corner Bead: As manufactured by Stockton Products, “Corneraid”, or equal.
5. Foundation Sill (Weep) Screed: Manufacturer’s standard profile with 3.5-inch vertical attachment flange, fabricated from minimum 26 gauge zinc-coated (galvanized) steel sheet, as manufactured by Cemco, “#34”, or equal.
7. Soffit Drip Edge: As manufactured by Cemco, #12”, or equal.
8. Soffit Vents: Provide soffit vents, with width as indicated on the Drawings, ASTM C1047, sheet steel zinc coated by hot-dip process. Flanges shall be free of dirt, grease and other materials that may adversely affect bond of joint treatment.
   a. Product: As manufactured by Cor-A-Vent, or equal.

E. Fasteners: Comply with ASTM C1063 for type and size of fastener required to rigidly secure materials in place.

2.2 PLASTER MATERIALS

A. Plaster Base Coats
   1. Portland Cement: ASTM C150, Type I.
   2. Sand for Portland Cement Plaster: ASTM C897; graded in accordance with PCA requirements.
   4. Water: Clean, fresh, potable and free of mineral or organic matter which can affect plaster.

B. Acrylic-Based Finish Coat: Factory-mixed formulation of acrylic emulsion, colorfast mineral pigments, and fine aggregates specifically recommended by acrylic-based finish manufacturer for use over portland cement plaster base coats; as manufactured by La Habra Products, Inc., or equal.

2.3 MIXES

A. Mix and proportion cement plaster in accordance with ASTM C926.

B. Base and Brown Coats
   1. Plasticizing Agents: 3 ounces of PRF per cubic foot. Add to water before adding cement and sand.
   2. Glass Fibers: Use fibers at the rate of 1/2 pound per sack of cement.


D. Proportions: In accordance with ASTM C926 and as follows:
   1. Scratch Coat: 1 part portland cement, 3-1/2 parts sand, 3 ounces PRF, 1/2-pound glass fibers.
   2. Brown Coat: 1 part portland cement, 4 parts sand, 1 part acrylic compound, 3 ounces PRF, 3 parts water.

2.4 FINISHES

A. Texture: Match existing.
PART 3 - EXECUTION

3.1 SELECTIVE DEMOLITION

A. Carefully cut back stucco to exposed 2 inches of undamaged lath and 6 inches of undamaged weather-resistive barrier. Edge of demolished stucco shall be "undercut" so that the exterior face of the remaining stucco extends beyond the remainder of the cut section.

3.2 INSTALLATION OF WEATHER-RESISTIVE BARRIER

A. Weather-Resistive Barrier
   1. Install weather-resistive barrier in accordance with manufacturer’s written instructions and “best practice” recommendations.
   2. Apply weather-resistive barrier over wood sheathing or gypsum sheathing substrate. Lap and seal edges with accessories per manufacturer’s recommendations.
   3. At locations of selective demolition, lap over existing weather-resistive barrier.

B. Self-Adhered Flashing: Course self-adhered flashing into all surrounding weather-resistive barriers. Self-adhered flashing shall be installed over solid backing. Where no backing is shown at details, provide 26 gauge galvanized metal sheet continuous.

3.3 INSTALLATION OF METAL LATH AND ACCESSORIES

A. Metal Lath Application
   1. At cement plaster conditions on sheathing use Type SFB lath.
      a. Apply metal lath with long dimensions across supports, with ends lapped minimum 2 inches and staggered in adjacent courses; sides lapped minimum 2 inches.
      b. If lapping between supports, lace ends together with tie wire.
      c. Wire tie accessories to lath.
      d. Furr out metal lath 1/4-inch over solid backing by self-furring lath or by special furring nails.
      e. Lap metal lath over flanges at control joints; do not continue lath across control joints.
   2. Lath Attachment: Attach in accordance with ASTM C1063.
   3. At Openings
      a. Hang lath at openings with cut-out to include at least 1 and possibly 2 opening corners.
      b. Horizontal joints in line with head or vertical joints in line with jamb will not be permitted.
   4. Accessories
      a. Apply corner reinforcement at external plaster corners using single lengths without joints.
      b. Install casing beads at terminations of plaster surfaces unless otherwise indicated. All corners and splices shall be watertight.
      c. At horizontal channel screeds and reveals, lap weather-resistive barrier over upper flange.
      d. Control Joints: Install control joints in specific locations approved by the District’s Representative for visual effect as follows:
1) As required to delineate plasterwork into areas (panels) of the following maximum sizes:
   a) Vertical Surfaces: 144 sq. ft.
   b) Horizontal and other Nonvertical Surfaces: 100 sq. ft.
2) At distances between control joints of not greater than 18 feet on center.
3) As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
4) Where control joints occur in surface of construction directly behind plaster.
5) Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.
6) Where indicated in the Drawings.
   e. Fasten at both ends and at maximum 12 inch centers to prevent dislodging or misalignment by subsequent operations.
   f. Where plaster meets dissimilar material, terminate with plaster casing bead unless otherwise shown.
   g. Install weep screed at all locations where walls terminate at decks or grade.
   h. Install drip screed at all horizontal returns including window heads, soffits and other locations where drip profile is required to shed water.

B. Do not fasten lath at recessed sills to avoid lath fasteners penetrating sill membrane where water may penetrate into the building.

C. Plaster Parapet Copings: Do not fasten through flexible flashing on horizontal surfaces.

3.3 MIXING

A. Mix materials in approved mechanical mixers of type in which quantity of water can be controlled accurately and uniformly.
1. Avoid excessive mixing or agitation.
2. Discard plaster which has begun to set before it is used; retempering will not be permitted. Do not use caked, or lumped materials.
3. Mix ready-mixed plaster in accordance with manufacturer's printed instructions.

3.4 PLASTER APPLICATION

A. Methods and workmanship for portland cement plastering shall meet requirements ASTM C926 and manufacturer’s recommendations.

B. Plaster Staging Joints
1. Schedule work so that entire area, bounded by natural breaking points, is completed top to bottom within 1 day period for each scratch, brown and finish coat.
2. Do not stop brown coat, except at an “architectural break”.
3. Score finish plaster at junction with metal frames.

C. 3-Coat Application: Apply scratch coat to a nominal thickness of 3/8-inch, brown coat to a nominal thickness of 3/8-inch and a finish coat to a nominal thickness of 1/8-inch.
D. 2-Coat Application at Concrete Masonry Units and Concrete Where Indicated: Apply 3/8-inch scratch coat and 1/8-inch finish coat in compliance with ASTM C926 for plaster bonded to solid base.
   1. Apply bonding agent in accordance with manufacturer’s written installation instructions.

E. Finish Coat: Apply in accordance with manufacturer’s written instructions.

F. Plaster Curing: Moist cure plaster base and finish coats. Minimum curing for first 2 coats is 7 days each coat and final coat is 7 days. Keep plaster continuously moist during curing period. Take special precautions on days of extreme weather to prevent too rapid drying and cracking of plaster.

3.5 TOLERANCES

A. Maximum Variation from True Flatness: 1/8-inch in 10 feet, with maximum inward and outward allowance not occurring in less than 20 feet.

3.6 ADJUSTING

A. Upon completion, point-up plaster around trim and other locations where plaster meets dissimilar materials.

B. Cut out and patch defective or damaged plaster, stained or discolored finished plaster, and conditions in violation of these Specifications by removing and replacing with acceptable work.

END OF SECTION
SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Gypsum board screw attached to metal and wood framing and furring members, joint treatment, and accessories.
   2. Installation of sound deadening insulation in walls and ceilings and including acoustical sealant, tape, and the like for work of this Section.

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

C. Related Sections
   2. Section 05 45 00 - Metal Support Assemblies: Provision of resilient sound isolation clip.
   4. Section 07 92 00 - Joint Sealants: Provision of caulking and sealants and backer rod.
   5. Section 09 90 00 - Painting and Coating: For finish painting.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials
   4. C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

B. CBC - California Building Code, 2016 Edition

C. CFR - Code of Federal Regulations
D. EPA - Environmental Protection Agency
   1. Method 24 - Determination of Volatile Matter Content, Water Content, Density, 
      Volume Solids, and Weight Solids of Surface Coatings.

E. GA - Gypsum Association
   1. 201 - Using Gypsum Board for Walls and Ceilings.
   2. 214 - Recommended Levels of Gypsum Board Finish.
   4. 253 - Application of Gypsum Sheathing.

F. UL - Underwriters Laboratories Inc.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data. Include the following:
   1. Fire Resistance Data: Include required fire test results for gypsum board systems on 
      partitions and ceilings.
   2. Sound Transmission Data: Include certified evidence that installed gypsum board 
      systems and materials meet required STC levels.

1.4 QUALITY ASSURANCE

A. Fire Test Response Characteristics: Where fire resistance rated gypsum board assemblies 
   are indicated, provide gypsum board assemblies that comply with the following 
   requirements:
   1. Fire Resistance Ratings: As indicated by GA File Numbers in GA 600 or design 
      designations in UL FRD or in the listing of another testing and inspecting agency 
      acceptable to authorities having jurisdiction.
   2. Gypsum board assemblies indicated are identical to assemblies tested for fire 
      resistance according to ASTM E119 by an independent testing and inspecting agency 
      acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site: Deliver materials in original packages, containers or bundles bearing 
   brand name and identification of manufacturer or supplier. Verify board and accessories as 
   undamaged.

B. Storage and Protection
   1. Store materials inside under cover and keep dry and protected against damage from 
      weather, direct sunlight, surface contamination, corrosion, construction traffic and 
      other causes. Neatly stack gypsum boards flat to prevent sagging.
   2. Handle gypsum boards to prevent damage to edges, ends and surfaces.

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Establish and maintain environmental conditions for application 
   and finish gypsum board to comply with ASTM C840 and with gypsum board
manufacturer's recommendations. Maintain not less than 40 degrees Fahrenheit minimum room temperature.

1. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during day, hot weather to prevent materials from drying too rapidly.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: United States Gypsum Co.; Georgia Pacific; Gold Bond Building Products Div., National Gypsum Co.; Pacific Coast Building Products, Pabco Gypsum Division, or equal.

2.2 MATERIALS

A. Gypsum Board Types
   1. Type 1: Fire rated board for fire resistance rated assemblies, ASTM C1396, Type X, tapered edges, 48 inches wide, 5/8-inch thick.
   2. Type 2: Fire rated water resistant board, Type X, tapered edges, 48 inches wide, 5/8-inch thick.

B. Sheathing: Silicone treated gypsum core, surfaced with inorganic glass mats and gold color alkali resistant surface coating, 5/8-inch thick, as manufactured by Georgia Pacific, "DensGlass Fireguard Sheathing"; United States Gypsum Co., "SECUROCK Glass Mat Sheathing; Pacific Coast Building Products, Pabco Gypsum Division, or equal.

C. Screws: ASTM C1002, machine thread for gypsum board to metal attachments.

D. Nails: ASTM C514, wood thread for metal or gypsum board attachment to wood.

E. Insulation: As specified in Section 07 21 01.

F. Adhesives: 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).


H. Joint Treatment Materials: Products of one manufacturer conforming to ASTM C475, ASTM C840, and recommendations of manufacturer of both gypsum board and joint treatment materials for application indicated. Conform to GA 201 and GA 216 for reinforcing tape, joint compound, and water.
   1. Joint Tape
      a. Cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape as recommended by setting type joint compound manufacturer.
      b. For silicone treated gypsum backer board, use 2 inch wide, 10-inch by 10-inch woven glass mesh tape.
2. Setting Type Joint Compound: Factory prepackaged, job mixed, chemical hardening powder products formulated for uses indicated or factory premixed product. Use hot type at exterior gypsum soffits.

I. Acoustical Sealant: As specified in Section 07 92 00.

J. Backer Rod: As specified in Section 07 92 00.

K. Resilient Sound Isolation Clip: As specified in Section 05 45 00.

2.3 FINISHES

A. Levels of Gypsum Board Finish as Defined by GA 214. Levels of finish as indicated on the Drawings or as selected by the Architect.
   1. Level 0: No taping, finishing, or accessories required.
   2. Level 1: All joints and interior angles shall have tape set in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.
   3. Level 2: All joints and interior angles shall have tape embedded in joint compound and wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Fastener heads and accessories shall be covered with a coat of joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable. Joint compound applied over the body of the tape at the time of tape embedment shall be considered a separate coat of joint compound and shall satisfy the conditions of this level.
   4. Level 3: All joints and interior angles shall have tape embedded in joint compound and one additional coat of joint compound applied over all joints and interior angles. Fastener heads and accessories shall be covered with two separate coats of joint compound. All joint compound shall be smooth and free of tool marks and ridges.
      Note: It is recommended that the prepared surface be coated with a drywall primer prior to the application of final finishes.
   5. Level 4: All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. All joint compound shall be smooth and free of tool marks and ridges.
      Note: It is recommended that the prepared surface be coated with a drywall primer prior to the application of final finishes.
   6. Level 5: All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. A thin skim coat of joint compound trowel applied, or a material manufactured especially for this purpose and applied in accordance with manufacturer’s recommendations, shall be applied to the entire surface. The surface shall be smooth and free of tool marks and ridges.
      Note: It is recommended that the prepared surface be coated with a drywall primer prior to the application of finish paint.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Gypsum Board
   1. Install and finish gypsum board to comply with ASTM C840 or GA 216.
      a. Single Layer: Install in accordance with ASTM C840, except as amended or
         required by specific fire resistive or sound isolation system detailed. In that
         instance, application shall conform to requirements of the manufacturer’s tests
         as reviewed and accepted in the submittal.
      b. Double Layer: Conform to applicable portions of ASTM C840, System
         Classification VIII for installations applied with screws. Conform to required
         fire resistance standards.
   2. Apply in horizontal direction with ends and edges falling on supports. Gypsum board
      shall be of maximum length possible to reach full wall or ceiling lengths with minimal
      number of joints.
   3. Position boards so that like edges abut, tapered edges against tapered edges and field
      cut ends against field cut ends. Do not place tapered edges against cut edges or ends.
      Stagger vertical joints over different studs on opposite sides of partitions.
   4. Start installation of panels at exterior wall to position butt joints as far away from
      exterior wall as possible.

B. Fire Resistant Assemblies: Wherever fire rated gypsum board construction is indicated,
   provide materials and installation methods, including types and spacing of fasteners, in
   accordance with CBC, GA Manual, or listed assembly indicated. Apply firestopping at top of
   wall and at penetrations through fire resistant assembly.

C. Gypsum Sheathing
   1. Comply with GA 253 and manufacturer’s written instructions.
   2. Cut boards at penetrations, edges, and other obstructions of work; fit tightly against
      abutting construction, unless otherwise indicated.
   3. Install boards with a 3/8-inch setback where non-load-bearing construction abuts
      structural elements.
   4. Coordinate 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 exterior wall assembly.
   5. Apply fasteners so screw heads bear tightly against face of sheathing boards but do
      not cut into facing.
   6. Do not bridge building expansion joints with sheathing; cut and space edges to match
      spacing of structural support elements.
   7. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge
      up. Interlock tongue with groove to bring long edges in contact with edges of adjacent
      boards without forcing. Abut ends of boards over centers of stud flanges, and stagger
      end joints of adjacent boards not less than one stud spacing. Screw-attach boards at
      perimeter and within field of board to each steel stud.
      a. Space fasteners approximately 8 inches on center and set back a minimum of
         3/8-inch from edges and ends of boards.
      Abut ends and edges of each board with those of adjacent boards. Screw-attach
      boards at perimeter and within field of board to each steel stud.
a. Space fasteners approximately 8 inches on center and set back a minimum of 3/8-inch from edges and ends of boards.

D. Penetrations Through Sound-Rated Construction: Existing sound-rated construction is present, and modifications shall be made in a manner that preserves sound rating. Cut-outs shall be regular and not fracture core or tear covering of gypsum board and meet the following requirements:
1. Minimize penetrations of insulated wall and ceiling constructions. Penetrate only where necessary and fully seal airtight at the perimeter using acoustical sealant.
2. Where ducts and piping greater than 3 inches diameter penetrate insulated wall or ceiling construction, provide a clearance of 1 inch plus or minus 1/4-inch at the perimeter of the penetration.
3. Where conduit piping 3 inches diameter and less (including mechanical, hydraulic, plumbing, etc.) pass through insulated wall or ceiling construction, provide a clearance of 1/4-inch plus or minus 1/8-inch between the conduit or piping and the structure, unless otherwise indicated.
4. After the ductwork, conduit, or piping has been installed, repair the gypsum board perimeter clearance to the specified tolerance as required. Where the clearance exceeds 3/4-inch, provide a sheet metal sleeve within the partition packed with saffing insulation batts and caulk both sides airtight with an acoustical sealant. Where the perimeter clearance exceeds 3/8-inch, use a flexible backing rod to caulk against.
5. Where penetration clearances are 3/8-inch or less, caulk airtight with acoustical sealant at gypsum board.
6. All gypsum board penetrations (including those resulting from wiring, cables, and electrical junction boxes) are to be sealed airtight with acoustical sealant.
7. The back and sides of junction boxes in sound rated construction shall be sealed airtight with sheet caulking. Caukl perimeter face at gypsum board with acoustical sealant.
8. Recessed panel boards, equipment, boxes, etc., with penetration area greater than 25 square inches at sound rated partitions shall be fully enclosed and sealed with 5/8-inch thick gypsum board.
9. Seal multiple conduit penetrations airtight with expanding fire foam sealant.
10. Seal other sound rated conditions with spray-applied (40 pcf) cementitious sealant, as manufactured by Grace Construction Products, “Monokote Z-146”; Rust-Oleum; Uline, or equal.

E. Wet Locations at Restrooms
1. At Walls and Ceilings: Conform to ASTM C840, System Classification X.
2. Treat cut edges and holes in water resistant gypsum board with sealant.

F. Fastenings: Attach gypsum board to framing with screws, lengths and sizes as recommended by manufacturer and in accordance with CBC.

G. Accessories
1. Install square corner beads at vertical and horizontal external corners with fasteners.
2. Install casing beads whenever edge of gypsum board would otherwise be exposed or semi-exposed, or where abutting dissimilar materials.
3. Install expansion joints where indicated on the Drawings.
4. After accessories are installed, correct surface damage and defects.
5. Install trims and expansion joints where required.
H. Resilient Sound Isolation Clip: As specified in Section 05 45 00.

I. Allowable Tolerances
   1. Offset Between Planes of Board Faces: 1/16-inch.
   2. Plane, Level, Warp and Bow: 1/8-inch in 8 feet.
   3. Shim panels as necessary to comply with tolerances.

3.2 FINISHING OF GYPSUM BOARD

A. Apply joint treatment at gypsum board joints; flanges of corner bead, edge trim and penetrations, fastener heads and surface defects in accordance with ASTM C840 or GA 216. Number of coats of treatment shall be as specified above.

B. Finish Painting: As specified in Section 09 90 00.

END OF SECTION
SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Suspended acoustical ceiling systems, ACT-1, ACT-2, and ACT-3.
   2. Acoustic ceiling panels where required to match existing.

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

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials
   2. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. CBC - California Building Code, 2016 Edition

C. UL - Underwriters Laboratories Inc.

1.3 SYSTEM DESCRIPTION

A. Design Requirements
   1. Design and detail ceilings to comply with requirements for seismic bracing and ceiling suspension according to CBC and ASTM E580.
   2. Architectural reflected ceiling plan drawings shall govern over Mechanical and Electrical Drawings.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data completely describing products.

B. Shop Drawings: Show complete ceiling layouts, seismic bracing methods and details of installation, and information required for related work.

C. Samples: Provide 1 panel of each type of acoustical ceiling specified.
D. Quality Control Submittals
   1. Manufacturer’s Instructions: Submit manufacturer’s installation instructions.
   2. Certification: Provide manufacturer’s signed statement that gypsum board materials
      are asbestos free.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who is approved by the acoustical
   ceiling manufacturer for installing the type of acoustical ceiling indicated for this Project.

B. Regulatory Requirements: Install fire rated ceiling systems in accordance with CBC and UL
   FRD listing and requirements of agency having jurisdiction.

1.6 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping: Deliver and store packaged products in original containers with seals
   unbroken and labels intact until time of use.

B. Storage and Protection
   1. Keep materials dry by storing off ground; under watertight covers.
   2. Immediately before installation, panels shall be stored for sufficient time to stabilize
      temperature and humidity conditions ambient during installation and anticipated for
      occupancy.

1.7 PROJECT CONDITIONS

A. Environmental Requirements: Do not begin work until residual moisture has dissipated and
   comply with the following:
   1. Acoustical Ceilings: Maintain uniform temperature of minimum 60 degrees
      Fahrenheit and maximum of 90 degrees Fahrenheit and humidity of 20 to 40 percent
      but no more than 90 percent prior to, during and after installation.

1.8 SEQUENCING AND SCHEDULING

A. Schedule installation of acoustic units after interior wet work is dry.

B. Coordinate installation of ceilings with mechanical and electrical work.

1.9 MAINTENANCE

A. Extra Materials: Provide 5 percent extra quantity of each type of acoustical surface
   installed. Provide in original unbroken containers plainly marked with type and quantity of
   contents.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Suspended Acoustical Ceiling, ACT-1
   1. Panels: Moisture resistant wet formed mineral fiber with factory applied vinyl latex
       paint, mildew resistant, recycled content, and with the following properties:
       a. Size: 24 inches by 48 inches.
       b. Light Reflectance: Minimum LR 0.90 in accordance with ASTM E1264.
       c. NRC Range: 0.70.
       d. Edge: Beveled tegular.
       e. Surface Burning Characteristics: Class A in accordance with ASTM E84, with
          flame spread 25 or under.
       g. Product: To match existing Campus Standard; as manufactured by Armstrong

2. Mechanical Suspension System: Heavy-duty, non-fire rated, exposed grid system for
   square edge ceiling panels, double-web tees, steel body with exposed surfaces factory
   painted with baked polyester paint.
   a. Provide panel centering devices built into each grid member.
   b. Pull out tension values greater than 300 pounds.
   d. Product: To match existing Campus Standard; as manufactured by Armstrong
      World Industries, Inc., “Prelude 15/16-Inch” or “Suprafine XL 9/16-Inch”.

B. Suspended Acoustical Ceiling, ACT-2
   1. Panels: Moisture resistant wet formed mineral fiber with factory applied vinyl latex
       paint, washable, scrubbable, anti-microbial, and with the following properties:
       a. Size: 24 inches by 48 inches.
       b. Light Reflectance: Minimum LR 0.86 in accordance with ASTM E1264.
       c. NRC Range: 0.70.
       d. Edge: Square lay in.
       e. Surface Burning Characteristics: Class A in accordance with ASTM E84, with
          flame spread 25 or under.
       g. Product: As manufactured by Armstrong World Industries, “Ultima Health
          Zone”, or equal.

2. Mechanical Suspension System: Heavy-duty, non-fire rated, exposed grid system for
   routed edge ceiling panels, double-web tees, steel body with exposed surfaces factory
   painted with baked polyester paint.
   a. Provide panel centering devices built into each grid member.
   b. Pull out tension values greater than 300 pounds.
   d. Product: As manufactured by Armstrong World Industries, “Prelude 15/16-Inch
      with Hemmed Edge Molding”, or equal.

C. Suspended Acoustical Ceiling, ACT-3
   1. Panels: Fiberglass with plant-based binder and acoustically transparent membrane,
      with factory applied vinyl latex paint, mildew resistant, and with the following
      properties:
b. Light Reflectance: Minimum LR 0.90 in accordance with ASTM E1264.
c. NRC Range: 0.95.
d. Edge: Square tegular.
e. Surface Burning Characteristics: Class A in accordance with ASTM E84, with flame spread 25 or under.
2. Mechanical Suspension System: Install with existing acoustical grid system.

D. Replacement Acoustic Panels Where Indicated: Match existing adjacent panels.

E. Fasteners and Attachments
1. Wire for Hangers and Ties: ASTM A641, Class 1 zinc coating, soft temper, with gauge in accordance with CBC.
2. Angle-Type Hangers: Angles with legs not less than 7/8-inch wide, formed from 0.0635-inch thick galvanized steel sheet complying with ASTM A653, G90 Coating Designation, with bolted connections and 5/16-inch diameter bolts.
3. Ceiling Clips: Minimum 13 gauge by 3/4-inch wide, as recommended by acoustical ceiling manufacturer.
4. Light Fixture Protection and Hold Down Clips: Provide light fixture protection panels, fasteners and hold down clips as required by UL FRD listing, manufacturer’s standard types.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive acoustical treatment and verify that:
   1. Installation of building components located in ceiling plenum is complete.
   2. Spacing, direction and details of grid members and supports to accommodate installation of light fixtures, diffusers and other ceiling located items are correct.
   3. Areas are clean and free of materials or rubble that could damage acoustical surfaces.

B. Do not start work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Suspended Ceiling System
   1. Install acoustical material and suspension system, including necessary hangers and other supporting hardware in accordance with manufacturer’s instructions and ASTM C636.
   2. Lay work out symmetrically about centers of rooms and provide symmetrical borders not less than half size of tile specified unless noted otherwise on the Drawings.
   3. Make penetrations through ceiling panels in such a manner to ensure tight fit and neat appearance. Center penetrations in tile unless otherwise noted.
   4. Where existing systems are to be repaired, make replacement components longest lengths possible. Mechanically attach new components to existing equivalent to splice requirements for new suspension system. Install flush, flat, and aligned with existing suspension members.
B. Suspension System
1. Install in accordance with CBC.
2. For Hanger and Lateral Bracing Wires: Install expansion bolts or ceiling clips as required.
3. Hanger Wires
   a. Insert hanger wires around expansion bolts or through ceiling clips in accordance with Code and secure as specified for hanger wires following in this Article. Load test hanger wires as specified in Article titled “Field Quality Control” in this Section.
   b. Plumb hanger wires. Add counterbrace wires when hanger wires are more than 1 in 6 out of plumb.
4. Provide additional metal framing and hanger wires to clear furred-area interferences with suspension system. Do not penetrate ductwork with hanger wires.
5. Ceiling wires and unbraced ducts, pipes and similar type items shall be separated by at least 6 inches.
6. Provide hanger wires at intersection of grid members.
7. Provide hanger wire supports for all recessed light fixtures and mechanical items as required for total support independent of acoustical ceiling systems.
8. Use of scrap or short-cut members is not permitted.
9. Connect grid members with positive interlocking method as standard with reviewed manufacturer.
10. Secure ends of suspension system members at 2 adjacent walls as indicated and leave floating at other 2 adjacent walls.
11. Interconnect carriers over 12 inches not interconnected to walls near free end with 16 gauge tie wire or a metal strut securely attached to prevent spreading.
12. Level grid assembly in each area after installation of mechanical and electrical equipment within 1/8 inch in 12 inches or conforming to slope as appropriate to area of installation.

C. Repair of Existing Acoustical Ceilings: Where existing suspension systems are indicated to remain, replace acoustic panels that are damaged or stained to match existing adjacent panels.

3.3 FIELD QUALITY CONTROL

A. Acoustical Ceiling Connection Devices: Test devices for capability to support the following loads:
   1. Hanger Wires: 100 pounds in accordance with requirements of CBC.
   2. Lateral Force Bracing Wires: 200 pounds or actual design load whichever is greater, with safety factor of 2, in accordance with CBC.

3.4 CLEANING AND ADJUSTING

A. Remove damaged or soiled material and replace with new prior to the District’s acceptance of Project.
3.5 PROTECTION

A. Protect acoustical treatment installation from damage during remainder of construction.

END OF SECTION
SECTION 09 65 00
RESILIENT FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Linoleum, RS-1.
   3. Prefabricated resilient cove base.
   4. Rubber wall base, WB-1.

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

C. Related Section
   1. Section 09 97 25 - Vapor Emission Treatment Systems: Provision of vapor emission treatment system, as required.

1.2 REFERENCES

A. ADA - Americans with Disabilities Act

B. ASTM - American Society for Testing and Materials
   3. F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

C. CALGreen - California Green Building Standards, 2016 Edition

D. CFR - Code of Federal Regulations

E. EPA - Environmental Protection Agency

1.3 SYSTEM DESCRIPTION

A. Adhesives used on the Project shall comply with CALGreen Code Nonresidential Mandatory Measures, Chapter 5, Division 5.5, Section 5.504, Article 5.504.4.1.
1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s product data for each type of product specified.

B. Samples: Submit samples for initial selection purposes in form of manufacturer’s color charts consisting of actual sections of sheet flooring and bases showing full range of colors and patterns available for each different product indicated.

1.5 MAINTENANCE

A. Extra Materials: Furnish 10 linear feet in roll form of each different composition, wearing surface, color, and pattern of sheet floor covering and resilient wall base installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers
   2. Medical Grade Sheet Vinyl: Armstrong World Industries, “Meditone” or Medintech”, or equal.
   4. Rubber Wall Base: Burke, or equal.

2.2 MATERIALS

A. Linoleum, RS-1: Consisting of linseed oil, wood flour and rosin binders, mixed and calendared onto polyglass backing, with the following properties:
   2. Static Load Limit: Exceeds 700 psi in accordance with ASTM F970.
   3. Slip Resistance: Meets or exceeds ADA recommendations of 0.6 coefficient of friction for flat surfaces.
   4. Fire Resistance
      a. Smoke Density: 450 or less in accordance with ASTM E662.
      b. Critical Radiant Flux: Class 1 in accordance with ASTM E648.
   5. Color: As selected by the Architect from manufacturer’s full range of colors.

B. Medical Grade Sheet Vinyl, RS-2: Single layered, homogeneous sheet vinyl flooring with colors and pattern detail dispersed uniformly throughout the thickness of the product. Color pigments are insoluble in water and resistant to cleaning agents and light.
   1. Slip Resistance: Meets or exceeds ADA recommendations of 0.6 coefficient of friction for flat surfaces.
   2. Color: As selected by the Architect from manufacturer’s full range of colors.
C. Prefabricated Resilient Cove Base: Fabricated from same material and dye lots as resilient sheet flooring where indicated, in maximum practical lengths, with 1-1/2 inches by 1-1/2 inches formed aluminum reinforcing bonded to back of base material.
   1. Dimensions
      a. Riser: 4 inches, unless otherwise indicated.
      b. Toe: 3 inches, unless otherwise indicated.
   2. Metal Base Cap: For adhesive installation; stainless steel cap; as manufactured by FlashCove Prefabricated Bases, Inc., "chiklet", or equal.

D. Rubber Wall Base, WB-1: Products complying with ASTM F1861.
   1. Style: Cove with top-set toe.
   3. Height: 4 inches.
   4. Lengths: Coils in lengths standard with manufacturer but not less than 100 feet.
   5. Interior and Exterior Corners and Ends: Formed in the field.
   6. Color: As selected by the Architect from manufacturer's full range of colors.

2.3 INSTALLATION ACCESSORIES

A. Concrete Slab Primer: Nonstaining type as recommended by flooring manufacturer.

B. Trowelable Underlayments and Patching Compounds: Latex modified, portland cement based formulation provided or approved by resilient flooring manufacturer for applications indicated.

C. Adhesives: Waterproof, nonflammable, type as recommended by resilient flooring manufacturer.
   1. General: Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
      a. Sheet Flooring Adhesives: Not more than 50 g/L.
      b. Cove Base Adhesives: 50 g/L.
      c. Rubber Floor Adhesives: 60 g/L.
   2. Adhesives shall be compatible with vapor emission treatment systems specified in Section 09 97 25.
      a. Provide adhesive as recommended by resilient flooring manufacturer for tested moisture vapor emission rate of concrete, not to exceed 8 lb/24 hr/1000 sq. ft.
   3. Prefabricated Flash Cove Base Adhesive: Low-VOC premium cove base adhesive as recommended by both flooring and prefabricated flash cove base manufacturer.

D. Rod for Heat-Welding Seams
   1. At Linoleum: Provide product of linoleum manufacturer in color to match field color of linoleum.
   2. At Sheet Vinyl: Provide solid color or patterned vinyl weld rod compatible with vinyl flooring and intended for heat welding of seams; color as selected by the Architect from manufacturer's standard colors.

E. Transition Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of sheet floor coverings and in maximum available lengths to minimize running joints.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting resilient flooring performance. Verify that substrates and conditions are satisfactory for resilient flooring installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 and the following:
   1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the resilient flooring manufacturer.
   2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
   3. Concrete shall be allowed to cure for 90 to 120 days and must be properly sealed. Test concrete for vapor emission by the Calcium Chloride Moisture test method in compliance with ASTM F1869. Emission rate shall not exceed 3.5 lb/24 hr/1000 sq. ft. Treat with vapor emission treatment systems specified in Section 09 97 25, as required.

3.2 PREPARATION

A. General: Comply with manufacturer’s installation specifications to prepare substrates indicated to receive resilient flooring accessories.

B. Use patching compounds per manufacturer’s directions.

C. Grind high spots (over 1/8-inch) and clean concrete floors to remove stains, markings, dust, and debris.

D. Wash and rinse surfaces prior to installation of resilient flooring in accordance with flooring manufacturer’s recommendations. Protect other Work from staining or damage due to cleaning operations.

3.3 INSTALLATION

A. General: Comply with manufacturers’ installation directions and other requirements indicated that are applicable to each type of installation included in Project.

B. Sheet Flooring Installation
   1. Lay out sheet floor coverings to comply with the following requirements:
      a. Maintain uniformity of sheet floor covering direction.
      b. Arrange for a minimum number of seams and place them in inconspicuous and low traffic areas, but in no case less than 6 inches away from parallel joints in flooring substrates.
      c. Match edges of resilient floor coverings for color shading and pattern at seams.
      d. Avoid cross seams.
   2. Where demountable partitions and other items are indicated for installing on top of finished floor covering, install floor covering before these items are installed.
3. Scribe, cut, and fit sheet floor coverings to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture, including cabinets, pipes, outlets, edgings, thresholds and nosings.
4. Extend sheet floor coverings into toe spaces, door reveals, closets, and similar openings.
5. Maintain reference markers, holes or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.
6. Adhere sheet floor coverings to flooring substrates by method approved by floor covering manufacturer.
   a. Produce completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections.
   b. Comply with floor covering manufacturer's directions including those for trowel notching, adhesive mixing, and adhesive open and working times.
7. Heat-weld seams in sheet floor coverings where this seaming method is indicated. Prepare, weld and finish seams to produce a surface flush with adjoining sheets.
8. Hand roll sheet floor coverings in both directions from center out to embed floor coverings in adhesive and eliminate trapped air. At walls, door casings and other locations where access by roller is impractical, press floor coverings firmly in place with flat-bladed instrument.
9. Flooring edges which abut walls, door casings, and pipes shall be sealed with acrylic latex silicon caulk.
10. Upon completion of installation of linoleum, apply minimum of 3 coats of floor finish. Implement maintenance procedures in accordance with manufacturer’s warranty requirements.

C. Prefabricated Resilient Cove Base Installation
1. Provide prefabricated flash cove base for integral base at resilient sheet flooring where indicated.
2. Dry-fit prefabricated flash cove base; cut and fit material to required lengths. Miter-cut inside and outside corners.
3. Dry-fit and cut metal cove cap prior to prefabricated flash cove base installation.
4. Scribe glue line on walls and floor at edge of prefabricated flash cove base material.
5. Apply adhesive in full spread (100 percent coverage on 2 surfaces) for full length of prefabricated flash cove base material. Apply prefabricated flash cove base to wall surface straight and level.
6. Slide metal base cap behind prefabricated flash cove base material.
7. Hand roll prefabricated flash cove base material onto wall and floor surface removing bumps, ripples and fishmouths. Remove excess adhesive.
8. Heat-weld seams (vertical and horizontal) in prefabricated flash cove base material.

D. Resilient Wall Base Installation
1. Apply resilient wall base to walls, casework and other permanent fixtures in rooms and areas where base is required. Install wall base in lengths as long as practicable. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
2. Place resilient accessories so they are butted to adjacent materials of type indicated and bond to substrates with adhesive. Install reducer strips at edges of flooring that otherwise would be exposed.
E. Transition Strips: Install in accordance with manufacturer’s written instructions.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing installation:
   1. Remove visible adhesive and other surface blemishes using cleaner recommended by manufacturers.
   2. Sweep or vacuum floor thoroughly.
   3. Do not wash floor until after time period recommended by manufacturer.
   4. Damp-mop resilient flooring and accessories to remove black marks and soil.

B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by tile manufacturer.

C. Protect prefabricated flash cove base from scratches, gouges, scuff marks, and other damage from time initial surface protection application until final inspection.

END OF SECTION
SECTION 09 67 23
RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Resinous flooring and integral cove base, RE-1.

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

C. Related Section
   1. Section 09 97 25 - Vapor Emission Treatment Systems: Provision of vapor emission treatment system, as required.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Provide slip retardant, tough-wearing, high impact, chemical- and abrasion-resistant coating with integral coved base over concrete surface.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s data describing products.

B. Samples
   1. Submit line of colors and surface textures for review and selection.
   2. Submit 12-inch by 12-inch panels of color and texture selected.

C. Quality Control Submittals
   1. Certificates: Submit letter from manufacturer certifying acceptability of installer.
   2. Manufacturer’s Instructions: Submit manufacturer’s application instructions.

D. Contract Closeout Submittals: Submit maintenance instructions for care of flooring.
1.5 QUALITY ASSURANCE
A. Installer Qualifications: Endorsement by materials manufacturer and evidence of 3 years minimum experience in satisfactory installation of this type of flooring.

1.6 DELIVERY, STORAGE AND PROTECTION
A. Packing and Shipping: Deliver components to site in factory sealed, marked containers with batch numbers and dates of manufacturer clearly visible.
B. Storage and Protection: Store in area protected from weather and kept at temperatures within range recommended by manufacturer.

1.7 PROJECT CONDITIONS
A. Environmental Requirements
   1. Arrange means of modifying and controlling air temperature and ventilation to provide optimum condition for application of work.
   2. Provide barriers and other controls to restrict work areas during application and curing periods.

1.8 WARRANTY
A. Provide manufacturer's standard warranty covering failures in material and workmanship.
   1. Warranty Period: 1 year from date of Substantial Completion.
B. Warranty shall not deprive the District of other rights the District may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Acceptable Manufacturers: Stonhard; BASF; Silikal America, or equal.

2.2 MATERIALS
A. Flooring with Integral Coved Base, RE-1
   1. Troweled jointless flooring of 2 component epoxy resin formulation incorporating chemical resistant aggregates to a thickness of 1/4-inch.
   2. Physical Characteristics
      a. Compressive Strength: 11,000 psi in accordance with ASTM C579.
      b. Tensile Strength: 1,643 psi in accordance with ASTM C307.
      c. Flexural Strength: 4,300 psi in accordance with ASTM C580.
      d. Abrasion Resistance: 0.0 gr in accordance with ASTM D1044.
      e. Surface Hardness: 8.5.5 Shore “D” in accordance with ASTM D2240.
B. Primer: As recommended by flooring manufacturer.
C. Sealer: Provide with pigmented top coat sealer with slip retardant profile.

D. Color: As selected by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Provide for infill slab cure, minimum 28 days or per manufacturer’s requirements, whichever is longer

B. Verify that concrete is free of surface contaminants and concrete laitance, oils, film forming curing or waxy curing compounds, dirt, grease, chemical contaminants, and unbonded coatings.

C. Verify that substrate concrete moisture is within range acceptable to flooring manufacturer, using a calcium chloride test in accordance with ASTM F1869. Emission rate shall not exceed 3.5 lb/24 hr/1000 sq. ft. Treat with vapor emission treatment systems specified in Section 09 97 25, as required.

D. Contractor shall report, in writing, surfaces left in improper condition by other trades. Do not proceed until unsatisfactory conditions have been corrected. Application will constitute acceptance of surfaces by the applicator.

3.2 PREPARATION

A. Preparation of Substrate
   1. Micro-abrasion method shall be used to remove contaminants, heavy laitance, sharp edges, or protrusions which will interfere with proper bonding of the coating.
   2. Acid etching should be used only when film forming curing compounds and oils are not present.
      a. If film forming curing compounds and oils are present, use combination of detergent scrubbing, abrasive blasting, alone or in combination with acid etching.
      b. Contact manufacturer for recommendations.

B. Thoroughly mix components in accordance with manufacturer’s instructions.

3.3 APPLICATION

A. Apply components of epoxy resin flooring and cove base in accordance with manufacturer’s instructions.

B. Protect adjacent surfaces and related adjacent work from damage.

C. Do not apply coating over standing water or let primer set before applying base coat.

D. Trowel topping maintaining 1/4-inch thickness including cove base.

E. Broadcast anti-skid finish in accordance with manufacturer’s instructions.
3.4 PROTECTION

A. Protect the completed work from water, airborne particles, or other surface contaminants until cured and tack free, approximately 18-24 hours after application.

B. Protect completed system from traffic and physical abuse per manufacturer’s requirements, approximately 72 hours. Protect completed system from immersion and chemical exposure until thoroughly cured, approximately 7 days at 70 degrees Fahrenheit.

END OF SECTION
SECTION 09 68 13
TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Tile carpeting, CT-1.

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

C. Related Sections
   1. Section 03 35 00 - Concrete Finishing: Provision of self-leveling underlayment.
   2. Section 09 97 25 - Vapor Emission Treatment Systems: Provision of vapor emission treatment system, as required.

1.2 REFERENCES

A. AATCC - American Association of Textile Chemists and Colorists
   1. 134 - Electrostatic Propensity of Carpets.

B. ADA - Americans with Disabilities Act

C. ASTM - American Society for Testing and Materials
   4. F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
   5. F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

D. CALGreen - California Green Building Standards, 2016 Edition

E. CRI - Carpet and Rug Institute
   1. 104 - Standard for Installation of Commercial Carpet.
   2. Green Label Plus Testing Program.

F. EPA - Environmental Protection Agency

G. FCIB - Floor Covering Installation Board

H. NFPA - National Fire Protection Association
I. State of California

1.3 SYSTEM DESCRIPTION

A. Performance Requirement: Carpet tile shall meet or exceed the CRI Green Label PLUS Program requirements or have been tested for low emissions according to State of California Specification 01350.

B. Carpet tile used on the Project shall comply with CALGreen Code Nonresidential Mandatory Measures, Chapter 5, Division 5.5, Section 5.504, Article 5.504.4.4.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s product data for each type of carpet material and installation accessory required. Submit written data on physical characteristics, durability, resistance to fading, and flame resistance characteristics.

B. Samples
   1. Submit 3 minimum 12 inch square samples of each carpet type illustrating color, weave, texture and pattern.
   2. Submit manufacturer’s full range of color selections for carpet edge strips.

C. Contract Closeout Submittals: Provide maintenance data including the following:
   1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer’s recommended maintenance schedule.
   2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by FCIB or who can demonstrate compliance with its certification program requirements.

B. Regulatory Requirements
   1. Flammability
      a. Radiant Panel: Meets NFPA Class 1 when tested in accordance with ASTM E648.
      b. NBS Smoke: Less than 450 when tested in accordance with ASTM E662.
   2. Static Control: Less than 3.5 kv, built-in permanent conductive fiber in accordance with AATCC 134.
   3. Carpet pile height shall meet requirements of ADA.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site: Deliver materials to Project site in original factory wrappings and containers, labeled with identification of manufacturer, brand name, and lot number.
B. Storage and Protection: Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soilage, extreme temperatures, and humidity. Lay flat, blocked off ground. Maintain minimum temperature of 68 degrees Fahrenheit at least 3 days prior to and during installation in area where materials are stored.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with CRI 104, Section 6.1. Do not install carpet tile until wet work in spaces 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. Where casework, fixed seating, or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.8 WARRANTY

A. Provide manufacturer’s standard lifetime limited warranty for fiber and backing system.
   1. Warranty shall be submitted to the District against product failure covering both labor and material in the following areas:
      a. Abrasive wear of fiber.
      b. Static protection of fiber.
      c. Tuftbind/zippering of backing.
      d. Edge ravel of backing.
      e. Integrity/delamination of backing.
      f. Integrity/dimensional stability of backing.

1.9 MAINTENANCE

A. Extra Materials
   1. Deliver extra materials to the District. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels describing contents.
   2. Carpet: Before installation begins, furnish quantity for each type of material equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Interface, Inc., or equal.

2.2 MATERIALS

A. Carpet Tile, CT-1
   2. Construction: Tufted textured loop.
   3. Yarn System: 100 percent recycled content Type 6 Nylon.
   5. Tufted Yarn Weight: 18.0 oz./yd².
7. Stitches Per Inch: 8.2.
8. Pile Height: 0.14-inch.
9. Pile Thickness: 0.093-inch.
11. Total Thickness: 0.28-inch.
13. Style: Cubic, Product Number 1380102500.

2.3 ACCESSORIES

A. Self-Leveling Underlayment: As specified in Section 03 35 00.

B. Adhesive: Water-based, clear acrylic co-polymer adhesive; solvent free, low odor, contains no hazardous chemicals; meets CRI Green Label criteria.
   1. Provide adhesive with total VOC limit of 50 g/L when tested according to ASTM D5116.
   2. Adhesives shall be compatible with vapor emission treatment systems specified in Section 09 97 25.
      a. Provide adhesive as recommended by tile carpeting manufacturer for tested moisture vapor emission rate of concrete, not to exceed 3.5 lb/24 hr/1000 sq. ft.

C. Carpet Edge Guards: Resilient molded rubber to match wall base, profile as detailed.

D. Thresholds: As detailed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Verify that substrates and conditions are satisfactory for carpet tile installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 and the following:
   1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the carpet tile manufacturer.
   2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
   3. Concrete shall be allowed to cure for 90 to 120 days and must be properly sealed. Test concrete for vapor emission by the Calcium Chloride Moisture test method in compliance with ASTM F1869. Emission rate shall not exceed 5 lb/24 hr/1000 sq. ft. Treat with vapor emission treatment systems specified in Section 09 97 25, as required.
   4. Before installing carpet tile, verify that concrete floors, regardless of age, comply with the moisture and pH requirements stated by the carpet tile manufacturer, and must otherwise be suitable for carpet tile installation.
a. The moisture conditions of the concrete shall be determined by use of the In Situ probe relative humidity (rH) test method, ASTM F2170, using a moisture testing device manufactured by Wagner or Vasela. The testing device shall be properly maintained and calibrated in accordance with the manufacturer’s specifications and frequency recommendations. Certificates of calibration shall be maintained for test validation.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, “Site Conditions; Floor Preparation”, and carpet tile manufacturer’s written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Clear away debris and scrape up cementitious deposits from concrete surfaces to receive carpet; apply sealer to prevent dusting.

C. Remove coatings, including curing compounds and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone without using solvents. Use mechanical methods recommended in writing by the carpet manufacturer.

D. Use trowelable leveling and patching compounds, according to manufacturer’s written instructions, to fill cracks, holes, and depressions in substrates.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

F. Unwrap carpet in a well ventilated location prior to installation. Air the carpet out in off-site location such as a ventilated warehouse for at least 2 days prior to installation.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 13.

B. Carpet shall be installed after building has been painted and subjected to an airing out of at least a week by forced ventilation, with maximum outside air. Contractor shall ensure construction involving high VOCs and other pollutants will be completed before the airing out.

C. Comply with manufacturer’s recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under door in closed position; do not place seams perpendicular to door frame, in direction of traffic through doorway.

D. Extend carpet under removable flanges and furnishings and into alcoves and closets of each space.

E. Provide cutouts where required, and bind cut edges where not concealed by protective edge guards or overlapping flanges. 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.
F. Install carpet edge guard where edge of carpet is exposed; anchor guards to substrate.

G. Install with pattern to match existing Campus Standard.

H. Observe CRI and EPA carpet air-out guidelines. Continuously operate the building ventilation system at normal temperature and maximum outdoor air during installation and for 72 hours after installation is complete. Avoid recirculating air from the installation area, through the heating, ventilation and air-conditioning system, and into occupied areas. Create a temporary exhaust system using fans, open doorways, stairwells, and windows. Seal return air grilles.

I. Recycle waste carpet. Provide carpet tiles larger than 1/2 tile to the additional material above the 5 percent extra materials specified above.

3.4 CLEANING

A. Remove adhesive from carpet surface with manufacturer’s recommended cleaning agent.

B. Remove and dispose of debris and unusable scraps.

3.5 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure carpet is not damaged or deteriorated at time of Substantial Completion.

END OF SECTION
SECTION 09 90 00

PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Surface preparation, painting and finishing of new and existing exposed exterior and interior items and surfaces.

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

C. Related Sections
   1. Section 05 50 00 - Metal Fabrications: For finish painting of miscellaneous metals.
   2. Section 06 10 00 - Rough Carpentry: For finish painting of rough carpentry.
   3. Section 06 20 00 - Finish Carpentry: For finish painting of finish carpentry.
   4. Section 06 41 10 - Custom Casework: For backpriming of custom casework.
   5. Section 07 62 00 - Sheet Metal Flashing and Trim: For finish painting of sheet metal flashing and trim.
   6. Section 08 11 15 - Steel Doors and Frames: For finish painting to steel doors and frames.
   7. Section 08 14 16 - Flush Wood Doors: For finish painting of flush wood doors.
   8. Section 09 29 00 - Gypsum Board: For finish painting of gypsum board.
   9. Section 12 35 53 - Laboratory Casework: For backpriming and finish painting of wood laboratory casework.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

B. CALGreen - California Green Building Standards, 2016 Edition

C. CARB - California Air Resources Board

D. FM - Factory Mutual

E. UL - Underwriters Laboratories Inc.

1.3 SYSTEM DESCRIPTION

A. Performance Requirements
   1. Paint exposed surfaces whether or not colors are designated in the schedules, except where a surface or material is specifically indicated not to be painted or is to remain natural.
   2. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts and labels.
3. Do not paint over UL, FM, or other code required labels or equipment name, identification, performance rating or nomenclature plates.
4. Comply with CARB requirements for maximum volatile organic compound (VOC) content.

B. Paints and coatings used on the Project shall comply with CALGreen Code Nonresidential Mandatory Measures, Chapter 5, Division 5.5, Section 5.504, Articles 5.504.4.3, 5.504.4.3.1 and 5.504.4.3.2.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s technical product data information, stating the material composition and analysis and the Material Safety Data Sheet (MSDS) on all paint to be used.

B. Samples
1. Following the selection of colors and glosses by the Architect, submit samples for the Architect’s review.
   a. Provide 3 samples of each color and each gloss for each material on which the finish is specified to be applied.
   b. Make samples approximately 8 inches by 10 inches in size.
2. Do not commence finish painting until samples are approved.

1.5 QUALITY ASSURANCE

A. Provide primers and undercoat paint produced by the same manufacturer as finish coats.
   1. Review other Sections of these Specifications as required, verifying the prime coats to be used and assuring compatibility of the total coating system for the various substrates.
   2. Provide barrier coats over non-compatible primers, or remove the primer and re-prime as required.
   3. Notify the Architect in writing of anticipated problems in using the specified coating systems over prime coatings supplied under other Sections.

1.6 MAINTENANCE

A. Upon completion of the work of this Section, deliver to the District an extra stock equaling 1 gallon of each color, type and gloss of paint used in the Work; tightly sealing each container, and clearly labeling with contents and location where used.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers
   1. At Cadaver Lab: Basis of Design is Dunn Edwards; Sherwin Williams, and equal paints are acceptable.
   2. At Other Locations: Basis of Design is Dunn Edwards; Sherwin Williams, and Kelly-Moore Paints are acceptable.
2.2 PAINT MATERIALS

A. Paint Materials, General
1. Material Quality: Provide manufacturer’s best quality trade sale paint material of the various coating types specified.
2. Provide block fillers, primers, finish coat materials and related materials that are compatible with one another and the substrates.

B. Colors
1. Exterior: Match existing.
2. Interior: Match existing.

C. Pigment
1. Pigment: To be no less than 24 percent and titanium dioxide to be no less than 20 percent of pigment by weight.
2. Vehicle: To be no less than 72 percent and vinyl resin to be no less than 26 percent of vehicle by weight.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Mix and prepare paint materials in strict accordance with the manufacturers’ recommendations as approved by the Architect.

B. Surface Preparation
1. General
   a. Perform preparation and cleaning procedures in strict accordance with the paint manufacturers’ recommendations as approved by the Architect.
   b. Remove removable items which are in place and are not scheduled to receive paint finish; or provide surface applied protection prior to surface preparation and painting operations.
   c. Following completion of painting in each space or area, reinstall the removed items by using workmen who are skilled in the necessary trades.
2. Schedule the cleaning and painting so that dust and other contaminants from the cleaning process will not fall onto wet newly painted surfaces.

C. Cementitious Materials: Prepare concrete and concrete masonry unit or board surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
1. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
2. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer’s written instructions.
3. At concrete floors, ensure substrate is fully cured, clean, and etched for best adhesion in accordance with paint manufacturer’s recommendations.
D. Preparation of Wood Surfaces
1. Clean wood surfaces until free from dirt, oil, and other foreign substance.
2. Smooth finished wood surfaces exposed to view, using the proper sandpaper. Where so required, use varying degrees of coarseness in sandpaper to produce a uniformly smooth and unmarred wood surface.
3. Unless specifically approved by the Architect, do not proceed with painting of wood surfaces until the moisture content of the wood is 12 percent or less as measured by a moisture meter approved by the Architect.

E. Preparation of Metal Surfaces
1. Thoroughly clean surfaces until free from dirt, oil and grease.
2. On galvanized surfaces, use solvent for the initial cleaning, and then treat the surface thoroughly with the phosphoric acid etch. Remove etching solution completely before proceeding.
3. Allow to dry thoroughly before application of paint.

3.2 PAINT APPLICATION

A. General
1. Touch-up shop-applied prime coats which have been damaged, and touch-up bare areas prior to start of finish coats application.
2. Slightly vary the color of succeeding coats.
3. Sand and dust between coats to remove defects visible to the unaided eye from a distance of 5 feet.
4. On removable panels and hinged panels, paint the back sides to match the exposed sides.

B. Drying: Allow sufficient drying time between coats, modifying the period as recommended by the material manufacturer to suite adverse weather conditions.

C. Brush Applications
1. Brush out and work the brush coats onto the surface in an even film.
2. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness and other surface imperfections will not be acceptable.

D. Spray Application
1. Confine spray application to metal framework and similar surfaces where hand brush work would be inferior.
2. Where spray application is used, apply each coat to provide the hiding equivalent of brush coats.
3. Do not double back with spray equipment to build up film thickness of 2 coats in 1 pass.

E. Miscellaneous Surfaces and Procedures
1. Exposed Mechanical Items
   a. Finish electric panels, access doors, conduits, pipes, ducts, grilles, registers, vents and items of similar nature to match the adjacent wall and ceiling surfaces, or as directed.
   b. Paint visible duct surfaces behind vents, registers, and grilles flat black.
   c. Wash metal with solvent, prime and apply 2 coats of alkyd enamel.
2. Exposed Pipe and Duct Insulation
   a. Apply 1 coat of latex paint on insulation which has been sized or primed under other Sections; apply 2 coats on such surfaces when unprepared.
   b. Match color of adjacent surfaces.
   c. Remove band before painting, and replace after painting.
3. Hardware
   a. Paint prime coated hardware to match adjacent surfaces;
   b. Paint metal portions of head seals, jamb seals, and astragal seals to match the color of the door frame unless otherwise directed by the Architect.
4. Exposed Vents: Apply 2 coats of heat resistant paint approved by the Architect.

3.3 EXTERIOR PAINT SCHEDULE

A. Cement Plaster
1. 100 Percent Acrylic Elastomeric Coating: 2 finish coats over transparent sealer.
   b. Finish Coat(s): As manufactured by Dunn Edwards, “Elast-O-Kote 5, High Build Elastomeric Waterprooﬁng; Kelly-Moore Paints, “1128 Kel Seal Terpolymer 100% Acrylic Elastomeric Coating”; Sherwin Williams, or equal.

B. Wood Intended for Transparent Finish
1. Waterborne Transparent Finish: 2 finish coats over a cleaner/neutralizer.
   a. Cleaner/Neutralizer: Apply prior to finish sanding.
      1) Product: As manufactured by Behr Products, “BEHR PREMIUM All-In-One Wood Cleaner No. 63”, or equal.
   b. First and Second Coats
      1) Waterproof penetrating sealer applied at thickness recommended by the manufacturer.
2. Product: As manufactured by Behr Products, “BEHR PREMIUM Transparent Weatherproofing All-In-One Wood Finish, No. 500 Natural”, or equal.

C. Galvanized Metal
1. Semi-Gloss Finish: 2 finish coats over primer. Primer is not required on shop-primed items. Reprime all areas where primer has been scratched, scraped, or removed.
   a. Pre-Treatment for New Galvanized Metal: As manufactured by Dunn Edwards, “Supreme Chemical Metal Clean & Etch, ME01”; Kelly-Moore Paints; Sherwin Williams, or equal.
   b. Primer: As manufactured by Dunn Edwards, “GALV-ALUM Premium, GAPR00”; Kelly-Moore Paints; Sherwin Williams, or equal.
   c. Finish Coat(s): As manufactured by Dunn Edwards, “SYN-LUSTRO, W-9” or “SPARTASHIELD, SSHL50”; Kelly-Moore Paints; Sherwin Williams, or equal.

D. Ferrous Metal
1. Semi-Gloss Finish: 2 finish coats over primer. Primer is not required on shop-primed items. Reprime all areas where primer has been scratched, scraped, or removed.
   a. Primer: As manufactured by Dunn Edwards, “BLOC-RUST Premium, BRPR00-1 Series”; Kelly-Moore Paints; Sherwin Williams, or equal.
b. Finish Coat(s): As manufactured by Dunn Edwards, “SYN-LUSTRO, W-9” or “SPARTASHIELD, SSHL50”; Kelly-Moore Paints; Sherwin Williams, or equal.

3.4 INTERIOR PAINT SCHEDULE

A. Gypsum Board, Typical
   1. Eggshell Finish, PT-1: 2 finish coats over a wall sealer.
      a. Wall Sealer: As manufactured by Dunn Edwards, “VINYLASTIC Select, VNSL00”; Kelly-Moore Paints; Sherwin Williams, or equal.
      b. Finish Coat(s): As manufactured by Dunn Edwards, “SPARTAWALL, SWLL30”; Kelly-Moore Paints; Sherwin Williams, or equal.
      a. Undercoater: As manufactured by Dunn Edwards, “INTER-KOTE, W6325”; Kelly-Moore Paints; Sherwin Williams, or equal.
      b. Finish Coat(s): As manufactured by Dunn Edwards, “SUPREMA, SPMA50” or “SPARTASHIELD, SSHL50”; Kelly-Moore Paints; Sherwin Williams, or equal.

B. Gypsum Board, Cadaver Lab
   1. Epoxy Finish, PT-3: Finish coat(s) to cover over a primer where required.
      a. Primer: If required, per manufacturer’s instructions.
      b. Finish Coat(s): 1-component, water based acrylic epoxy, gloss level as selected by the Architect, as manufactured by Dunn Edwards, “ENDURACAT”; Sherwin Williams, “Pro Industrial™ Pre-Catalyzed Waterbased Epoxy”, or equal.

C. Wood Intended for Opaque Finish
      a. Undercoater: As manufactured by Dunn Edwards, “INTER-KOTE, W6325”; Kelly-Moore Paints; Sherwin Williams, or equal.
      b. Finish Coat(s): As manufactured by Dunn Edwards, “SUPREMA, SPMA50” or “SPARTASHIELD, SSHL50”; Kelly-Moore Paints; Sherwin Williams, or equal.

D. Wood Intended for Transparent Finish
   1. Waterborne, Satin-Varnish Finish: 3 finish coats of a waterborne, clear-satin varnish over waterborne, interior wood stain.
      a. Stain Coat: Waterborne, interior wood stain applied at spreading rate recommended by the manufacturer; as manufactured by Kelly-Moore Paints, “2050”; Dunn Edwards; Sherwin Williams, or equal.
      b. First, Second and Third Finish Coats: Waterborne acrylic urethane varnish finish applied at spreading rate recommended by the manufacturer; as manufactured by Kelly-Moore Paints, “2097”; Dunn Edwards; Sherwin Williams, or equal.
E. Galvanized Metal

1. Semi-Gloss Finish: 2 finish coats over primer. Primer is not required on shop-primed items. Reprime all areas where primer has been scratched, scraped, or removed.
   a. Pre-Treatment for New Galvanized Metal: As manufactured by Dunn Edwards, “Supreme Chemical Metal Clean & Etch, ME01”; Kelly-Moore Paints; Sherwin Williams, or equal.
   b. Primer: As manufactured by Dunn Edwards, “ULTRA-GRIP Premium, UGPR00”; Kelly-Moore Paints; Sherwin Williams, or equal.
   c. Finish Coat(s): As manufactured by Dunn Edwards, “SYN-LUSTRO, W-9” or “SPARTASHIELD, SSHL50”; Kelly-Moore Paints; Sherwin Williams, or equal.

2. Epoxy Gloss Finish: 2 finish coats over a primer.
   a. Primer
      1) 2-component, water reducible, epoxy-polyamide primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.
      2) Product: Kelly-Moore Paints, “7126 Envira-Poxy”; Dunn Edwards; Sherwin Williams, or equal.
   b. First and Second Coats
      1) Gloss, 2-component, water reducible epoxy-polyamide, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.
      2) Product: Kelly-Moore Paints, “7100 Envira-Poxy”; Dunn Edwards; Sherwin Williams, or equal.

F. Ferrous Metal

1. Semi-Gloss Finish: 2 finish coats over primer. Primer is not required on shop-primed items. Reprime all areas where primer has been scratched, scraped, or removed.
   a. Primer: As manufactured by Dunn Edwards, “BLOC-RUST Premium, BRPR00-1 Series”; Kelly-Moore Paints; Sherwin Williams, or equal.
   b. Finish Coat(s): As manufactured by Dunn Edwards, “SYN-LUSTRO, W-9” or “SPARTASHIELD, SSHL50”; Kelly-Moore Paints; Sherwin Williams, or equal.

2. Epoxy Gloss Finish: 2 finish coats over a primer.
   a. Primer
      1) 2-component, water reducible, epoxy-polyamide primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.
      2) Product: Kelly-Moore Paints, “7126 Envira-Poxy”; Dunn Edwards; Sherwin Williams, or equal.
   b. First and Second Coats
      1) Gloss, 2-component, water reducible epoxy-polyamide, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.
      2) Product: Kelly-Moore Paints, “7100 Envira-Poxy”; Dunn Edwards; Sherwin Williams, or equal.

END OF SECTION
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SECTION 09 97 25

VAPOR EMISSION TREATMENT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Vapor control barrier applied to new and existing concrete slabs at interior areas scheduled to receive moisture sensitive floor coverings not limited to resilient and carpet, as required.

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

C. Related Sections
   1. Section 03 35 00 - Concrete Finishing: For concrete finishes.
   2. Section 09 65 00 - Resilient Flooring: Provision of resilient flooring.

1.2 REFERENCES


1.3 SUBMITTALS

A. Product Data: Provide the following:
   1. Descriptive Literature: Materials and accessories.
   2. Project References: Similar project completed within 5 years.
   3. Installer: Direct factory/manufacturer employed personnel certificates for each installer.
   4. Field Documents: Manufacturer shall provide written acceptance of on-site conditions, concrete mix design, admixtures, concrete salts, sub-slab vapor retarder, and surface applied contaminates, prior to barrier installations. No exceptions.

B. Quality Assurance Submittals: Provide the following independent test results indicating compliance
   1. ASTM C309 Curing Requirements.
   2. ASTM D1308 Alkali Resistance.
3. ASTM C1315 Curing/Sealing Requirements.
4. ASTM C156 Water Retention Level.
5. ASTM D4541 Floor Adhesion Testing.

1.4 QUALITY ASSURANCE

A. Qualifications
   1. Manufacturer: Manufacturing history of 10 years and product liability insurance in
      the amount of $1,000,000 per occurrence.
   2. Installer: Manufacturer direct installations by factory employed personnel. No
      exceptions.

1.5 WARRANTY

A. Manufacturer’s Warranty: Written warranty, signed by manufacturer, agreeing to replace
   water system that does not comply with requirements or that does not remain watertight
   during specified warranty period.

B. Warranty shall not exclude concrete salts, admixtures, surface contaminants, or resin and
   silicate surface treatments. Installations on slab surfaces deems acceptance of on-site
   conditions. Manufacturer is responsible for complete review of concrete mix designs,
   admixtures, sub-slab vapor retarder installed, and curing methods, for written acceptance
   prior to installation.

C. Prior to installation of its vapor emission treatment system, manufacturer shall confirm the
   system is compatible with and does not negate the floor covering manufacturer’s warranty.

D. Workmanship and Materials Warranty
   1. Manufacturing Defects Warranty Period: 10 years.
   2. Installation Defects Warranty: 10 years.
   3. Warranty Covering Improper Installations: 10 years.
   4. Moisture and Alkalinity Damage to Flooring: 10 years.
   5. Manufacturer’s limited warranty shall cover 100 percent of the cost to repair or
      replace floor coverings damaged by moisture and alkalinity. Coverage shall include:
      a. Installed epoxy based vapor/alkalinity barrier.
      b. Floor covering systems or resinous materials.
      c. Adhesives, patching materials and installation accessories.
      d. All installation labor charges involved.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers
   1. At New Concrete: Floor Seal Technology, Inc., “Vapor Seal 309”; Synthetics
      International, or equal.
   2. At Existing Concrete: Floor Seal Technology, Inc., “MES-100”; Synthetics
      International, or equal.
2.2 MATERIALS

A. At New Concrete: Provide vapor/alkalinity barrier, 36 percent modified resin based penetrating barrier, containing specifically formulated chemicals and resins to saturate slab surfaces for seamless vapor/alkali barrier to protect floor coverings from damage.

B. At Existing Concrete: Provide low emission, resin penetrant applied to slab surfaces with vapor emission and alkalinity levels caused by residual water-of-convenience and interstitial condensation of moisture from building atmosphere.

C. Materials containing water based solutions of sodium, potassium, and lithium silicates do not meet performance levels specified in this Section and are not acceptable for use. Silicate based solutions are chemically reactive and do not meet the intent of ASTM C309. See ASTM documents for verification.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Verify that sub-slab vapor retarder meets ASTM E1745 Class A; the concrete water-to-cement ratio maximum of 0.45; sub-soil over vapor retarder is not rained on or saturated, and concrete is not poured during a day of rain.

B. Manufacturer shall accept conditions in writing prior to installation.

3.2 PREPARATION

A. General: Coordinate work with work specified under other sections to ensure proper and adequate interface of work. Protect all adjacent surfaces from drips, spray, air pollution of surrounding environment, and other damage from work.

B. Concrete Substrates: Apply when concrete is not marred by walking workman. Freshly poured concrete shall be free of surface contaminates, rain, and other sealing/curing materials.

3.3 APPLICATION

A. At New Concrete
   1. General: Apply material while concrete is still wet to produce a uniform, monolithic wearing surface.
   2. Coordinate application of components to provide optimum adhesion to substrate.
   3. Begin application by manufacturer employed personnel or factory installer when on-site conditions are accepted.
   4. Apply system coat(s) in thickness to achieve maximum performance.
   5. Barrier Application: Coverage rate for system shall be based on the surface texture and porosity of the substrates. Maximum cure time of 12 hours. Allow walking traffic in 4 hours.
B. At Existing Concrete
1. Shot blast concrete surface to open pore and grind near edges. Remove bond
breakers; remove curing compounds, and ensure a clean surface profile.
2. All structural cracks, control joints and cold joints shall be cleaned for treatment
application. Broom sweep and vacuum out debris. Any features with large, thorough
passage into soil substrate shall be thoroughly dugout, vacuumed, filled with
appropriate crack filling material.
3. All cleaned structural cracks and control joints shall be treated per system
requirements for a warranted system.
4. Fill all structural cracks, control joints and cold joints, and clean and fill all divots,
voids, chips or other surface feature irregularities with an approved resin/ 100 percent
portland based type compound. Gypsum based filling materials will fail under
moisture conditions and are not allowed under any circumstances.
5. The acceptable concrete surface profile will feature a texture that is similar to a 200
grit sandpaper. Slick surfaces from curing compounds and/or release agents must be
shot blasted completely off.

3.4 FIELD QUALITY CONTROL

A. Validation Testing: Perform post installation testing at 1 calcium chloride test per 1,000
square feet. Interior temperature and humidity to be similar during the District’s occupancy.

B. Reapply materials in areas above flooring manufacturer’s limits, prior to floor covering
installations at no additional charge to the District.

3.5 PROTECTION

A. Protection: Protect installations during specified cure periods from any kind of traffic,
topical water, and contaminants.

END OF SECTION
SECTION 10 11 00

VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Markerboards.
   2. Tackboards with backing and trim.

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

C. Related Sections
   1. Section 05 45 00 - Metal Support Assemblies: Provision of metal support assemblies.
   2. Section 09 29 00 - Gypsum Board: Provision of gypsum board surfaces.

1.2 REFERENCES

A. AAMA - American Architectural Manufacturers Association
   1. 603.8 - Voluntary Performance Requirements and Test procedures for Pigmented Organic Coatings on Extruded Aluminum.

B. APA - American Plywood Association

C. NAAMM - National Association Architectural Metal Manufacturers
   1. MFM - Metal Finishes Manual for Architectural and Metal Products.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer’s product data for markerboards and tackboards.

B. Shop Drawings: Provide shop drawings for each type of markerboard and tackboard required. Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

C. Samples: Provide the following samples of each product for initial selection of colors, patterns, and textures, as required, and for verification of compliance with requirements indicated.
   1. Porcelain Enamel Markerboard: Manufacturer’s color charts consisting of actual sections of porcelain enamel finish showing the full range of colors available for each type of markerboard required.
   2. Tackboard: Manufacturer’s standard color samples.
   3. Aluminum Trim and Accessories: Samples of each finish type and color, on 6 inch long sections of extrusions and not less than 4 inch squares of sheet or plate, showing the full range of colors available.
D. Manufacturer’s Installation Data: 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.

1.4 QUALITY ASSURANCE

A. The Drawings indicate size, profiles, and dimensional requirements of visual display boards and are based on the specific type and model indicated. Other visual display boards having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions and profiles are minor and do not change the design concept or intended performance as judged by the Architect. The burden of proof of equality is on the proposer.

1.5 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.
   1. Allow for trimming and fitting wherever taking field measurements before fabrication might delay the Work.

1.6 WARRANTY

A. Porcelain Enamel Markerboard Warranty: Furnish the manufacturer’s written warranty, agreeing to replace porcelain enamel markerboards that do not retain their original writing and erasing qualities, become slick and shiny, or exhibit crazing, cracking, or flaking, provided the manufacturer’s instructions with regard to handling, installation, protection, and maintenance have been followed.
   1. Warranty Period: 10 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers
   1. Markerboard: Claridge Products and Equipment, Inc., “Polyvision e3 CeramicSteel”, or equal.
   2. Tackboards: Best-Rite; Forbo Industries, Inc., or equal.

2.2 MATERIALS

A. Porcelain Enamel Markerboards: Provide balanced, high pressure laminated porcelain enamel markerboards of 3-ply construction consisting of face sheet, core material, and backing.
   1. Surface: Provide face sheet of low gloss, magnetic, 24 gauge vitracte face over backing. Coat the exposed face and exposed edges with a 3-coat process consisting of primer, ground coat, and color cover. Fuse cover and ground coats to steel at the manufacturer’s standard firing temperatures, but not less than 1,200 degrees Fahrenheit.
      a. Color: As selected by the Architect.
2. Chalktray: Continuous, solid extrusion-type aluminum chalktray, triangular profile, with ribbed section and formed aluminum end caps.
3. Map Rail: Provide 2-inch wide extruded aluminum map rail with cork insert. Aluminum end stops and 4 metal map hooks per linear feet of display board width.
4. Backing: 1/4-inch thick interior type standard underlayment bearing trademark of APA or high quality hardboard as standard with reviewed manufacturer.
6. Adhesive: As recommended by markerboard manufacturer.

B. Tackboard/Bulletin Board
1. Surface: Unicolored linoleum equivalent to Forbo, 1/4-inch bulletin board mounted on hardboard, 1/2-inch thick. Material shall be colored throughout its thickness and provide a self-healing surface.
2. Frame: Clear anodized aluminum, profile as indicated.
3. Size: As indicated.

2.3 ACCESSORIES

A. Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062-inch thick aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units wherever possible; keep joints to a minimum. Miter corners to a neat, hairline closure.

B. Where the size of boards or other conditions exist that require support in addition to the normal trim, provide structural supports or modify the trim as indicated or as selected by the Architect from the manufacturer’s standard structural support accessories to suit the condition indicated.

C. Field-Applied Trim: Provide the manufacturer’s standard slip-on aluminum trim, to eliminate grounds.

2.4 FABRICATION

A. Porcelain Enamel Markerboards: Laminate facing sheet and backing sheet to core material under pressure with manufacturer’s recommended flexible, waterproof adhesive.

B. Tackboards
   1. Linoleum: Manufacturer’s standard.
   2. Fiberboard: Manufacturer’s standard, exterior grade where applicable.
   3. Adhesives: As recommended by reviewed tackboard manufacturer.
C. Assembly: Provide factory-assembled visual display units, except where field-assembled units are required.
   1. Make joints only where total length exceeds maximum manufactured length. Fabricate with the minimum number of joints, balanced around the center of the surface, as acceptable to the Architect.
   2. Provide the manufacturer’s standard vertical joint system between abutting sections of visual display surfaces.

2.5 METAL FINISHES

A. General: Comply with NAAMM’s MFM for recommendations relative to application and designations of finishes.

B. Organic Coating: Thermosetting modified acrylic enamel primer/topcoat system complying with AAMA 603.8 except with minimum dry film thickness of 1.5 mils, medium gloss.

C. Color: As selected by the Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Markerboards and Tackboard
   1. Deliver factory-built visual display surfaces completely assembled in 1 piece without joints, where possible. Where dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to the Architect. When overall dimensions require delivery in separate units, prefnt components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.
   2. Install units in locations and at mounting heights indicated in accordance with the manufacturer’s instructions. Keep perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for a complete installation.
   3. Coordinate job-site assembled units with grounds, trim, and accessories. Join parts with a neat, precision fit.

3.2 ADJUST AND CLEAN

A. Verify that accessories required for each unit have been properly installed and that operating units function properly.

B. Clean units in accordance with the manufacturer’s instructions. Break in visual display surfaces only as recommended by the manufacturer.

END OF SECTION
SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Signage as indicated on the Drawings.

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

1.2 REFERENCES

A. ADA - Americans with Disabilities Act

B. CBC - California Building Code, 2016 Edition

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Design all signs as required by ADA and CBC - Title 24 and in accordance with District’s signage standards using Diablo Valley College Campus Wayfinding Sign System V1.0.
   1. Signage font, size, color and background color as indicated on the Drawings.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with ADA and CBC requirements for signage, to include Braille.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer’s product data describing materials and signs.

B. Shop Drawings
   1. Provide shop drawings showing construction details for approval before proceeding with fabrication. Include full size details of exposed edges, joints between materials, hanging, hinging and locking systems and any other details which would affect sign appearance.
   2. Fasteners: Detail methods of fastenings and provide exact specifications for all fasteners noted on shop drawings.
   3. Artwork: Submit full size patterns or prints of typical copy layouts and/or graphic elements to be applied on signs. Using layouts on the Drawings as a guide, optically enlarge and hand correct images before submitting to the Architect for approval before fabrication.
   4. Sign Location: Provide Graphic Schedule and location plans to identify and locate all signs. Item numbers listed in the Graphic Schedule shall be found on location plans and shall identify locations of specific sign items.
C. Samples
1. On 6-inch by 6-inch pieces of actual sign materials, submit to the Architect for review and approval, 3 samples of painted and graphic finishes, in each material, color and finish, with texture to simulate actual conditions.
2. Provide listing of the material and application for each coat of each finish sample.
3. Be prepared to resubmit each sample as requested until required sheen, color and texture are approved.
4. Acrylic: Submit color and finish samples of plastics for approval before proceeding with fabrication. No substitution in color, thickness, finish or plastics will be accepted without written approval of the Architect.
5. Fasteners: Submit 1 sample of all fasteners and hardware for approval.
6. Paint: Submit 3 color and finish samples of all paints and finishes for approval prior to fabrication.

D. Operation and Maintenance: Provide the District’s Project Manager with proper cleaning instructions required for continued maintenance of signs.

1.6 QUALITY ASSURANCE

A. Pre-Installation Conferences: Sign locations shown on the location plans are for general information only. Prior to installation and as required, arrange meetings with the Architect at the site for final location for all sign items.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: ASI Sign Systems, Inc.; Superior Sign Systems; Vomar Products, Inc., or equal.

2.2 MATERIALS

A. Metal Letterforms at Exterior Building Signage: Minimum 12-inch stainless steel with brushed faces and finished returns.

B. Plastic Signs: 0.125-inch thick, nonglare acrylic photopolymer with 0.125-inch thick acrylic backer and surface paint, raised logo and raised letters, grade II contracted Braille.
   1. Use colored coatings, including inks and paints for copy and background colors, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are non-fading for the application intended.

C. Vinyl Film: Opaque reflective or non-reflective vinyl film as indicated, 0.0355-inch minimum thickness, with pressure sensitive permanent adhesive backing; as manufactured by 3M, “Scotchcal”, or equal.
   1. All colors shall be integral and not surface applied except where custom color(s) are specified in the Drawings. All custom colors shall be flood coated on white vinyl.

D. Mounting Tape: Double-sided vinyl foam tape, as manufactured by 3M, “VHB”; Essentra Specialty Tapes; Uline, or equal. Provide silicone adhesive for attachment to wall surface.
E. Fasteners: Where fasteners are indicated or required, use exposed “torx type” tamper-proof security screws.

2.3 ACRYLIC SIGNS

A. Acrylic Signs: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

B. Unframed Acrylic Signs: Fabricate signs with edges mechanically and smoothly finished to conform with the following requirements:
   1. Edge Condition: Square cut.
   2. Corner Condition: 1/2-inch radius.
   3. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16-inch measured diagonally.

C. Graphic Content and Style: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.

D. Message Inserts: Where sign type makes provision for changeable name slots, provide laser printed name strips with text as scheduled. Obtain message from the District’s Project Manager before fabrication. Where no text is scheduled, insert blank message strip in slot for future text by the District’s Project Manager.

E. Photopolymer (Raised Copy): Machine-cut copy characters from matte finish opaque acrylic sheet and chemically weld onto the acrylic sheet forming sign panel face. Produce precisely formed characters with square cut edges free from burrs and cut marks.
   1. Panel Material: Matte-finished acrylic stock with opaque color coating surface applied; 2 colors, minimum 70 percent contrast between color 1 and color 2.
   2. Raised Copy Thickness: Not less than 1/32-inch.

2.4 FINISHES

A. Colors: For exposed sign material that requires applied colors and other characteristics related to appearance, see Drawings.

2.5 BRAILLE SYMBOLS

A. Braille Symbols: California Contracted Grade 2 Braille shall be used wherever Braille symbols are specifically required in other portions of these standards. Dots shall be 1/10-inch on centers in each cell with 2/10-inch space between cells. Dots shall be raised a minimum of 1/40-inch above the background.
   1. Provide men/women restroom door and wall signs, exit, exit route, and exit stair down signs, and room identification signs in Braille as indicated.
2.6 BUILDING IDENTIFICATION

A. Remove and reinstall existing individual metal letters as indicated.
   1. Record layout and letter spacing and submit full size template for reinstallation including stud locations for each letter.
   2. Carefully remove existing letters to preserve existing mounting pins. If pins are missing or damaged, replace with 1/2-inch long threaded studs drilled and epoxied in place. Clean letters prior to reinstallation.
   3. When reinstalling existing metal letters, template and drill holes in stucco; set studs with translucent silicone adhesive, as manufactured by GE Momentive, “RTV 118”: Dow Corning; MG Chemicals, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the substrate and conditions in which the work is to be installed. Correct all unsatisfactory substrate and conditions prior to start of installation.

3.2 INSTALLATION

A. General
   1. Install signage in neat and proper manner.
   2. Install sign items, including all components, in accordance with reviewed Graphic Schedule at locations shown.
   3. Install signs properly aligned, level and true to line and dimension.

B. Install with reviewed manufacturer’s adhesive or mechanical fasteners after application of finish painting at heights noted.

END OF SECTION
SECTION 10 28 13

TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Toilet accessories, including backing plates for grab bars.
   2. Installation of District furnished, Contractor installed soap dispensers and hard roll towel dispenser.

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

1.2 REFERENCES

A. ADA - Americans with Disabilities Act

B. AISI - American Iron and Steel Institute

C. ASTM - American Society for Testing and Materials
   2. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. CBC - California Building Code, 2016 Edition

1.3 SYSTEM DESCRIPTION

A. Performance Requirements: Comply with Contra Costa College Campus guidelines.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s product data for each toilet accessory item specified, including construction details relative to materials, dimensions, gauges, profiles, mounting method, specified options, and finishes.

B. Shop Drawings: Submit setting drawings where cutouts are required in other work, including templates, substrate preparation instructions, and directions for preparing cutouts and installing anchorage devices.

C. Contract Closeout Submittals: Submit maintenance instructions including replaceable parts and service recommendations.
1.5 QUALITY ASSURANCE

A. Regulatory Requirements
   1. Grab Bars and Fasteners: Strength of grab bars, fasteners and mounting devices shall comply with CBC Section 1115B.8 and ADA requirements.
   2. Grab Bar Surfaces: Conform to CBC Section 1115B.8.4.
   4. Operating Pressure for Soap Dispensers: Comply with ADA.

B. Inserts and Anchorages: Furnish accessory manufacturers’ standard concealed inserts and anchoring devices. Coordinate delivery with other work to avoid delay.

1.6 PROJECT CONDITIONS

A. Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference with and ensure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

1.7 WARRANTY

A. Warranty: Submit a written warranty executed by mirror manufacturer, agreeing to replace any mirrors that develop visible silver spoilage defects within warranty period.

B. Warranty Period: 10 years from date of Substantial Completion.

C. Warranty shall not deprive the District of other rights the District may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Bobrick Washroom Equipment, Inc.; American Specialties, Inc.; Kimberly-Clark Professional, or equal.

2.2 MATERIALS

A. Materials - General: Fabricate toilet accessory items from the following materials and according to requirements specified for individual accessory items.
   1. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22 gauge minimum thickness, unless otherwise indicated.
   2. Sheet Steel: Cold-rolled, commercial quality, 20 gauge minimum thickness, unless otherwise indicated. Surface preparation and metal pretreatment as required for applied finish.
6. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.
7. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing, resupply. Provide a minimum of 6 keys to the District.

2.3 ACCESSORIES

A. Provide the following accessories:
   2. Grab Bars at Ambulatory Stall: Surface-mounted to existing partition, with snap flange, lengths as indicated, 1-1/2 inch diameter, satin finish stainless steel, as manufactured by Bobrick Washroom Equipment, Inc., “B-6806 Series”; American Specialties, Inc.; Kimberly-Clark Professional, or equal.

B. District shall provide the following accessories for installation by the Contractor:
   1. Soap Dispenser: As furnished by the District.
   2. Hard Roll Towel Dispenser: As furnished by the District.

C. Underlavatory Guards
   1. Molded vinyl covering for supply and drain piping with flip tops at valve to allow service access without removing coverings.
   2. Product: As manufactured by Brocar Trap Wrap, “C500R”; Trubro Lav Guard; IPS Corporation, or equal.

D. Mounting Plates: Non-corrosive material. Provide as required.

2.4 FABRICATION

A. General: Only a maximum 1-1/2 inch diameter, unobtrusive stamped manufacturer logo, as approved by the Architect, is permitted on exposed face of toilet or bath accessory units. On either interior surface not exposed to view or back surface, provide additional identification by either a printed, waterproof label or a stamped nameplate, indicating manufacturer’s name and product model number.

B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.

2.5 FINISHES

A. Stainless Steel: 630 Satin Stainless Steel, unless otherwise noted.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install toilet accessory units according to manufacturer’s instructions, using fasteners appropriate to substrate as recommended by unit manufacturer. Install units plumb and level, firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, according to manufacturer’s instructions for type of substrate involved.

C. Install grab bars to withstand a downward load of at least 250 lbf, complying with ASTM F446.

3.2 ADJUSTING AND CLEANING

A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

B. Clean and polish all exposed surfaces strictly according to manufacturer’s recommendations after removing temporary labels and protective coatings.

END OF SECTION
SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Fire extinguishers complete with cabinets.

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

1.2 REFERENCES

A. NAAMM - National Association of Architectural Metal Manufacturers
   1. MFM - Metal Finishes Manual for Architectural and Metal Products.

B. SSPC - The Society for Protective Coatings
   1. SP 1 - Surface Preparation Specification No. 1: Solvent Cleaning.
   2. SP 5 - Surface Preparation Specification No. 5: White Metal Blast Cleaning.
   3. SP 8 - Surface Preparation Specification No. 8: Pickling.

C. UL - Underwriters Laboratories Inc.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s product data for cabinets include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style, door construction, panel style, and materials.

B. Samples: Submit samples for initial selection purposes in the form of manufacturer’s color charts consisting of actual units or sections of units showing full range of colors, textures, and patterns available for each type of cabinet finish indicated or exposed to view.

C. Obtain Project Fire Inspector’s approval of cabinet and extinguisher model prior to purchase.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain extinguishers and cabinets from one source from a single manufacturer.

B. UL Listed Products: Fire extinguishers shall be UL listed with UL listing mark for type, rating, and classification of extinguisher.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Potter Roemer; Larsen’s Manufacturing Co.; J. L. Industries, or equal.

2.2 MATERIALS

A. Fire Extinguishers: Multipurpose under pressure, dry chemical type bearing UL rating of 3-A:40-B:C, 5 pounds nominal capacity, in enameled steel container.

B. Cabinets
   1. Semi-recessed, 1-piece steel construction with 18 gauge steel box, with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.
   2. Provide reviewed manufacturer’s stainless steel door handles.
   3. Door Style: Manufacturer’s door with glass view panel.

C. Identify fire extinguisher in cabinet with FIRE EXTINGUISHER red lettering applied to door. Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location.

2.3 FINISHES FOR CABINETS, GENERAL

A. Comply with NAAMM’s MFM for recommendations relative to applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying temporary strippable protective covering prior to shipping.

2.4 STEEL CABINET FINISHES

A. Surface Preparation: Solvent-clean surfaces complying with SSPC SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC SP 5 or SSPC SP 8.

B. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately following surface preparation and pretreatment.
   1. Shop Primer: Manufacturer’s or fabricator’s standard fast-curing, lead-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 pretreatment, apply manufacturer’s standard 2 coat baked enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer’s instructions for applying and baking to achieve a minimum dry film thickness of 2.0 mils.
1. Color and Gloss: As selected by the Architect from manufacturer’s standard choices for color and gloss. Paint the following:
   a. Exterior of cabinet, except for those surfaces indicated to receive another finish.
   b. Interior of cabinet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for thickness and framing for cabinets to verify cabinet depth and mounting prior to cabinet installation.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Follow manufacturer’s printed instructions for installation.

B. Install in locations and at mounting heights indicated or, if not indicated, at heights to comply with applicable regulations of governing authorities.
   1. Fasten mounting brackets and cabinets to structure, square and plumb.

END OF SECTION
SECTION 10 51 13

METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Metal lockers.

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

C. Related Section
   1. Section 05 45 00 - Metal Support Assemblies: Provision of metal support assemblies.

1.2 REFERENCES

A. ADA - Americans with Disabilities Act

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s printed data including materials, accessories, construction, finishes, assembly and installation instructions for lockers.

B. Shop Drawings: Submit layout and dimensions of metal lockers. Indicate relationship to adjoining surfaces. Show locker elevations and details, fillers, trim, base, sloping tops and accessories. Include locker numbering sequence. Indicate installation and anchorage requirements.

C. Samples: Submit samples showing actual colors prepared on same material to be used for the Work.

D. Contract Closeout Submittals: Submit maintenance instructions for cleaning lockers and for adjusting, repairing and replacing locker doors and latching mechanisms.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Provide manufacturer product and style to match existing lockers.

2.2 MATERIALS

A. Sheet Steel: All parts shall be made from prime grade, mild cold-rolled sheet steel free from surface imperfection, and capable of taking a high grade enamel finish.
B. Hinges: 0.074-inch thick, 2 inches high, double spun, full loop, tight pin, 5-knuckle hinges, projection welded to door frame and securely fastened to the door with 2 steel rivets. Doors shall have 2 hinges.

C. Finishing: Chemically pretreated metal with a multiple stage cleaning and metal preparation process. Finish coat shall be electrostatically applied powder coat enamel properly cured to paint manufacturer specifications to achieve optimum performance. All lockers shall be painted inside and outside with the same color.

D. Equipment: Coat hooks and coat rods are zinc-plated. Truss fin head bolts and hex nuts are zinc-plated.

2.3 LOCKERS

A. Overview of Lockers: Provide the following:
   2. Dimensions: As indicated.
   3. Construction: Knock down.
   4. Tops, Backs, Sides, and Shelves: 24 gauge sheet steel; sloped top hood.
   6. Doors: 14 gauge sheet steel; solid with no louvers.
   7. Legs: As indicated.
   8. Splice/End Base Single Row: 4 inches high by 24 inches deep; catalog number 66705H.
   9. Vertical Filler: 5 inches wide by 72 inches high; catalog number 66115C.
   10. Wall Angle Slip Joint: 72 inches high; catalog number 66119C.
   11. Shelves for the District’s Stock: Provide 3 standard shelves of appropriate dimensions with mounting hardware for ADA retrofitting where required.
   12. Louvers: Standard, depth and width coordinated with existing lockers.
   13. Handle: Recessed, stainless steel, manufacturer’s “Classic III”.
   14. Provide labeling of ADA lockers.
   15. Colors
      a. At Café: As selected by the Architect.
      b. Where Indicated: Match existing.

2.4 FABRICATION

A. Construction: Built on the unit principle; each locker shall have an individual door and frame, individual top, bottom, back, and shelves with common intermediate uprights separating compartments. Lockers shall be fabricated square, rigid, and without warp. Doors shall be flat and free of distortion.

B. Door Frame: All door frame members shall be not less than 16 gauge formed to a channel shape. Vertical members shall have an additional flange to provide a continuous door strike. Intermembering parts shall be mortised and tenoned and electrically welded together in a rigid assembly capable of resisting strains. Cross frame members of 16 gauge channel shapes, including intermediate cross frame on double and triple tier lockers, shall be securely welded to vertical framing members to ensure rigidity.
C. Body: Bolt spacing in locker body construction not to exceed 9 inches on center. All locker body components shall be made of cold-rolled steel specially formed for added strength and rigidity and to ensure tight joints at fastening points. Unless otherwise indicated, tops and bottoms shall be 24 gauge with 3 sides formed 90 degrees and the front offset formed to be flush with the horizontal frame member. Shelves shall be 24 gauge with 4 sides formed to 90 degrees, the front edge shall have a second bend. Backs and sides shall be 24 gauge.

D. Doors: Doors shall be formed from 1-piece 14 gauge cold-rolled sheet steel. Formations shall consist of a full channel shape on the lock side of adequate depth to fully conceal the lock bar, channel formation on the hinge side, and right angle formations across the top and bottom.

E. Door Handle and Latching: Handles shall be recessed in the door and be finger lift control. The 20 gauge drawn pocket shall be brushed stainless steel securely fastened to the door with 2 tabs plus a positive tamper-resistant decorative fastener. The pocket shall be of sufficient depth to prevent a combination padlock, built-in combination lock, or key lock from protruding beyond the face of the door. A lock hole cover plate shall be provided for use with padlocks. The lifting piece shall be 14 gauge formed steel, attached to the latching channel with 1 concealed retaining lug and 1 rivet assuring a positive 2-point connection. Handle finger lift shall have a padlock eye for use with a 9/32-inch diameter padlock shackle. It shall have a sound deadening molded comfortable finger lift. Doors shall have latch clip engaging the door frame at 2 points on 20-inch through 36-inch high doors. Locking device shall be positive, automatic type, whereby locker door may be locked when open, then closed without unlocking; 1 rubber silencer shall be firmly secured in the frame at each heavy gauge latch hook. Latch clips shall be glass filled nylon for long life and low friction and shall hold doors shut by engaging the latch hooks.

F. Ventilation: Shall be facilitated by air flow slots located in the top and bottom flange of the door. The door front shall be flush with no exposed louvers.

G. Number Plates: Each locker shall be supplied with a polished aluminum number plate, 2-1/4 inches wide by 1-inch high, with black numerals not less than 3/8-inch high. Number plates shall be attached to the face of the door with 2 aluminum rivets.

H. Interior Equipment: 4 single prong hooks are supplied; 30-inch and 36-inch high lockers shall have 4 single-prong wall hooks and 1 double-prong ceiling hook. Hooks shall be attached with 2 bolts per hook.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install metal lockers complete with accessories according to manufacturer’s recommendations. Install plumb, level, rigid, and flush.

B. Connect together welded locker groups with standard fasteners according to manufacturer’s recommendations, with no exposed fasteners on face frames.
C. Anchor lockers to support at intervals recommended by manufacturer but no greater than 36 inches. Install anchors through back-up reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.

D. Install recess trim to recessed lockers using concealed fasteners. Provide hairline joints and concealed splice plates.

3.2 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust doors and latches to operate easily without binding. Verify that integral locking devices are operating properly.

B. Clean interior and exposed exterior surfaces.

C. Protect lockers from damage, abuse, dust, dirt, stain or paint. Do not permit locker use during construction.

D. Touch up marred finishes, or replace locker units that cannot be restored to factory finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION
SECTION 10 56 13
METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
1. Remove, salvage, and reinstall existing shelving units.
2. New cantilever fixed shelving system.

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

C. Related Section
1. Section 05 45 00 - Metal Support Assemblies: Provision of metal support assemblies.

1.2 SYSTEM DESCRIPTION

A. Performance Requirement: Provide fixed shelving capable of withstanding the effects of earthquake motions determined according to the building codes.

1.3 SUBMITTALS

A. Shop Drawings: Show installation details for metal storage shelving, including upright-to-shelf/arm connections, lateral bracing, and attachments to other work. Include plans, elevations, sections, details, and relationship to other work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Systems & Space, Inc., “Spacesaver Four Post Steel Shelving” and “Shutter-Down Doors”, or equal.

2.02 MATERIALS

A. Cantilever Shelving: Provide steel, high-density manual file system with adjustable shelves and “Shutter-Down” roll-up doors.
1. Shelving Type: Steel, 4-post, static shelving with 5 adjustable shelves.
   a. Dimensions: 48 inches wide by 18 inches deep by 76-1/4 inches high, unless otherwise indicated.
2. “Shutter-Down” Roll-Up Door: 1 spring-assisted door for use with each 48-inch wide shelving unit.
   b. Box-Housing Dimensions: 6.5 inches by 6.5 inches.
   c. File Extenders: 1.75 inches.
d. Locking: Low profile “waist high” cam lock or standard plunger lock with
removable core as selected by the District.

e. End Panels: Laminate; 20.75 inches wide by 83.75 inches high by 3/4-inch
thick.

3. Finish: Manufacturer’s standard finish in color as selected by the Architect.

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 work.

B. Examine floors for suitable conditions where metal storage shelving will be installed.

C. Examine walls to which metal storage shelving will be attached for properly located
blocking, grounds, or other solid backing for attachment of support fasteners.

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

3.2 PREPARATION

A. Vacuum finished floor over which metal storage shelving is to be installed.

3.3 INSTALLATION

A. Install metal storage shelving level, plumb, square, rigid, and true, and within erection
tolerances specified.

1. Anchor shelving units to floor with postinstalled expansion anchors or power-actuated
fasteners through foot plate. Shim foot plate as required to achieve level and plumb
installation.

2. Install seismic supports and bracing as recommended by manufacturer and authorities
having jurisdiction, and as required for stability. Extend and fasten members to
supporting structure.

3. Connect side-to-side shelving units together at corner posts with support ties.

4. Install shelves in each shelving unit at spacing indicated on Drawings.

B. Erection Tolerances: Erect metal storage shelving with a maximum tolerance from vertical
of 1/2-inch from 0 to 10 feet of height and remaining constant at a maximum of 1 inch for
all heights taller than 10 feet.

3.4 ADJUSTING AND CLEANING

A. Verify that shelves adjust easily and properly.

B. On completion of installation, clean exposed surfaces as recommended by manufacturer.

C. Touch up marred finishes or replace metal storage shelving that cannot be restored to
factory-finished appearance. Use only materials and procedures recommended or furnished
by metal storage shelving manufacturer.
D. Replace metal storage shelving that has been damaged or has deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION
SECTION 1140 00

FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Equipment and fittings specified, shown, and described in these Specifications.

B. Utility lines: Wiring and piping required within equipment or component configuration. Terminate lines at designated and accessible points for connection in field. Exposed lines shall be chrome-sleeved or chrome plated.

C. Electrical: Switches, terminal boxes, circuit panels, cords and plugs, controls, solenoid valves and motor starters for equipment provided herein; electrical receptacles mounted in or on Foodservice Equipment, where applicable.

D. Plumbing: Sink faucets, drains, strainers, and tailpieces; vacuum breakers, where attached to equipment; equipment fill faucets.

E. Food Service Equipment Contractor to coordinate and verify all requirements of Owner, Purveyor, Operator, Other, Etc. equipment items that are located within the food service areas and indicated on FS series drawings or specified in this section.

1.2 RELATED WORK

A. Equipment furnished as part of this section, but installed as part of work within other sections:
   1. Fittings: Where applicable, furnish electrical and mechanical fittings, valves, switches, controls, regulators, strainers, and devices required for the proper operation of the equipment except as specified otherwise herein. Where such items are not mounted on the equipment, furnish items to the appropriate contractor the building site for installation in the utility lines.

1.3 ARCHITECTURAL / STRUCTURAL / MECHANICAL / PLUMBING / ELECTRICAL WORK

A. Utility rough in, utility lines and final connections between rough-in and foodservice equipment are part of Plumbing, Mechanical and/or Electrical drawings and specifications.

B. Installation of mechanical and electrical fittings and devices in utility lines, including interconnecting field wiring/piping between foodservice equipment are part of Plumbing, Mechanical and/or Electrical drawings and specifications.

C. Final disconnects electrical receptacles in building structure; contactors; and conduit in structure required for electrical lines are part of Electrical drawings and specifications.
D. Floor drains, floor sinks, P-traps, shut-off valve, grease traps/interceptors, water heaters, pressure reducers and regulators are part of Plumbing drawings and specifications.

E. Backing plates or blocking in wall or ceiling partitions are part of Architectural / Structural drawings and specifications.

F. The forming of architectural enclosures, floor, wall openings or recesses for foodservice equipment are part of Architectural / Structural drawings and specifications.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. At least 5 years’ experience in this type of work. Upon request provide at least three references for jobs of similar size and content.
   2. Commercially manufactured equipment is not acceptable unless evidence furnished that similar equipment has been operating successfully in a minimum of three (3) installations (excluding testing laboratories, field-testing or prototypes) for at least one (1) year.
   3. Commercially manufactured equipment will be reviewed based on submittal data provided on manufacturer’s literature and/or manufacturers shop drawings for prime alternate or substituted items. Failure of the equipment to meet the capacity, operation, size, utility and production as submitted will result in the rejection of the equipment regardless of disclaimers. All equipment items, where available, to be provided as Energy Star rated and listed.
   4. Custom-fabricated equipment shall be manufactured by a foodservice equipment fabricator with at least five (5) years’ experience in this type of work, who has the plant, personnel, and engineering facilities to properly design, detail and manufacture high quality kitchen equipment.
   5. All millwork and fabrication of wood component products to be performed by a qualified manufacturer that is certified for chain of custody (COC) by an FSC-accredited certification body.

B. References:
   1. ADA - American Disabilities Act.
   2. AGA - American Gas Association
   4. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
   5. ASME - American Society of Mechanical Engineers, Inc.,
   7. BOCA - Building Officials and Code Administrators.
   8. ETL - Electric Testing Laboratory.
   9. FDA - U.S. Food and Drug Administration.
   10. ICBO - International Conference of Building Officials.
   11. NBFA - National Board of Fire Underwriters.
   12. NEMA - National Electrical Manufacturers Assoc.
   13. NSF - National Sanitation Foundation.
   14. PS - U.S. Dept. of Commerce Product Standards.
   16. UL - Underwriters Laboratories, Inc.
17. USDA - United States Department of Agriculture.

C. Requirements of Regulatory Agencies:
1. NSF Compliance: Equipment subject to NSF approval shall be so labeled, or shall be constructed in accordance with applicable published NSF standards.
2. Evaporators to be NSF approved; electrical components UL (or ETL) approved.
3. Electrical Equipment: Equipment shall carry UL (or ETL) approval and comply with applicable standards of the National Electric Code. Where specified, items shall be UL approved as a unit; if not so specified component electrical parts shall be approved separately. Where applicable, equipment shall comply with NEMA and NBFU standards. Where local regulations permit, a certified test report by an approved nationally recognized independent testing organization establishing proof of conformance to the standards, including test methods of UL, will be considered in lieu of UL label. All drop-in equipment to be wired with waterproof conduit.
4. Civil Authorities: Comply with ordinances, codes and regulations of civil authorities having jurisdiction at Job Site.
5. Sheet Metal Fabrication: Comply with NFPA standard No. 51: "Welding and Cutting"; and applicable NSF standards.
6. ADA Compliance: Installation and construction of equipment and furnishings to comply with the American Disabilities Act as described in the Department of Justice Register Volume 56, No. 144. Food service aisles shall be a minimum of 36” wide and tray slides shall be mounted at 34” maximum above the floor. Food service equipment requires to be accessible shall conform to all reach requirements in CBC figures 11B-16 and 11B-17.

1.5 DISCREPANCIES

A. In the event of discrepancies within the Contract Documents, the Consultant shall be so notified, within sufficient time, to verify, correct and create addendum.

B. If, in the event that time does not permit notification or clarification of discrepancies prior to the Bid Opening, the following shall apply: The drawings govern in matters of quantity, and the specifications govern in matters of quality. In the event of conflict within the drawings involving quantities, or within the specifications involving quality, the greater quantity and higher quality shall apply. No additional allowances will be made because of errors, ambiguities, or omissions, which reasonably should have been discovered during the preparation of the Bid.

1.6 SUBSTITUTIONS

A. Requests for substitution of equipment manufactured by other than the Prime or Alternate Manufacturers named in the specification shall be submitted prior to bid opening. Such items will be reviewed and accepted or denied during the bidding period only and accepted or rejected on the basis of equality to the prime equipment specified.
B. Contractor Must: Submit full descriptive and technical data, test results in detail, and samples, if requested, to be received by the Architect in accordance with Division 1 Specifications.

1.7 SUBMITTALS

A. All submittals to be provided in electronic PDF format. Minimum sheet size for all shop drawings to be 24”x36”.

B. Submittals to be provided in the following sequence. 1-Underground utility penetration MEP plan; 2-Itemized equipment cutsheets; 3-Manufacturers shop drawings; 4-MEP Rough-in Shop drawings; and, 5-Custom fabricated equipment (counters/tables etc.) shop drawings.

C. Product Data:
   1. Equipment Brochure:
      a. Provide list of equipment items with item number, manufacturer, and Model No. and quantity in front of product data books.
      b. Form: Print item number clearly in upper right-hand corner of each sheet; show manufacturer's name; model number; options, alternates, or attachments, electrical and mechanical data, and valves, regulators, controls, and devices provided. If no printed data exists, submit required information on manufacturer's drawing(s) in form described below for Shop Drawings; insert reference sheet in brochure in number sequence referring to item number, manufacturer, and drawing number. Include Company's name and address, project name, and submittal date on brochure cover.

D. Shop Drawings: Submit the following along with equipment brochures:
   1. Floor Plans: No less than 1/4” to 1’-0” scale. Include itemized equipment layout(s), equipment schedules, and rough-in plans. Reproductions of Contract Documents for purposes of shop drawing preparation are not acceptable.
   2. Rough-In Plans: Include mechanical and electrical equipment requirements, including Owner, By Other, By Vender, etc. furnished equipment. Identify connection points, and identify and dimension rough-in points (including those presently sleeved, if) with both vertical (above finished floor), and horizontal dimensions from column centerlines or exterior walls. Detail and dimension structural recesses and depressions required for equipment provided.
   3. Shop Details: Food Service Equipment Contractor/Fabricator is required to provide shop drawings for approval by consultant, prior to fabrication. Scale: not less than 3/4” to 1’-0”, larger where required for clarity. Show plans, elevations, sections and details of equipment as required to indicate arrangements, construction, and connection with other Work; Kinds, types, grades, thickness and finishes of materials; reinforcements, joints, bracing, supports, and anchorage; and method of installation. Food Service Equipment Contractor/Fabricator to coordinate fabrication/installation of counter with equipment items that are to be dropped into top, rolled under and be attached to/through counter. Note: All fabrication drawings that are a combination of multiple fabricated or custom manufactured components/items are to be provided as one shop drawing, no exceptions. All fabrication shop drawings are to indicate equipment cut-out requirements/dimensions. Shop drawings to include multiple sections through counter/equipment (provide minimum three (3) sections serving
4. Backing Drawings: Submit separate drawings locating architectural backing required to support equipment. Dimension in plan, elevation, and (where required) in section. Show maximum load factors for each item requiring wall, ceiling, or special floor support.

E. Certificates: Provide certifications of compliance with requirements of governing regulatory agencies.

F. Operating and Maintenance Data:
   1. Refer to the following and Division 1 specification requirements.
      a. Inventory List: Before final payment, submit an "as-built" list of equipment provided indicating item number and name; manufacturer and model, where applicable; and item price. Include extra equipment, if, ordered during the progress of the Work.
   2. Service Agencies: After award of a contract, submit a list of names and addresses of service agencies to be used on the project. Agencies shall be approved by the Owner Representative and shall be from the jobsite area or within a 150-mile radius from the project.
   3. Nameplates: Provide permanently affixed, corrosion resistant nameplate, proportionate to size of fixture, bearing manufacturer's name, model and serial numbers, and ratings and characteristics for servicing and maintenance, where applicable, on each item of equipment.
   4. Operating and Maintenance Manuals: Upon substantial completion of project, provide completed, bound manuals for each applicable item of equipment provided. Include operating and maintenance instructions/diagrams, wiring diagrams and replacement parts lists/diagrams. Provide list of serial numbers corresponding to each Item Number in the front of each manual.

G. As-Built Shop Drawings: Submit the following at project completion.
   1. As-Built/Constructed equipment Floor Plans: No less than 1/4” to 1’-0” scale. Include itemized equipment layout(s), equipment schedules, and rough-in plans.
   2. Rough-In Plans: Include mechanical and electrical equipment requirements, including Owner, By Other, By Vender, etc. furnished equipment.
   3. Drawings to include incorporation of all provided responses to RFI’s, change requests or/and any other changes incorporated in the field documented or un-documented.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Equipment:
   1. Coordinate delivery with proper schedule and jobsite conditions.
   2. Deliver equipment in manufacturer's original packaging, clearly identified as to product, manufacturer, and Item Number corresponding to numbers in the itemized specification.
   3. Where possible, deliver each item of equipment in one (1) piece. If not possible, assemble equipment in the building in accordance with workmanship standards specified herein.
B. Storage of Equipment:
   1. Store equipment in protected areas, in manufacturer's original packaging where possible, in such a way as to prevent damage to equipment and finishes, and to the structure. Damaged or defective materials and equipment shall be replaced at no cost to the Owner.

1.9 SITE CONDITIONS

A. Examine appropriate existing job site areas and notify Owners Representative if conditions exist which will impede, inhibit, or prevent the contractor from completing the Work. In the absence of such notification it will be assumed that no such conditions exist.

B. Verify site conditions and dimensions prior to production of all equipment items, notify GC of any conditions that affect ability to complete scope of work. Any fabricated/buy-out equipment items that are to abut and be sealed to walls must not have any gaps greater than 1/8" – if gaps exceed dimension the GC and Design team can reject and or accept on a condition by condition bases. All costs associated with replacing improperly provided equipment items is the responsibility of the food service equipment contractor.

1.10 COORDINATION

A. Coordinate work as part of this phase, including but not limited to Mechanical, Electrical and Foodservice Equipment Installation. Do cutting, drilling, and fitting in equipment necessary to accommodate work of mechanical and electrical connections.

1.11 WARRANTIES

A. Work shall be guaranteed against defects for one (1) year from the date of operation of the equipment. Guarantee shall cover replacement of every particular piece of defective material, including transportation, installation and labor, but shall exclude replacement cost of damaged parts or work caused by carelessness or misuse of the equipment. If the contractor fails to respond to written notification of warranty item within 10 days, the Owner may then have the defects and/or problem corrected at the contractor’s expense.

B. In addition to the standard warranties, for equipment, guarantees or warranties offered by manufacturers or contractors in excess of the standard warranties (for example, 5-year warranties on motor-compressors) shall be consigned to and deemed to run to the benefit of the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURED EQUIPMENT

A. General: Equipment so identified refers to Item bearing a manufacturer's name and/or model number. Such standard materials, components, and features normally furnished for that model, whether noted or not, are inherent in the specification.

B. Utility Requirements: Major deviation from the utility requirements shown or specified, resulting either from change of model or manufacturer, or from submitted alternates, shall be clearly indicated on the submittals. Additional costs incurred as a result of a failure to do so
shall be borne by the general contractor.

C. Sanitation: Manufactured equipment shall be either sealed to walls, with no openings or crevices between wall and equipment, or shall be installed the proper distance from wall, as required by NSF. Wall shelving shall be 1" minimum from wall or sealed thereto.

2.2 MATERIALS

A. General: New and first grade. See also various types of equipment, e.g., Sheet Metal Work.

B. Metal:
   1. General: Metal gauges specified are minimum and refer to U.S. Standard Gauge for sheets and plates and to Stub Gauge for tubular material. Gauges established after polishing in accordance with ANSI standards.
   2. Stainless Steel: ASTM A167, type 304, 18-8, No. 2D finish on totally concealed surfaces, No.4 finish elsewhere.

PART 3 - EXECUTION

3.1 PREPARATION

A. Field Measurements: Prior to fabricating, ordering, or delivering equipment verify essential measurements at the Work Site. Verify mechanical and electrical conditions having bearing on the work, as well as pertinent existing equipment and architectural conditions. Make every effort necessary to clarify conditions not accessible to visual examination. Any fabricated/buy-out equipment items that are to abut and be sealed to walls must not have any gaps greater than 1/8" – if gaps exceed dimension the GC and Design team can reject and or accept on a condition by condition bases. All costs associated with replacing improperly provided equipment items is the responsibility of the food service equipment contractor.

B. The food service equipment contractor is responsible to locate all equipment in the field for installation by themselves or any of their subcontractors – this includes both buy-out and custom fabricated equipment items. Contractor to coordinate installation with installed rough-ins and make any adjustments required to equipment to accommodate.

3.2 INSTALLATION

A. Cutting and Welding Operations: gas operated cutting and welding equipment and operations shall be in strict accordance with the National Fire Protection Association Standard No. 51.

B. Standards: Comply with NSF standards in methods of installing, mounting, and securing equipment.

C. Trim: Where separate fixtures abut each other as in a battery of cooking equipment, joint, seal, and fit with matching trim strips to eliminate crevices. Where fixtures penetrate or abut walls, fit wall edges with trim molding, of matching material, to close spaces between fixture and building structure. At wall penetrations mount fixture on enclosed channel base
of similar material to close spaces, where specified.

D. Irregular Surfaces: Where fixture abuts curved or irregular surfaces or angles, or projecting wall corners, fixture shall conform to such surfaces.

E. Metal Bases: Set bases in solid, full-perimeter bed of sealant. If space exceeds 1/4” at point, provide a continuous, full-height scribe strip of matching material to conceal gap.

3.3 FIELD QUALITY CONTROL

A. After installation, test mechanical and electrical equipment including, but not limited to general valves, regulators, tubing, wiring, piping, connections, gauges, safety devices, sensors, and other devices required for the proper operation of the equipment, for operating efficiency and conformance to requirements specified. Test and re-test until equipment is properly operating.

B. Manufacturer's representative Field Service: Representatives of the Food Service Equipment and Accessory manufacturers shall make inspections prior to start of installation, during installation and upon completion of installation to ascertain that the entire system(s) has been installed according to manufacturer's specifications and approved details.

3.4 ADJUSTMENT AND CLEANING

A. Perform fitting, joining, leveling, fastening, scribing, sealing, and adjusting of fixed equipment; depot mobile and portable equipment as shown. Do cutting, drilling, and fitting in equipment necessary to accommodate work of mechanical and electrical trades.

B. Cleaning: Remove from equipment stains, paint spots, protective wrappings, coatings, tapes, grease, oil, plaster, dust, polishing compounds, rust, and other foreign substances.

C. Touch-up: After installation, damaged, stained, or otherwise disfigured portions of the work shall be touched up, refinished, or replaced to the satisfaction of the Owners representative.

3.5 DEMONSTRATION/COMMISSIONING

A. Prior to final acceptance, Food Service Equipment Contractor is to schedule and provide for factory authorized representative or service agent to demonstrate and instruct operating personnel in the uses and maintenance of all equipment provided – No exceptions. In the case of complex equipment, demonstrations shall utilize videotapes as provided by the manufacturers. Such equipment shall include but not be limited to major cooking equipment; exhaust ventilation systems, food processing equipment (such as cutters, mixers, slicers); warewashing equipment; and complex control, monitoring, and alarm systems. Provide RAS with schedule of start-up and demonstrations.

B. Process of commissioning of equipment to include the following:
   1. Factory authorized representative or service agent to verify that all utility connections are complete and proper per manufacturer’s requirements and specifications.
   2. All equipment to be started up and tested for proper operation by the factory authorized service agent or representative. Start-up and testing done by the G.C. does not constitute acceptance by Owner, owner’s representative and/or design team.
3. At time of start-up a commissioning form is to be completed and signed by the factory representative or authorized service agent that has performed the work. Form to indicate date, time, name and company name of representative, equipment item # and description, duration of visit, and names of staff equipment demonstrated to.

3.6 ITEMIZED EQUIPMENT DESCRIPTION

A. Refer to all FS Drawings as they are inclusive as the construction documents and therefore pertinent with this specification to the details of this contract. In the event of a conflict, the greater quality of the two in conflict shall apply.

B. Refer to contract document drawings for quantities required, general notes, utility load requirements etc.

C. Contractor is required to list name of intended custom fabrication company at time of bid.

Item 1: Service Counter
Manufacturer: Millwork/Plastic Laminate/Solid Surface Material
Model: See Architect’s Drawings
Fabricate and set in place per Part 2 Products, Elevations, Details and the following:
1. Counter to be fixed with millwork body/base – millwork finish and operable doors. Solid Surface Material Top as selected by architect.
2. Refer to architectural finish specifications for grain/pattern etc.
3. Field verify all dimensions prior to fabrication.
4. All furniture grade plywood construction – no melamine or particle board allowed.
5. Provide openings in top for drop-in/built in equipment.
6. Food Service Equipment Contractor/Fabricator to coordinate fabrication/installation of counter with equipment items to be dropped into top, rolled under and be attached to/through counter.
7. Door pulls as selected by the architect.
8. Refer to architect’s drawings for adjustable shelving, storage areas, and drawers.
9. Refer to architect’s drawings for cove base and false kick locations.

Item 2: Drop-In Hand Sink with Faucet
Manufacturer: Elkay
Model: LRADQ2219554/LKAD35/(LKG1041/LKD2443 – TBD) – ADA Compliant
Furnish and set in place per manufacturer’s standard specification, Part 1 – General Conditions, Part 2-Products, Part 3 - Execution and the following:
1. Drop-In Sink, one compartment, ADA bowl design with rear drain.
2. Provide with an Elkay model LKAD35 Drain Assembly.
3. Provide with an Elkay model LKG1041 and LKD2443C Faucet – TBD.

Item 3: Soap/Towel Dispensers
Manufacturer: OFCI (Owner Furnished, Contractor Installed), See Architect’s Drawings
Model: TBV – Wall Mounted – ADA Compliant
College District to furnish and set in place per manufacturer’s standard specification, Part 1, 2 and 3.
Item 4: Display Case, Refrigerated  
Manufacturer: True Food Service  
Model: GDM-49RL-HC-LD (OFCI – Owner Furnished, Contractor Installed)  
Furnish and set in place per manufacturer’s standard specification, Part 1 – General Conditions, Part 2-Products, Part 3 - Execution and the following:  
1. Refrigerated Merchandiser, two-section, (8) shelves, laminated vinyl exterior, white interior with stainless steel floor, (2) front Low-E thermal glass hinged doors, (2) rear solid doors, LED interior lights, R290 Hydrocarbon refrigerant, cULus, UL EPH Classified, MADE IN USA, ENERGY STAR®.  
2. Self-contained refrigeration standard.  
3. Rear load.  
4. Provide with 6” seismic/flanged legs.

Item 5: Display Case, Frozen  
Manufacturer: True Food Service  
Model: GDM-49F-HC-TSL01 (OFCI – Owner Furnished, Contractor Installed)  
Furnish and set in place per manufacturer’s standard specification, Part 1 – General Conditions, Part 2-Products, Part 3 - Execution and the following:  
1. Freezer Merchandiser, two-section, True standard look version 01, -10° F, (8) shelves, powder coated steel exterior, white interior with stainless steel floor, (2) triple-pane thermal glass hinged door, LED interior lights, R290 Hydrocarbon refrigerant, UL EPH Classified, MADE IN USA, ENERGY STAR®.  
2. Self-contained refrigeration standard.  
3. Swing door.  
4. Provide with 6” seismic/flanged legs.

Item 6: Display Case, Refrigerated  
Manufacturer: True Food Service  
Model: GDM-49-HC-TSL01 (OFCI – Owner Furnished, Contractor Installed)  
Furnish and set in place per manufacturer’s standard specification, Part 1 – General Conditions, Part 2-Products, Part 3 - Execution and the following:  
1. Refrigerated Merchandiser, two-section, True standard look version 01, (8) shelves, powder coated steel exterior, white interior with stainless steel floor, (2) double pane thermal insulated glass hinged doors, LED interior lights, R290 Hydrocarbon refrigerant, cULus, UL EPH Classified, MADE IN USA, ENERGY STAR®.  
2. Self-contained refrigeration standard.  
3. Swing door.  
4. Provide with 6” seismic/flanged legs.

Item 7: Island Service Counter  
Manufacturer: Millwork/Plastic Laminate/Solid Surface Material  
Model: See Architect’s Drawings  
Fabricate and set in place per Part 2 Products, Elevations, Details and the following:  
1. Counter to be fixed with millwork body/base – millwork finish and operable doors. Solid Surface Material Top as selected by architect.  
2. Refer to architectural finish specifications for grain/pattern etc.  
3. Field verify all dimensions prior to fabrication.  
4. All furniture grade plywood construction – no melamine or particle board allowed.  
5. Provide openings in top for drop-in/built in equipment.
6. Food Service Equipment Contractor/Fabricator to coordinate fabrication/installation of counter with equipment items that are to be dropped into top, roll under and be attached to/through counter.
7. Door pulls as selected by the architect.
8. Refer to architect’s drawings for adjustable shelving and storage areas.
9. Refer to architect’s drawings for cove base and false kick locations.
10. With drawers.

Item 8: Raised Privacy Screen
Manufacturer: Millwork/Plastic Laminate/Solid Surface Material
Model: See Architect’s Drawings

Item 9: Microwave Oven
Manufacturer: Panasonic
Model: NN-SA651S (OFCI – Owner Furnished, Contractor Installed)
Furnish and set in place per manufacturer’s standard specification, Part 1 – General Conditions, Part 2-Products, Part 3 - Execution and the following:
1. Microwave Oven, 1,200 Watts, 1.2 cu. ft., single shelf, 10 power levels, s/s cabinet & cavity, 4-digit digital display, cavity, 3 stage cooking, interactive, multi-lingual menu action screen, non-sensor auto re-heat.

Item 10-11: Not Used

Item 12 – 12A: Milkshake Blending System
Manufacturer: F’Real
Model: B6 Self-Serve Mini Blending Bar (OFCI – Owner Furnished, Contractor Installed)
Furnish and set in place per manufacturer’s standard specification, Part 1 – General Conditions, Part 2-Products, Part 3 - Execution and the following:
1. B6 Self-Serve Blender and Freezer – Mini Blending Bar: 33.5” W x 32.5” D x 56” H, 90 cup capacity; 15 facings; 295 lbs. when full; NSF, TUC, SUD.
2. Integrated internal cleaning system automates sanitization; LCD screen; interactive touch-screen panel; Service Alert™ Diagnostics provides maintenance alerts.
3. 10 ft. ¾” ID antimicrobial drain – drain required.
4. Inline regulator quick-connect fitting provided with barbed end for use with ¼” ID braided input water line (not provided).
5. Coordinate with filter item #14.

Item 13: Service Counter
Manufacturer: Millwork/Plastic Laminate/Solid Surface Material
Model: See Architect’s Drawings
Fabricate and set in place per Part 2 Products, Elevations, Details and the following:
1. Counter to be fixed with millwork body/base – millwork finish and operable doors. Solid Surface Material Top as selected by architect.
2. Refer to architectural finish specifications for grain/pattern etc.
3. Field verify all dimensions prior to fabrication.
4. All furniture grade plywood construction – no melamine or particle board allowed.
5. Provide openings in top for drop-in/built in equipment.
6. Food Service Equipment Contractor/Fabricator to coordinate fabrication/installation of counter with equipment items to be dropped into top, rolled under and be attached to/through counter.
7. Door pulls as selected by the architect.
8. Refer to architect’s drawings for adjustable shelving and storage areas.
9. Refer to architect’s drawings for cove base and false kick locations.
10. 30” H x 36” D.

Item 14: Undercounter Filter System
Manufacturer: Everpure
Model: EV9100-31
Furnish and set in place per manufacturer’s standard specification, Part 1 – General Conditions, Part 2-Products, Part 3 - Execution and the following:
1. CB20-124E, Single BB Prefilter; 25.875” H x 7.25” W x 8.55” D.
2. Service flow rate max 5gpm; high pressure housing includes head, mounting bracket and bowl; ¾” FNPT inlet and outlet connection; provide min 4” clearance under the filter to facilitate cartridge change;
3. Mounted undercounter.
4. Provide twelve (12) additional replacement filters.

Item 15: Stainless Steel Cove Base
Manufacturer: Custom Fabricated
Model: Stainless Steel
Fabricate and set in place per Part 2 Products, Elevations, Details and the following:
1. Attach custom fabricated 6” high 16 gauge stainless steel removable kick-plates to seismic flanged feet with CHG spring clips #A76-4460.
2. Coordinate with items #4, 5 and 6.
3. See detail #1 on sheet FS1.1.
4. Field verify all dimensions prior to fabrication and installation.

END OF SECTION
SECTION 11 52 00

AUDIO-VISUAL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Surface mounted, manually operated projection screen.
   2. Projector mount, adjustable extension ceiling type.
   3. Mounting brackets for audio-visual equipment.

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

1.2 REFERENCES

A. FED STD - Federal Standard

B. FS - Federal Specifications

C. NFPA - National Fire Protection Association
   1. 701 - Standard methods of Fire Tests for Flame-Resistant Textiles and Films.

1.3 DEFINITIONS

A. Gain: Ratio of light reflected from or refracted by screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per FS GG-S-00172D(1).

B. Half-Gain Angle: The angle, measured from the axis of the screen surface, to the most central position on perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s product data.

B. Shop Drawings: Submit shop drawings showing layout and types of projection screens. Show the following:
   1. Location of screen centerline relative to ends of screen case.
   2. Location of seams in viewing surfaces.
   3. Connections to suspension systems for pendant and recess-mounted screens.
   4. Anchorage details.
   5. Details of juncture of exposed surfaces with adjacent finishes.
   6. Frame details.
   7. Accessories.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers
   2. Projector Mount: Chief Manufacturing, or equal.

2.2 PROJECTION SCREEN

A. Material and Viewing Surface of Front Projection Screen: Provide screen manufactured from mildew and flame resistant fabric of type indicated for screen specified and complying with the following requirements:
   1. Matte white viewing surface with gain characteristics complying with FS GG-S-00172D(1) for Type A screen surface.
   3. Fire Performance Characteristics: Provide projection screen fabric identical to materials that have been tested for flame resistance according to both small and large scale tests of NFPA 701.
   4. Seams: Where length of screen indicated exceeds maximum length produced without seams in fabric specified, provide screen with horizontal seam placed at bottom of screen at juncture between extra drop length and viewing surface.
   5. Edge Treatment: Black masking borders.
   6. Size of Viewing Surface: 54 inches high by 96 inches wide; final dimensions shall be coordinated.
   7. Extra Drop: Provide 10 feet-0 inches wide by 4 feet-0 inches at top of screen, in black color.

B. Surface-Mounted, Metal Encased, Manually Operated Screen: Unit designed and fabricated for surface mounting on wall, fabricated from formed steel sheet not less than 0.027 inch thick or aluminum extrusions; with flat back design and vinyl covering or baked-enamel finish. Provide end caps and universal mounting brackets, finished to match end caps.

2.3 PROJECTOR MOUNT

A. Projector Mount: A pre-threaded 1-1/2 inch NPT pipe attachment shall be mounted for the attachment of projector extension pipe mounting hardware by the District. Refer to the reflected ceiling plan drawings for mounting locations.
   1. Mounting Hardware Weight Capacity: 50 pounds.
   2. Products: Provide for each location, as manufactured by Chief Manufacturing, or equal.
      a. Ceiling Mounting Plate: CMA110.
      b. Adjustable Extension Column: CMS006009.
      c. Projector Mount: RPMA 278.

2.4 ACCESSORIES

A. Backing: As indicated on the Drawings.
B. Mounting Brackets for Projection Screens: Metal “L” bracket, size as recommended by the projection screen manufacturer; as manufactured by Elite Screens, “Type X”, or equal.

PART 3 - EXECUTION

3.1 COORDINATION

A. Coordinate with other trade contractors affected by the work to assure work is performed in proper sequence.

B. Coordinate requirements for blocking and auxiliary structural supports to ensure adequate means for installation of screens.

C. Ceiling Projector Mount Coordination: Once the final NPT pipe mounting is installed, coordinate for the ceiling to be installed with a cutout opening at the exact pipe installation location, with a finished opening or escutcheon ring at the NPT pipe location.

3.2 INSTALLATION

A. Install projection screen mounting brackets at locations indicated and in compliance with manufacturer’s written instructions.

B. Install projector mounts at locations indicated and in compliance with manufacturer’s written instructions.

3.3 PROTECTING AND CLEANING

A. Protect audio-visual equipment after installation from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION
SECTION 12 24 00

WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Manually-operated window shades.

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

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

B. FS - Federal Specifications
   1. CCC-C-521e - Cloth, Coated, Window Shade.

C. NFPA - National Fire Protection Association

D. UL - Underwriters Laboratories Inc.

1.3 SYSTEM DESCRIPTION

A. Performance Requirements: Shade cloth shall be constructed of a woven screen material consisting of yarns comprised of extruded vinyl coated polyester core yarn as a composite thermoplastic shade cloth that shall be sealed at the edges, assuring binding the core yarn to the coating at the cut edge to assure a sealed edge to substantially minimize raveling. Screen cloths to have inert core yarns; i.e. fiberglass shall not be acceptable.

1.4 SUBMITTALS

A. Product Data: Submit for each type of product specified. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

B. Shop Drawings: Show location and extent of shades. Include elevations, sections, details, and dimensions not shown in product data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.

C. Samples for Initial Selection: For each colored component of each type of shade indicated.
   1. Include similar samples of accessories involving color selection.

D. Samples for Verification
   1. Operating Unit: Complete, full-size, not less than 16 inches wide for each type of shade indicated.
2. Shade Material: Not less than 3 inches square, with specified treatments applied. Mark face of material.

E. Qualification Data: For installer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for each type of shade.

G. Contract Closeout Submittals: Submit maintenance data for window treatments to include the following:
   1. Methods for maintaining treatments and finishes.
   2. Precautions for cleaning materials and methods that could be detrimental to finishes and performance.
   3. Operating hardware.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Source Limitations: Obtain shades through 1 source from a single manufacturer.

C. Fire Test Response Characteristics: Provide roller shade band 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:

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver and store products in cartons with seals unbroken and labels intact until time of installation.

B. Provide proper storage facilities to prevent damage.

1.7 PROJECT CONDITIONS

A. Field Measurements: Check actual dimensions by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 WARRANTY

A. Specialty Warranty
   1. Shade fabric to be warranted for colorfastness for minimum of 10 years, regardless of color, including white.
   2. In the event of a warranted product failure, the shade contractor will, at no cost to the District, facilitate acquisition and delivery of all necessary components to the District.
1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Shades: Before installation begins, for each size, color, texture, and pattern indicated, full-size units equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: MechoShade Systems, Inc., “Mecho/5 System”, or equal.
   1. Provide system with blackout accessories at Cadaver Lab.

2.2 WINDOW SHADES

A. Cadaver Lab Privacy Shades at Interior Doors and Windows: Provide manually-operated roller privacy shade system with heavy-duty commercial grade hardware.
   1. Sizes: As indicated on the Drawings; oversized installations may require seaming running one way versus the other.
   2. Housing: Provide surface-mounted closure pocket, finished on all exposed surfaces. Include optional matching end caps and bottom closures.
      a. Color: As selected by the Architect.
   3. Provide extruded aluminum sill and blackout channels at ends and adjacent shades, finished to match closure pocket.
   4. Provide fixed tensioner at window and door installations.
      a. Color: As selected by the Architect from manufacturer’s standard colors.

B. Exterior and Interior Window Roller Shades: Provide manually-operated roller shade system with adjustable slip clutch and heavy-duty commercial grade hardware.
   1. Sizes: Width of shade to exceed minimum 2 inches beyond overall width of window.
   2. Provide “Snaploc” fascia and end caps.
      a. Color: As selected by the Architect from manufacturer’s standard colors.
   3. Privacy Shade Material: 5 percent openness factor.
      a. Color: As selected by the Architect from manufacturer’s standard colors.

C. Room Darkening Shade Material: Meet requirements of FS CCC-C-521e for fire retardancy and NFPA 701 Small Scale requirements. Antimicrobial without topical treatment. Material shall meet requirements of ASTM E84, with flame spread rating of 17 and smoke density index of 118.
1. Cloth: Smooth, percent openness factor as selected by the Architect; as manufactured by MechoShade Systems, Inc., or equal.
2. Color: Opaque white.

D. Manually Operated Shade System: Chain operated roller shade system with adjustable slip clutch.

E. Mounting: As indicated.

2.3 MISCELLANEOUS MATERIALS

A. Accessories: Provide accessories, brackets, fittings, and fastenings as necessary for proper operation and installation of shades; conceal fasteners or finish flush, painted to match exposed metal finish.
   1. Mounting Brackets: Manufacturer’s standard for wall or ceiling mounting as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine construction to support, adjoin or otherwise contact and verify that shade dimensions are correct, painting has been completed, setting conditions are dry, clean and otherwise proper for installation.

B. Do not install shades until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Employ mechanics skilled in installations required.

B. Adjust as required such that shades permit proper positioning over full range of movement and smooth raising and lowering without binding.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train the District’s maintenance personnel to adjust, operate, and maintain roller shades.

END OF SECTION
SECTION 12 35 53
LABORATORY CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
1. Steel laboratory casework.
2. Wood laboratory casework.
3. Epoxy resin countertops and sinks.
4. Laboratory accessories, including the following:
   a. Lab bench coat hooks.
   b. Wall-mounted coat hooks.
   c. Drying rack pegboards.
   d. Plumbing chase enclosures.

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

C. Related Sections
1. Section 06 41 10 - Custom Casework: Provision of custom casework.
2. Section 09 90 00 - Painting and Coating: For back priming and finish painting.
3. Division 22 - Plumbing: Provision of sinks and other plumbing fixtures and fittings for elements located in countertops including rough-in and connection to such fixtures.

1.2 REFERENCES

A. ANSI - American National Standards Institute
   1. A208.2 - Medium Density Fiberboard (MDF) for Interior Applications.

B. ASTM - American Society for Testing and Materials
   2. D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
C. CALGreen - California Green Building Standards, 2016 Edition
D. Cal/OSHA - The Division of Occupational Safety and Health
E. CBC - California Building Code, 2016 Edition
F. NFPA - National Fire Protection Association
   1. 30 - Flammable and Combustible Liquids Code.
G. SEFA - Scientific Equipment & Furniture Association
   1. 8 - Testing Standards.
H. WI - Woodwork Institute

1.3 DEFINITIONS

A. Definition of cabinet components by surface visibility.
   1. Exposed Surfaces
      a. Surfaces visible when drawers and solid doors are closed.
      b. Front edges of cabinet body members are visible or seen through a gap of
greater than 1/8-inch with doors and drawers closed.
      c. Portions of cabinets visible when fixed appliances are installed.
   2. Semi-Exposed Surfaces
      a. Surfaces visible when doors and drawers are open.
      b. Surfaces visible behind clear glass doors.
      c. Interior surfaces of open units.
      d. Bottoms of cabinets 30 inches or more above finished floor.
      e. Tops of cabinets less than 78 inches above finished floor, or are visible from an
upper floor or staircase after installation.
   3. Unexposed Surfaces
      a. Surfaces not normally visible after installation.
      b. Bottoms of cabinets less than 30 inches above finished floor.
      c. Tops of cabinets over 78 inches above finished floor which are not visible from
an upper level.
      d. Stretchers, blocking, and/or components concealed by drawers.

1.4 SYSTEM DESCRIPTION

A. Performance Requirements
   1. Structural: Casework components shall withstand the following minimum loads
   without damage to the component or to the casework operation:
      a. Steel Base Unit Load Capacity: 500 lbs. per lineal foot.
      b. Drawers in a Cabinet: 150 lbs.
      c. Utility Tables (4 Legged): 300 lbs.
      d. Hanging Wall Cases: 300 lbs.
      e. Load Capacity for Shelves of Base Units, Wall Cases and Tall Cases: 100 lbs.
   2. Metal Finish: Manufacturer shall provide verification of metal finish performance.
   Testing shall be performed by independent testing agency.
B. Composite wood used on the Project shall comply with CALGreen Code Nonresidential Mandatory Measures, Chapter 5, Division 5.5, Section 5.504, Articles 5.504.4.5 and 5.504.4.5.3.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer’s data for each item of laboratory furnishings and equipment. Include component dimensions, configurations, construction details, joint details, and attachments. Indicate location, size, and service requirement for each utility connection.

B. Shop Drawings
   1. Provide 1/2-inch = 1 foot-0 inch scale elevations of each individual and battery of casework units showing cross sections, rough-in and anchor placements, tolerances, and clearances. Indicate relationship of units to surrounding walls, ceilings, windows, doors, and other building components.
   2. Provide 1/4-inch = 1 foot-0 inch rough-in plan drawings for coordination with trades. Rough-in shall show free area.

C. Samples
   1. Material Samples: Submit 3 inch by 3 inch product sample of each type of casework.
   2. Hardware Samples: Provide samples of door and drawer pulls, locks, and hinges.

1.6 QUALITY ASSURANCE

A. Single Source Responsibility: Laboratory casework and accessories included in this Section shall be supplied by a single laboratory supplier. Proposals from brokers or multiple suppliers will not be accepted.

B. The supplier for work in this Section shall use manufacturers with production facilities including all tools, equipment, and special machinery necessary for specializing in the fabrication and installation of the type of equipment specified, with skilled personnel, factory trained workmen, and an experienced engineering department. Each shall have the demonstrated knowledge, ability, and the proven capability to complete an installation of this size and type within the required time limits:
   1. 10 years or more experience in manufacture of laboratory casework and equipment of type specified.
   2. 10 installations of equal or larger size and requirements within the last 5 years.

1.7 DELIVERY, STORAGE AND HANDLING

A. Schedule delivery of casework and equipment so that spaces are sufficiently complete to allow for installation immediately following delivery.

B. Protect finished surfaces from soiling or damage during handling and installation. Cover working surfaces with cardboard. Mark in large lettering “NO STANDING”.

1.8 PROJECT CONDITIONS

A. Do not deliver or install equipment until the following conditions have been met:
   1. Windows and doors are installed, and the building is secure and weathertight.
2. Ceiling, overhead ductwork, and lighting are installed.
3. All painting is completed and floor finish is installed.
4. Casework and related materials require the interior building temperature not to exceed 80 degrees Fahrenheit in temperature and/or humidity levels during the course of the material installation, or once materials are installed, must be avoided to prevent damage to equipment.
5. Under no conditions should moisture levels exceed 50 percent relative humidity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers for Steel Casework: Hamilton Laboratory Solutions; Air Master Systems; BedcoLab, or equal.

B. Acceptable Manufacturers for Wood Casework: Hamilton Laboratory Solutions; Diversified Casework; Kewaunee, or equal.

2.2 STEEL LABORATORY CASEWORK

A. General
   1. Flush Overlay Construction: Surfaces of doors, drawers, and panel faces shall align with cabinet fronts without overlap of case ends, top, or bottom rails. Horizontal and vertical case shell members shall meet in the same plane without overlap.
   2. Slimline Styling: Maximum front width of end panels 3/4-inch and maximum front height of top and bottom members 1 inch.
   3. Self-Supporting Units: Completely welded shell assembly without applied panels at ends, backs, or bottoms, so that cases can be used interchangeably or as a single, stand-alone unit.
   4. Interior of Case Units: Easily cleanable, flush interior. Base cabinets, 30 inches and wider, with double swinging doors shall provide full access to complete interior without center vertical post.
   5. Drawers: Sized on a modular basis for interchange to meet varying storage needs and designed to be easily removable in field without the use of special tools.
   6. Case Openings: Rabbeted-like joints all four sides of case opening for hinged doors and 2 sides for sliding doors in order to provide dust resistant case.
   7. Framed Glazed Doors: Identical in construction, hardware, and installation to solid panel doors. Design frame glazed doors to be removable for glass replacement.
   8. Flammable Storage Cabinets: Provide flammable storage cabinets conforming to NFPA 30 and Cal/OSHA requirements. Integrate flammable storage cabinets into steel base cabinets where indicated in laboratory plans and elevations. Provide closure panels and aprons as required to close gaps and openings.

B. Materials and Finishes
   1. Sheet Steel: Mild, cold rolled and leveled unfinished steel shall be treated at the mill to be free of scale, ragged edges, deep scratches, or other injurious effects.
   2. Minimum Gauges
      a. 20 Gauge: Solid door interior panels, drawer fronts, scribing strips, filler panels, enclosures, drawer bodies, shelves, security panels, and sloping tops.
b. 18 Gauge: Case tops, ends, bottoms, bases, backs, vertical posts, uprights, glazed door members, door exterior panels, and access panels.

c. 16 Gauge: Top front rails, top rear gussets, intermediate horizontal rails, table legs and frames, leg rails, and stretchers.

d. 14 Gauge: Drawer suspensions, door and case hinge reinforcements, and front corner reinforcements.

e. 11 Gauge: Table leg corner brackets and gussets for leveling screws.

3. Glass: Laminated safety glass nominal 7/32-inch on framed glass doors on wall and upper cases. Provide glass without imperfections or marred surfaces.

4. Metal Finish

a. Preparation: Spray clean metal with a heated cleaner/phosphate solution, pretreat with iron phosphate spray, water rinse, and neutral final seal. Immediately dry in heated ovens, gradually cooled, prior to application of finish.

b. Application: Electrostatically apply urethane powder coat of selected color from manufacturer’s standard color offering and bake in controlled high temperature oven to assure a smooth, hard satin finish. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thicknesses:

1) Exterior and Interior Surfaces Exposed to View: 1.5 mil average and 1.2 mil minimum.

2) Backs of Cabinets and Other Surfaces Not Exposed to View: 1.0 mil average.

c. Finish drawer bodies in matching or harmonizing color and apply corrosion-resistant treatment to selected, concealed interior parts.

d. Finish must be UV stable.

C. Cabinet Surface Finish Tests: Casework construction and performance characteristics shall be in full compliance with SEFA 8 standards. At the District’s request, independent third party performance testing must be submitted validating compliance and adheres to the finish specifications.

1. Chemical Spot Test

a. Purpose of Test: The purpose of the chemical spot test is to evaluate the resistance a finish has to chemical spills. Note: Many organic solvents are suspected carcinogens, toxic and/or flammable. Great care should be exercised to protect personnel and the environment from exposure to harmful levels of these materials.

b. Test Procedure: Obtain one sample panel measuring 14 inches by 24 inches. The received sample to be tested for chemical resistance as described herein. Place panel on a flat surface, clean with soap and water and blot dry. Condition the panel for 48-hours at 73 degrees plus or minus 3 degrees Fahrenheit and 50 plus or minus 5 percent relative humidity. Test the panel for chemical resistance using forty-nine different chemical reagents by one of the following methods:

1) Method A: Test volatile chemicals by placing a cotton ball saturated with reagent in the mouth of a 1-ounce bottle and inverting the bottle on the surface of the panel.

2) Method B: Test volatile chemicals by placing 5 drops of the reagent on the surface of the panel and covering with a 24mm watch glass, convex side down.
For both of the above methods, leave the reagents on the panel for a period of one hour. Wash off the panel with water, clean with detergent and naphtha, and rinse with deionized water. Dry with a towel and evaluate after 24-hours at 73 degrees plus or minus 3 degrees Fahrenheit and 50 plus or minus 5 percent relative humidity using the following rating system:
1) Level 0 - No detectable change.
2) Level 1 - Slight change in color or gloss.
3) Level 2 - Slight surface etching or severe staining.
4) Level 3 - Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.

<table>
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<th>Test No.</th>
<th>Chemical Reagent</th>
<th>Test Method</th>
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<tbody>
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<td>Acetate, Amyl</td>
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<tr>
<td>2)</td>
<td>Acetate, Ethyl</td>
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</tr>
<tr>
<td>3)</td>
<td>Acetic Acid, 98%</td>
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<td>4)</td>
<td>Acetone</td>
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<td>5)</td>
<td>Acid Dichromate, 5%</td>
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<tr>
<td>6)</td>
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39) Sodium Hydroxide, 40% B
40) Sodium Hydroxide, Flake B
41) Sodium Hydroxide, Saturated B
42) Sulfuric Acid, 33% B
43) Sulfuric Acid, 77% B
44) Sulfuric Acid, 96% B
45) Sulfuric Acid, 77% and Nitric Acid 70%, equal parts B
46) Toluene A
47) Trichloroethylene A
48) Xylene A
49) Zinc Chloride, Saturated B

c. Acceptance Level: Results will vary from manufacturer to manufacturer. Laboratory grade finishes should result in no more than four Level 3 conditions. Suitability for a given application is dependent upon the chemicals used in a given laboratory.

2. Hot Water Test
   a. Purpose of Test: The purpose of this test is to ensure the coating is resistant to hot water.
   b. Test Procedure: Hot water, 190 degrees Fahrenheit to 205 degrees Fahrenheit, shall be allowed to trickle (with a steady stream and at a rate of not less than 6 ounces per minute) on the surface, which shall be set at an angle of 45-degrees, for a period of 5 minutes.
   c. Acceptance Level: After cooling and wiping dry, the finish shall show no visible effect from the hot water.

3. Impact Test
   a. Purpose of Test: The purpose of this test is to evaluate the ductility of the coating.
   b. Test Procedure: A 1-pound ball approximately 2 inches in diameter shall be dropped from a distance of 12 inches onto a flat horizontal surface, coated to manufacturer’s standard manufacturing method.
   c. Acceptance Level: There shall be no visible evidence to the naked eye of cracks or checks in the finish due to impact.

4. Paint Adhesion on Steel Test
   a. Purpose of Test: The paint adhesion test is used to determine the bond of the coating to steel. This does not apply to non-steel products.
   b. Test Procedure: This test is based on ASTM D2197-86. Two sets of eleven parallel lines 1/16-inch apart shall be cut with a razor blade to intersect at right angles thus forming a grid of 100 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. They shall then be brushed lightly with a soft brush for one minute. Examine under 100-foot candles of illumination.
   c. Acceptance Level: Ninety or more of the squares shall show finish intact.

5. Paint Hardness on Steel Test
   a. Purpose of Test: The paint hardness test is used to determine the resistance of the coatings to scratches.
   b. Test Procedure: Pencils, regardless of their brand, are valued in this way: 8-H is the hardest, and next 11 order of diminishing hardness are 7-H, 6-H, 5-H, 4-H, 3-H, 2-H, H, F, HB, B (soft), 2-B, 3-B, 4-B, 5-B (which are softest). The
pencils shall be sharpened on emery paper to a wide sharp edge. Pencils of increasing hardness shall be pushed across the paint film in a chisel-like manner until one is found that will cut or scratch the film. The pencil used before that one, that is the hardest pencil that will not rupture the film, is then used to express or designate the hardness.

c. Acceptance Level: The paint shall have a hardness of 4-H minimum.

2.3 WOOD LABORATORY CASEWORK AND FIXED BENCHES

A. Solid Stock Lumber and Veneer Plywood
   1. Exposed and Semi-Exposed Portions for Transparent Finish: Select White Maple, Grade A. No heart wood allowed.
   2. Concealed Portions: Maple.

B. Medium Density Fiberboard (MDF): ANSI A208.2, 3/4-inch thick, water-resistant, paint grade, with low VOC/formaldehyde-free, as manufactured by SierraPine, “Medex”, or equal.

C. Wood Cabinets for Transparent Finish
   1. Quality Standard: Comply with WI V3.0, including but not limited to, Section 10: Basic, Laboratory & Seismic Installation requirements.
   2. Grade: Custom.
   3. WI Construction Style: Style A, Frameless.
   4. WI Construction Type: Type I, multiple self-supporting units rigidly joined together.
   5. WI Door and Drawer Front Style: Flush overlay.
   6. Edge Profile: Square with thick applied band.

2.4 MISCELLANEOUS MATERIALS

A. Hardware
   1. Drawer/Door Pulls: Stainless steel wire with satin finish.
   2. Hinges: 5 knuckle projecting barrel, stainless steel mortise with 5/8-inch round corners in satin finish.
   3. Door Catches: Non-locking cabinets, adjustable type, spring actuated nylon roller catches.
   4. Shelf Supports: Die formed steel, zinc plated, designed to engage in self adjustment holes.

B. Accessories
   1. Lab Bench Coat Hook: Heavy-duty stainless steel hook with concealed mounting, as manufactured by Bobrick, “Model B2116”, or equal.
   2. Wall-Mounted Lab Coat Hook: Surface-mounted strip shall be fabricated of minimum 22 gauge stainless steel in satin finish; hooks shall be of minimum 14 gauge stainless steel, as manufactured by G2 Automated Technologies, “Model GAT-LAB-CT-HOOKS-244-WM”, or equal.
4. Plumbing Chase Enclosures: Provide pre-manufactured or fabricated plumbing chase enclosures from minimum 18 gauge galvanized steel, as shown on Laboratory Furnishings and detail drawings. Seal all joints between dissimilar metals and all panel seams with 100 percent silicone sealant. Finish shall be pre-finished epoxy paint, color as selected by the District’s Representative.

2.5 EPOXY RESIN COUNTERTOPS AND SINKS

A. Cast Epoxy Resin Tops: Factory-molded tops of modified epoxy resin formulation, uniform mixture throughout full thickness; especially compounded and cured to provide optimum physical and chemical resistance; smooth, nonspecular finish of color indicated.

1. Provide standard edge overhang of 1 inch over base cabinets (unless indicated otherwise on the Drawings), form with continuous drip groove on under surface 1/2-inch from edge; tolerance not exceeding plus or minus 1/32-inch. Provide in longest practical lengths.
   a. Thickness: 1 inch.
   b. Color: Black.

2. Backsplash: Applied butt type; 4 inches high, unless indicated otherwise; provide end curbs where tops abut walls, fume hoods, and other fixed surfaces.

3. Edge Profile: Square with beveled edge.

4. Physical Properties: Comply with the following minimum requirements:
   b. Flexural Strength (ASTM D790): 16,000 psi.
   c. Tensile Strength (ASTM D638): 10,500 psi.
   d. Density (ASTM D792): 196 kg/m3.
   e. Rockwell M. Hardness (ASTM D785): 110.
   h. Water Absorption (ASTM D570): 0.0076 percent.

5. Chemical Resistance: Spot test with the following reagents in the listed laboratory concentrations, in contact with finished top for 16 hours; with the following ratings:
   a. No Effect: Glacial acetic acid, acetone, ammonium hydroxide 28 percent, benzene, carbon tetrachloride, citric acid 10 percent, diethyl ether, dimethyl formamide, ethyl acetate, ethyl alcohol 95 percent, ethylene dichloride, heptane, hydrochloric acid 20 percent, hydrogen peroxide 28 percent, isooctane, methyl alcohol, nitric acid 70 percent, phenol, sodium carbonate 2 percent, sodium hydrochloride 5 percent, sulfuric acid 60 percent, toluene.
   b. Slight Spot: Chromic acid 40 percent, hydrochloric acid 37 percent, sodium hydroxide 18 percent, sodium hydroxide 50 percent.
   c. Spot: Dichromate cleaning solution, sulfuric acid 96 percent.

6. Workmanship: Cast surfaces smooth, with drip grooves; provide factory cutouts for sinks. Fabricate plain butt-type joints assembled with epoxy adhesive and prefitted, concealed metal spline.

7. Fabrication Tolerances: Measure top in unrestrained condition.
   a. Thickness: Plus or minus 1/32-inch.
   b. Size
      1) Length: Plus or minus 1/8-inch.
      2) Width: Plus or minus 1/16-inch.
c. Squareness: Difference between diagonals shall not exceed 1/64-inch for each 12 inches of length.
   1) Warp: 1/16-inch in 36 inches of length; 3/32-inch maximum in 96 inches length.
   2) Location of Cutouts: Plus or minus 1/8-inch.
   3) Size of Cutouts: Plus 1/8-inch, minus 0-inch.

8. Cutouts
   a. Provide cutouts in work surface for cable penetrations and service outlets.
   b. Coordinate locations of cutouts for sinks with Division 22.
   c. Provide reinforcement or additional support, if needed, to make panels with cutouts comply with standard performance requirements.

B. Epoxy Resin Sinks: Integrally molded from modified thermosetting black epoxy resin, specially compounded and oven cured. Cove inside corners and pitch bottom to threaded drain outlet.
   1. Size: As indicated on the Drawings.
   2. Drain Location: Sink rear center.

2.6 FABRICATION OF STEEL LABORATORY CASEWORK

A. Base Units and Cases
   1. Base Units and High Wall Cases: End panels and back, reinforced with internal reinforcing front and rear posts.
   2. Tall Cases: Formed end panels with front and rear reinforcing post channels; back shall be formed steel panel, recessed 3/4-inch for mounting purposes.
   3. Posts: Front post fully closed with full height reinforcing upright. Shelf adjustment holes in front and rear posts shall be perfectly aligned for level setting, adjustable to 1/2-inch on center.
   4. Provide gusset reinforcement at front corners.
   5. Base Unit Backs: Provide drawer units without backs and cupboard units with removable backs.
   6. Bottoms: Base units and wall cases shall have one piece bottom with front edge formed into front rail, rabbeted as required for swinging doors and drawers, and flush design for sliding doors.
   7. Top Rail for Base Units: Flush with front of unit and interlock with end panels.
   8. Toe Base for Base Units: 4 inches high by 3 inches deep with formed steel base and 11 gauge die formed steel gussets at corners. Provide 3/8-inch diameter leveling screw with integral bottom flange of minimum 0.56 sq. in. area at each corner, accessible through openings in toe space.
   9. Tops of Wall Cases: One piece, with front edge formed into front rail.

B. Drawers
   1. Steel Drawer Fronts: 3/4-inch thick, double wall construction, pre-painted prior to assembly and sound deadened; top front corners welded and ground smooth. Reinforce interior of front panel with welded steel hat channels. Secure hinges with screws to internal 14 gauge reinforcing in case and door. Hinges shall be removable; welding of hinges not acceptable. Doors shall close against rubber bumpers. Friction centering devices are not acceptable.
2. **Drawer Bodies**: Bottom and sides formed into one-piece center section with bottom and sides coved and formed top edges. Front and back panels spot welded to center section.

3. **Drawer Suspension**: Heavy duty 100# coved raceways for both case and drawer with nylon tired, ball bearing rollers; self-centering and self-closing when open to within 5 inches of the closed position.

C. **Doors**
1. **Steel Solid Panel Steel Doors**: 3/4-inch thick, double wall, telescoping box steel construction with interior pre-painted and sound deadened, all outer corners welded and ground smooth. Reinforce interior of front panel with welded steel hat channels. Secure hinges with screws to internal 14 gauge reinforcing in case and door. Hinges shall be removable; welding of hinges not acceptable. Doors shall close against rubber bumpers.

2. **Frame Glazed Doors**: Outer head to be one piece steel construction. Inner head to consist of steel top, bottom and side framing members which are removable for installation or replacement of glass. Provide continuous vinyl glazing retainer to receive glass. In all other respects, framed glazed door construction and quality shall match solid panel doors.

D. **Shelves**
1. Form front and back edges down and back 3/4-inch. Form ends down 3/4-inch.
2. Reinforce shelves over 36 inches long with welded hat channel reinforcement the full width of shelf.
3. Pull-Out Shelves: Same suspension as specified for drawers.

2.7 **FABRICATION OF WOOD LABORATORY CASEWORK AND FIXED BENCHES**

A. **Interior Woodwork Grade**: Provide Custom grade interior laboratory casework complying with WI where indicated on the Drawings.

B. **Fixed Laboratory Benches**
1. **Tops**: Refer to Epoxy Resin Countertops & Sinks.
2. **Rails**: Not less than 3/4-inch by 4 -5/16 inches hardwood with attached heavy duty steel corner braces grooved and screwed into both rails at each corners. Groove rails for “Z” irons or drill for top attachment.
3. **Reinforcing Cross Rails**: Hardwood doweled and glue into front and back rails and pinned at intervals not more than 33 inches on center.
4. **Legs**: Not less than 2 inches by 2 inches hardwood. Provide stainless steel table leg floor anchor affixed to concrete floor under integral coved base as indicated in Laboratory Furnishing Drawings.
5. **Access Panels**: Provide access panels to match construction and finish of bench.
6. **Electrical Receptacles**: Where indicated in the Laboratory Furnishing Drawings, table manufacturer shall provide cutouts for electrical receptacles and devices to be installed by Division 26.

C. **Wood Moisture Content**: Comply with requirements of WI for wood moisture content in relation to relative humidity conditions existing during time of fabrication and in installation areas.
1. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
2. Complete fabrication, including assembly and concealed hardware application, before shipment to Project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
3. Shop-cut openings, to maximum extent possible, to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges with a water-resistant coating.

D. Finishing
   1. Quality Standard: Comply with WI Section 5, unless otherwise indicated; provide finishes of same grades as items to be finished.
   2. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
   3. Backpriming: Sand and apply 1 coat of sealer or primer compatible with finish coats to concealed surfaces of woodwork, including backs of cabinets and underside of countertops. Backprime surfaces to be set against concrete or plaster, as specified in Section 09 90 00.
   4. Transparent Finish: Chemical resistant finish, per WI V3 Appendix, applied over permanent wood stain color to match, or approximate, existing DVC SR science laboratory casework finish color. Submit a selection of Maple stain color samples from casework manufacturer's standard colors for final selection by the District and Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Casework Installation
   1. Set casework components plumb, square, and straight with no distortion and securely anchored. Shim as required using concealed shims and or leveling bolts.
   2. Screw continuous cabinets together with joints flush, tight, and uniform, and with alignment of adjacent units within 1/16-inch tolerance.
   3. Secure wall cabinets to solid supporting backing material, not to plaster, lath or gypsum board.

B. Countertop Installation: Anchor securely to base units and other support systems as indicated. Caulk space between backsplash and wall with specified sealant.
   1. Install countertops with no more than 1/8-inch in 96 inch sag, bow, or other variation from a straight line.
   2. Secure backsplashes to tops with concealed metal brackets at 16 inches on center.
C. Accessory and Fittings Installation: Install accessories and fittings in accordance with manufacturer’s recommendations. Turn screws to seat flat; do not drive.

3.2 ADJUSTING

A. Repair or remove and replace defective work, as directed by District’s Representative upon completion of installation.

B. Adjust doors, drawers, hardware, fixtures, and other moving or operating parts to function smoothly.

3.3 CLEANING

A. Clean shop finished casework, work surfaces, and accessories; touch up as required, wipe down and broom clean interior and exterior of equipment.

3.4 PROTECTION OF FINISHED WORK

A. Provide all necessary protective measures to prevent exposure of casework and equipment from exposure to other construction activity during installation.

B. Advise contractor of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

END OF SECTION
SECTION 12 36 61.16
SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Solid surfacing countertops.

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

C. Related Sections
   1. Section 05 50 00 - Metal Fabrications: Provision of countertop supports.
   2. Section 06 41 10 - Custom Casework: Provision of custom casework.
   3. Section 07 92 00 - Joint Sealants: Provision of sealants.

1.2 REFERENCES

A. WI - Woodwork Institute

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s product literature.

B. Shop Drawings: Show all items at large scale including methods of fabrication and construction.

C. Samples: Submit 3 solid surfacing materials, 6 inches square.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: DuPont Polymers, “Zodiaq”, or equal.

2.2 MATERIALS

A. Solid Surfacing: Homogeneous mixture containing 93 percent or greater pure quartz.
   1. Thickness: As indicated.
   2. Color: As selected by the Architect.

B. Plywood Backing for Countertops: Provide 1/2-inch marine plywood.

C. Sealant: As specified in Section 07 92 00.

D. Grommet: Liner and cap for 1-3/4 inch hole; satin chrome finish; as manufactured by Doug Mockett & Company, Inc.; Grainger; Electriduct, or equal.
2.3 FABRICATION

A. Quality Standard: Comply with WI Section 17D, “Decorative Synthetic Marble Countertops and Sinks”.
   1. Grade: Premium.
   2. Thickness of solid surfacing shall be constant and shall not vary.

B. Fabricate tops in 1 piece with shop-applied edges, unless otherwise indicated. Comply with solid surfacing material manufacturer’s recommendations for adhesives, sealers, fabrication, and finishing.
   1. Drill holes in countertops for grommets and other openings as indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor countertops securely to support systems as indicated. Caulk space between countertop and wall with specified sealant.
   1. Install countertops with no more than 1/8-inch in 96 inch sag, bow, or other variation from a straight line.

B. Seal joints in accordance with manufacturer’s instructions.

3.2 ADJUSTING AND CLEANING

A. Remove damaged or otherwise disfigured portions and replace with new prior to the District’s acceptance.

END OF SECTION
SECTION 21 00 00

FIRE SUPPRESSION BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Work included in 21 00 00, Fire Suppression Basic Requirements applies to Division 21, Fire Suppression work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of fire protection systems for proposed project.

B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.

C. Definitions:
   1. Provide: To furnish and install, complete and ready for intended use.
   2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
   3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete Item of work furnished.
   4. Or Equal: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent," substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted item.
   5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.2 RELATED SECTIONS

A. Content of Section applies to Division 21, Fire Suppression Contract Documents.

B. Related Work:
   1. Additional conditions apply to this Division including, but not limited to:
      a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
      b. Drawings
      c. Addenda
      d. Owner/Architect Agreement
      e. Owner/Contractor Agreement
      f. Codes, Standards, Public Ordinances and Permits
1.3 REFERENCES AND STANDARDS

A. References and Standards per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 21, Fire Suppression Sections and those listed in this Section.

B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
   1. State of California:
      a. CBC - California Building Code
      b. CEC - California Electrical Code
      c. CEC T24 - California Energy Code Title 24
      d. CFC - California Fire Code
      e. CMC - California Mechanical Code
      f. CPC - California Plumbing Code
      g. CSFM - California State Fire Marshal

C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
   1. ABA - Architectural Barriers Act
   2. ADA - Americans with Disabilities Act
   3. AHRI - Air-Conditioning Heating & Refrigeration Institute
   4. ANSI - American National Standards Institute
   5. ASCE - American Society of Civil Engineers
   6. ASCE-7 Minimum Design Loads for Buildings and Other Structures
   7. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
   8. ASHRAE Guideline 0, the Commissioning Process
   9. ASME - American Society of Mechanical Engineers
   10. ASPE - American Society of Plumbing Engineers
   11. ASSE - American Society of Sanitary Engineering
   12. ASTM - ASTM International
   13. AWWA - American Water Works Association
   14. CFR - Code of Federal Regulations
   15. FM - FM Global
   17. IAPMO - International Association of Plumbing and Mechanical Official
   18. ICC - International Code Council
   19. IEC - International Electrotechnical Commission
   21. HI - Hydraulic Institute Standards
   22. ISO - International Organization for Standardization
   23. MSS - Manufacturers Standardization Society
   24. NEC - National Electric Code
   25. NEMA - National Electrical Manufacturers Association
   26. NFPA - National Fire Protection Association:
      a. NFPA 13 - Standard for the Installation of Sprinkler Systems
      b. NFPA 24 - Standard for Installation of Private Fire Service Mains and Their Appurtenances
c. NFPA 25 - Standard for Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

d. NFPA 70 - National Electrical Code

e. NFPA 72 - National Fire Alarm and Signaling Code

27. OSHA - Occupational Safety and Health Administration
28. UL - Underwriters Laboratories Inc.

D. See Division 21, Fire Suppression individual Sections for additional references.

E. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.

F. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

G. Piping Insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.4 SUBMITTALS

A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 21, Fire Suppression sections.

B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.

C. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.

D. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one zip file per specification division containing a separate file for each Specification Section. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.

E. Submit shop drawings, calculations and product data sheets as one complete stand-alone package to Owner's insurance underwriter and Engineer.

F. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 21, Fire Suppression Sections.

G. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered
cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.

1. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed Item. Highlight connections by/to other trades.

2. Include technical data, installation instructions and dimensioned drawings for products, equipment and devices installed, furnished or provided. Reference Division 21, Fire Suppression specification Sections for specific Item required in product data submittal outside of these requirements.

3. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.

4. For vibration isolation of equipment, list make and model selected with operating load and deflection. Indicate frame type where required. Submit manufacturer's product data.

5. See Division 21, Fire Suppression Sections for additional submittal requirements outside of these requirements.

H. Maximum of two reviews provided of complete submittal package. Arrange for additional reviews and/or early review of long-lead Item; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.

I. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer’s comments. Identify Engineer’s comments and provide an individual response to each of the Engineer’s comments. Cloud changes in the submittals and further identify changes which are in response to Engineer’s comments.

J. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 21, Fire Suppression coordination documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical and Division 28, Electronic Safety submittals.

K. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.

L. Substitutions and Variation from Basis of Design:
   1. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
   2. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed...
M. Shop Drawings:

1. Provide coordinated Shop Drawings which include physical characteristics of all systems, equipment and piping layout, pipe layout, hanger layout, sway brace layout, seismic restraints, sway brace calculations, drains, location of drain discharge, risers, valves, details, water test information, physical device layout plans, and control wiring diagrams. Reference individual Division 21, Fire Suppression Sections for additional requirements for shop drawings outside of these requirements.

2. Provide Shop Drawings which indicate information required by NFPA 13. Include room names and fire sprinkler occupancy hazard classifications.

3. Provide Shop Drawings illustrating information for Hydraulic Information Sign for each hydraulic remote area calculated.

4. Utilizing the Reflected Ceiling backgrounds, provide Shop Drawings illustrating locations of fire sprinklers and piping.

5. Utilizing the Structural backgrounds, provide Shop Drawings illustrating locations and types of hangers and sway braces.

6. Provide Shop Drawings illustrating each type of hanger, including fasteners to structure.

7. Provide Shop Drawings illustrating each type of branchline restraint and sway brace, including length of sway brace member, sway brace fittings, minimum and maximum angles from vertical of sway brace member, method of attachment to structure, size, length and embedment of attachment to structure and size and type of structural member to which sway brace will be attached. Number each type of restraint and sway brace. Indicate on Drawings locations of each type of numbered restraint and sway brace.

8. Provide details for any hanger, attachment, or sway brace to be attached to any I-joist, structural insulated panels (SIPs), cross laminated timber, and similar engineered structural products according to the specifications of the engineered product manufacturer.


10. Shop Drawings to include a cross-sectional view that shows the sprinkler heads and piping in relation to the building's architectural and structural information. View to be chosen based on a location that will display the most information.

11. When required, provide Coordination Drawings.

12. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.

13. Provide details of hanger, sway bracing and branch line restraint attachments to structure and to piping. Include details on the size and load capacities of fasteners. Provide verification of the structural capacity to withstand seismic load.

14. Provide sway bracing calculations on drawings showing horizontal seismic design load and requirements, with indication of zone of influence for each bracing location.

15. Provide a schedule of sway bracing type, size, and design criteria, including length, angle from vertical, and load capacities.

16. Clearly indicate the elevation of the highest sprinkler in relation to the elevation of the flow test pressure gauge monitor hydrant.
17. Provide details of flexible sprinkler hose fitting per manufacturer's schedule of equivalent feet used in hydraulic calculations, showing device length, maximum number of 90-degree bends and expected radius of bends.

18. Provide a schedule of signage to be installed at each flexible sprinkler hose fitting.

19. On the drawings, provide a list of number, model, temperature, sprinkler Identification number, manufacturer, orifice, deflector type, thermal sensitivity and pressure rating, quantity of each type to be contained in the spare sprinkler cabinet and the issue date or revision date of the list."

20. Spare sprinkler head cabinet size indicating the number of spare sprinkler head to be contained therein.

N. Samples: Provide samples when requested by individual Sections.

O. Resubmission Requirements:
1. Make any corrections or change in submittals when required. Provide submittals as specified. The Engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Clearly indicate changes on Drawings and cloud changes in the submittals.

2. Resubmit for review until review indicates no exceptions taken or make "corrections as noted".

P. Operation and Maintenance Manuals/Owners Instructions:
1. Submit, at one time, electronic files (PDF format) on CD/DVD of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or Item requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
   a. Include copies of certificates of code authority acceptance, code-required acceptance tests; test reports and certificates.
   b. Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Sections.
   c. Catalog description of each item of equipment actually installed on job.
   d. Instructions for operation and maintenance of fire suppression systems composed of operating instructions, maintenance instructions and manufacturer's literature as follows:
      1) Testing and Maintenance Schedule Chart: Provide an 8-1/2- by 11-inch typewritten list of each item of installed equipment requiring testing inspection, lubrication or service, describing and scheduling performance of maintenance.
      2) Manufacturer's Literature: Provide copies of manufacturer's instructions for operation and maintenance of fire suppression equipment, including replacement parts list with name and address of nearest distributor. Mark each copy with equipment identification label as listed in equipment schedule, i.e. F-5 etc.
   e. Include product certificates of warranties and guarantees.
   f. Include Record Drawings,
   g. Include copy of water supply flow test used as basis for hydraulic calculations.
h. Include hydraulic calculations and sway brace calculations.

i. Include Contractor’s Material and Test Certificates for Aboveground Piping/Underground Piping.

j. Include a copy of NFPA 25.

k. Include a copy of the list to be included in the spare sprinkler head box.

l. Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.

m. Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, and quantities relevant to each piece of equipment: i.e. belts, motors, lubricants, and filters.

n. Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub-assemblies.

o. Include copy of startup and test reports specific to each piece of equipment.

p. Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.

2. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 21 00 00, Fire Suppression Basic Requirements, Article titled "Demonstration".

3. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.

Q. Record Drawings:

1. Maintain at site at least one set of Drawings for recording “As-constructed” conditions. Indicate on Drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical item. Include items changed by field orders, supplemental instructions, and constructed conditions.

2. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.

3. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.

4. Invert elevations and dimensioned locations for water services and drainage piping below grade extending to 5-feet outside building line.

5. Record Drawings to include site information or reference site information for complete understanding of the fire protection system between the building and the point of connection to the water supply and location of flow test pressure hydrants.

6. See Division 21, Fire Suppression individual Sections for additional items to include in Record Drawings.
1.5 **QUALITY ASSURANCE**

A. Regulatory Requirements: Work and materials installed to conform with all local, State, Federal and other applicable laws and regulations.

B. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every Item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

C. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.

D. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.

E. Provide products that are UL listed.

1.6 **WARRANTY**

A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.7 **COORDINATION DOCUMENTS**

A. Prior to construction, prepare and submit coordinated layout drawings (composite drawings), to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, fire alarm, plumbing, cable trays, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, electrical, fire alarm ceiling suspension and tile systems, etc.), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling and finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence. Unless otherwise required by Division 00, Procurement and Contracting Requirements and/or Division 01, General Requirements, Division 23, HVAC to combine information furnished by other trades onto master coordination documents.
B. Prepare Drawings as follows:
   1. Coordination models/drawings may be created using Revit 3D modeled elements or a 3D
      CAD software. The modeled elements to be graphically represented within the model as
      a specific system, object or assembly in terms of size, shape, location, quantity, and
      orientation with detailing, fabrication, assembly, and installation information.
      Non-graphic information may also be attached to the model elements. Model elements
      must have the ability to be spatially coordinated with other modeled elements using
      either Revit, Autodesk Navisworks or Autodesk A360.
   2. Provide drawings in CAD Format. CAD format release equal to design documents.
      Drawings to be same sheet size and scale as Contract Drawings and indicate location,
      size and elevation above finished floor of equipment and distribution systems.
   3. Review and revise, as necessary, section cuts in Contract Drawings after verification of
      field conditions.
   4. Indicate fire protection system piping including fittings, hangers, access panels, valves,
      and bottom of pipe elevations above finished floor.
   5. Indicate inverts and provision for piping that must be graded to have right-of-way over
      more flexible Item. Drawings also to indicate proposed ceiling grid and lighting layout as
      shown on electrical drawings, architectural reflected ceiling drawings and HVAC
      equipment, ductwork and piping. Drawings to indicate proposed and identified structural
      members to which hangers and sway braces will be attached as shown on structural
      drawings.
   6. Incorporate Addenda Item and change orders.
   7. Provide additional coordination as requested by other trades.

C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs
   resulting from failure to properly coordinate installation or failure to advise Architect of
   conflict.

D. Verify in field exact size, location, invert, and clearances regarding existing material,
   equipment and apparatus, and advise Architect of discrepancies between that indicated on
   Drawings and that existing in field prior to installation related thereto.

E. Submit final Coordination Drawings with changes as Record Drawings at completion of
   project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide like Item from one manufacturer, including but not limited to sprinkler heads, pipe,
   fittings, hangers and bracing materials.

2.2 MATERIALS

A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used
   for construction are to be new, latest products as listed in manufacturer's printed catalog data
   and are to be UL, ETL, FM, ICC-ES, and CSFM approved for their intended fire protection
   function or have adequate approval or be acceptable by State, County, and City authorities.
B. Articles, fixtures and equipment of a kind to be standard product of one manufacturer.

C. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.

D. Hazardous Materials:
   1. Comply with local, State of California, and Federal regulations relating to hazardous materials.
   2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
   3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

B. Install equipment requiring access (i.e. drains, control operators, valves, motors, engines, pumps, controllers, air compressors, gauges, fill cups, tanks, cleanouts and the like) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.

C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.

D. Earthwork:
   1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with the following:
      a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with the provisions specified. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
      b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
      c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

E. Firestopping:
1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:
   a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM International E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

F. Pipe Installation:
   1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating coordinating installation of piping systems.
   2. Include provisions for servicing and removal of equipment without dismantling piping.

G. Plenums: Provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

3.2 SEISMIC CONTROL

A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 21, Fire Suppression Sections.

B. Provide fire suppression equipment and piping, both hanging and base mounted, with mounting connection points of sufficient strength to resist lateral seismic forces equal to lateral seismic forces as determined by building code and NFPA 13 calculations, whichever is more demanding.

C. See Structural Drawings for seismic design criteria for sway bracing and seismic restraint.

D. Provide details of flexible drops for sprinklers in conformance with Building Code and ASCE 7 requirements of ceilings. Coordinate with Architectural and Structural Drawings and Specifications.

E. Piping: Per NFPA 13, ASCE-7 and local requirements.

F. Equipment:
   2. Provide means to prohibit excessive motion of fire protection equipment during an earthquake.
3.3 REVIEW AND OBSERVATION

A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
   1. Underground piping installation prior to backfilling.
   2. Prior to covering walls.
   3. Prior to ceiling cover/installation.
   4. When main systems, or portions of, are being tested and ready for inspection by AHJ.
   5. When mains or branchlines are to be permanently concealed by construction or insulation systems.
   6. When fire suppression systems, or portions of, are being tested and ready for inspection by AHJ.

C. Bear responsibility and cost to make piping accessible, to expose concealed lines, or to demonstrate acceptability of the system. If Contractor fails to notify Architect at times prescribed above, costs incurred by removal of such work are the responsibility of the Contractor.

D. Final Punch: Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 CUTTING AND PATCHING

A. Confirm Cutting and Patching requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:
   1. Cutting and patching performed under Division 21, Fire Suppression includes, but is not limited to:
      a. Cutting and patching of plaster or partitions.
      b. Cutting and patching of finished ceilings.
   2. Perform cutting and patching by skilled craftsmen in trade of work to be performed. Fill holes which are cut oversized for completed work. Match refinished areas with existing adjacent finish in a manner acceptable to Architect.
   3. When masonry to concrete construction must be penetrated, provide a steel pipe sleeve in opening and grout in place in a neat manner. Leave grout surface to match existing finish. Provide escutcheons. If sleeves are not provided, core drill penetrations.
   4. Locate concealed utilities to eliminate possible service interruption or damage.
   5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.
   6. Proposed floor cutting/core drilling/sleeve locations to have prior approval by Project Structural Engineer and DSA. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type
construction, show column cap extent and cell locations relative to proposed penetration(s).

7. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.

8. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.

9. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, landscaping, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.

10. Repair mutilation of building around pipes, equipment, hangers, and braces.

**3.5 EQUIPMENT SELECTION AND SERVICEABILITY**

A. Replace or reposition equipment which is too large or located incorrectly to permit servicing at no additional cost to Owner.

**3.6 DELIVERY, STORAGE AND HANDLING**

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:

1. Handle materials delivered to project site with care to avoid damage and deterioration.
   Store materials in original containers which identify manufacturer, name, brand and model numbers on site inside building or protected from weather, sun, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.

2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.

3. Protect bright finished shafts, bearing housings and similar Item until in service.

**3.7 DEMONSTRATION**

A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements,
Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

D. Prior to acceptance of work and during time designated by Architect, provide necessary qualified personnel to operate system for a period of two hours.

E. Instruct the Owner in the operation of the sprinkler system, including main valve position (open or closed) recognition, system drainage, system testing, dry pipe valve reset and the relation to the fire alarm system.

F. Upon completion of work and adjustment of equipment, test systems to demonstrate to Owner's Representative and Architect that equipment is furnished and installed or connected under provisions of these Specifications.

3.8 CLEANING

A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

B. Upon completion of installation, except for sprinklers, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

C. Sprinklers may not be cleaned except for vacuuming in a manner in which no part of the sprinkler is touched by the vacuuming equipment. Replace sprinklers which bear traces of foreign substances with sprinklers of same model, temperature, K-factor, orifice, finish, style, orientation, and the like.

3.9 INSTALLATION

A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

B. Install equipment in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.

C. Start-up equipment, in accordance with manufacturer's start-up instructions, in the presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment. Provide pump impellers to obtain Basis of Design design capacities.

D. Provide miscellaneous supports/metals required for installation of equipment and piping.
3.10 PAINTING

A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:

1. Ferrous Metal: After completion of fire protection work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
2. After acceptance by Authority Having Jurisdiction (AHJ), in a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
3. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
4. Piping: Clean, primer coat and paint exposed piping on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
5. Covers: Covers such as vault covers and the like will be furnished with finishes which resist corrosion and rust.

3.11 ACCEPTANCE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Sections in Division 21, Fire Suppression and the following:

1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
   b. Cleaning
   c. Operation and Maintenance Manuals
   d. Training of Operating Personnel
   e. Record Drawings
   f. Warranty and Guaranty Certificates
   g. Start-up/Test Document and Commissioning Reports
   h. Letter of Conformance

3.12 FIELD QUALITY CONTROL

A. Confirm Field Quality Control requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

B. Upon completion of installation of equipment, sprinklers, hose valves and piping and after units are water pressurized, test system to demonstrate capability and compliance with
requirements. When possible, correct malfunctioning Item at site, then retest to demonstrate compliance; otherwise remove and replace with new Item and proceed with retesting.

C. Inspect each installed Item for damage to finish. If feasible, restore and match finish to original, except fire sprinklers, at site; otherwise, remove Item and replace with new Item. Feasibility and match to be judged by Architect. Remove cracked or dented Item and replace with new Item.

D. Fire sprinklers may not be reused, or cleaned, except for dusting. Replace damaged, field painted, oversprayed, overcoated or field coated sprinklers with new sprinklers of same manufacturer, model, finish, K-factor and performance characteristics. Where identical replacement sprinklers are not available, provide sprinklers of similar finish, style, K-factor and performance characteristics.

3.13 LETTER OF CONFORMANCE

A. Provide Letter of Conformance and copies of manufacturers' warranties and extended warranties with a statement that fire suppression items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.14 ELECTRICAL INTERLOCKS

A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize fire protection equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

3.15 CONNECTIONS TO EXISTING

A. Prior to connection of piping to existing piping or utilities, field verify existing conditions and exact sizes and locations of existing piping. Provide additional offsets, transitions, joints, cut-ins, and replace portions of existing as required to facilitate connections of new.

END OF SECTION
SECTION 21 05 00
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY
A. Work Included:
   1. Aboveground Black Steel Pipe and Fittings
   2. Wall and Floor Penetrations and Sleeves
   3. Hangers and Supports
   4. Struts and Strut Clamps
   5. Sway Braces and Restraints
   6. Anchors and Attachments

1.2 RELATED SECTIONS
A. Contents of Division 21, Fire Suppression and Division 01, General Requirements apply to this Section.
B. In addition, reference the following:
   1. Division 22, Plumbing
   2. Division 23, Heating, Ventilating and Air Conditioning
   3. Division 26, Electrical
   4. Division 28, Electronic Safety
   5. Division 31, Earthwork
   6. Section 21 00 00, Fire Suppression Basic Requirements
   7. Section 21 13 00, Fire Suppression Sprinkler Systems

1.3 REFERENCES AND STANDARDS
A. References and Standards as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS
A. Submittals as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE
A. Quality assurance as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.
B. In addition, meet the following:
2. Provide per AHJ requirements.
3. References to product Specifications for materials are listed according to accepted ANSI, ASTM, ASME, AWWA and other base standards. Materials to meet latest approved versions of these standards.
4. See Section 21 00 00, Fire Suppression Basic Requirements where piping materials are approved for use.
5. Fire Suppression Screw-Thread Connections: Comply with local fire department/fire marshal regulations for sizes, threading and arrangement of connections for fire department equipment to fire department connections.
6. Manufacturers: Unless an item is marked "No substitutions", submit substitution request for materials of other than named manufacturers.
7. Noise and Vibration:
   a. Install vibration isolators and measures required to prevent noise and vibration from being transmitted to occupied areas. Select equipment to operate within noise coefficient (NC) design level for particular type of installation in relation to its location.
   b. After installation, make proper adjustments to reduce noise and vibration to acceptable levels as defined by Architect.
   c. In acoustically sensitive areas, design system in a manner that minimizes the number of wall penetrations.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.7 FLOW TEST

A. Provide materials and labor for a new water supply test on the closest nearby fire hydrants per NFPA 13 and NFPA 291. Base hydraulic calculations on new flow test.

1.8 SYSTEM IMPAIRMENT

A. When returning a water-based fire protection system to service after impairment or control valve closure, verify the system is in working order by performing a main drain test per NFPA 25.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Aboveground Black Steel Pipe and Fittings:
   1. Pipe:
      a. Bull Moose Tube
      b. Or equal.
2. Fittings, Mechanical and Grooved Couplings:
   a. Victaulic
   b. Or equal.
3. Fittings, Threaded:
   a. Anvil International
   b. Or equal.
4. Fittings, Rubber Gasketed:
   a. Victaulic
   b. Or equal.
5. Fittings, Welded:
   a. Anvil International
   b. Or equal.
6. Fittings, Flanged:
   a. Victaulic
   b. Or equal.

B. Wall and Floor Penetrations and Sleeves:
1. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
2. Fire Protection Products Incorporated (FPPI)
3. Or equal.

C. Hangers and Supports:
1. Cooper B-Line Tolco
2. Or equal.

D. Struts and Strut Clamps:
   1. Struts:
      a. Cooper B-Line Tolco
      b. Or equal.
   2. Strut Clamps:
      a. Cooper B-Line Tolco
      b. Or equal.

E. Sway Braces and Restraints:
1. Cooper B-Line Tolco
2. Or equal.

F. Anchors and Attachments:
   1. Concrete:
      a. Cast-In Place Anchors for Hangers:
         1) Cooper B-Line Tolco
         2) Or equal.
      b. Cast-In Place Anchors for Braces:
         1) Cooper B-Line Tolco
         2) Or equal.
      c. Attachments as specified or described by structural. If not specified or described by structural, then as follows:
         1) Hilti; Model Kwikbolt TZ.
2) Or equal.
2. Steel:
   a. Cooper B-Line Tolco
   b. Or equal.

2.2 ABOVEGROUND BLACK STEEL PIPE AND FITTINGS

A. Wet Pipe Systems:
   1. Pipe Size 2-inch Diameter and Smaller: ASTM A53, ASTM A135, or ASTM A795;
      minimum of Schedule 40 or minimum Corrosion Resistance Ratio (CRR) of 1.00 per UL
      Listing or FM Global Approval.
      minimum of Schedule 10 or minimum CRR of 1.00 per UL Listing or FM Global
      approval. Wall thickness greater than Schedule 5. Schedule 5 not approved.

B. Joints:
   1. Threaded, flanged or bevel welded.
   2. Piping installed in plenums or shafts to have welded joints.

C. Fittings:
   1. Threaded:
      a. Malleable Iron: Class 150 and Class 300, ANSI B16.3.
      b. Cast Iron: Class 125 and 250, ANSI B16.3.
   2. Flanged:
      b. Raised ground face, bolt holes spot faced.
   3. Welded:
      a. Carbon Steel: Long radius, standard weight or extra strong.
      d. Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for
         Moderate and Elevated Temperatures: ASTM A234.
      e. Steel Pipe Flanges and Flanged Fittings: ASME B16.5.
      f. Forged Steel Fittings, Socket Welded and Threaded: ASME B16.11.
   4. Mechanical Fittings and Grooved Couplings:
      a. Couplings: UL 213, AWWA C606, ASTM A536 ductile iron or ASTM A47
         malleable iron, with enamel finish and grooves or shoulders designed to accept
         grooved couplings. Synthetic-rubber gasket with central-cavity,
         pressure-responsive design and ASTM A183 carbon-steel bolts and nuts.
      b. FM Global approved.

D. Anti-Microbial Coating: Factory-applied coating to inhibit corrosion from microbiological
   organisms.

2.3 WALL AND FLOOR PENETRATIONS AND SLEEVES

A. Below Grade and High Water Table Areas: Waterproof elastomeric compound.
2.4 HANGERS AND SUPPORTS

A. General: Select size of hangers and supports to exactly fit pipe size for bare piping.

B. Hangers: Ferrous.

C. Hanger Rods:
   1. Concealed Spaces: Continuously threaded or threaded ends.
   2. Exposed Spaces: Threaded ends.

D. Finishes: Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

E. Materials:
   1. Use carbon steel pipe hangers and supports, metal trapeze pipe hangers and attachments for general service applications.
   2. Use stainless steel hangers, rods and attachments for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries and the like.

F. Anti-Scratch Padding: Use padded hangers for piping subject to scratching.

2.5 STRUTS AND STRUT CLAMPS

A. Electro-galvanized steel.

B. Designed for supporting pipe runs from strut supports.

C. UL listed for pipe up to 8-inches in diameter.

D. Stainless steel for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries and the like.

2.6 SWAY BRACES AND RESTRAINTS

A. Sway Bracing: From a single manufacturer and compatible with sway brace calculation program.

B. Stainless steel for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries, and the like.
2.7 ANCHORS AND ATTACHMENTS

A. General: Anchor supports to masonry, concrete and block walls per anchoring system manufacturer’s recommendations, or as modified by project Structural Engineer.

B. Materials:
   1. Ferrous.
   2. Stainless steel for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries, and the like.

C. Cast in Place Anchors for Hangers: Verify listing is for hangers, braces, or both.

D. Attachments in Concrete:
   1. Suitable for hanging and bracing fire protection systems in concrete which is subject to cracking in a seismic event.
   2. Seismic Design Areas C, D, E and F:
      b. All models of Hilti HDI and ITW Red Head Multi-Set II anchors are not approved for attaching fire protection systems in Seismic Design Areas C, D, E and F. No Exceptions.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install in conformance with UL Listing, FM Approval or ICC-ES requirements and restrictions.

3.2 ABOVEGROUND BLACK STEEL PIPE AND FITTINGS

A. Piping Routing:
   1. Route piping, except as otherwise indicated, vertically and horizontally (sloped to drain). Avoid diagonal runs wherever possible. Orient horizontal routes parallel with walls and beam lines.
   2. Install piping as shown or described by diagrams, details and notations on Drawings or, if not indicated, install piping to provide the shortest route which does not obstruct usable space or block access for servicing the building and its equipment.
   3. Install piping in concealed spaces above finished ceilings. Prior to design and installation, obtain pre-approval by Architect for exposed piping.
   4. In open-to-structure areas which are open to public view, route exposed piping to minimize visual impact. Obtain Architect's and Engineer's approval of exposed piping installation.
   5. Coordinate installation with other trades. Route piping as required to avoid building structure, equipment, plumbing piping, HVAC piping, ductwork, lighting fixtures,
electrical conduits and bus ducts and similar work. Final location of lighting will have priority over final sprinkler locations. Provide drains to trapped sections of system which result from such routing. Other trades take precedence for installation space.

6. Support piping adjacent to walls, overhead construction, columns and other structural and permanent enclosure elements of the building. Limit clearance to 2-inches wherever furring is indicated for concealment of piping. Allow for insulation thickness. Locate insulated piping to provide minimum 1-inch clearance outside insulation.

7. Wherever possible in finished and occupied spaces, conceal piping from view by locating within column or beam enclosures, hollow wall construction, or above suspended ceilings. Do not encase horizontal routes in solid partitions, except where approved.

8. General Electrical Equipment Clearances: Do not route piping through electrical rooms, transformer vaults, elevator equipment rooms and other electrical or electronic equipment spaces and enclosures. Within equipment rooms, provide minimum 3-feet lateral clearance from sides of electric switchgear panels. Do not route piping above electric power or lighting panel, switchgear, or similar electric device. Coordinate with electrical and coordinate exact pipe routing to provide proper clearance with such Item.

9. Route water filled and dry system piping around, not into or through, rooms protected by pre-action systems, clean-agent systems, gaseous suppression systems and other alternative fire suppression systems.

10. Install piping as close as possible to ceiling to avoid conflicts with other trades.

11. Install pipe runs to minimize obstruction to other work.

12. Pitch pipe for dry system piping passing through warm as well as cold areas.

B. Couplings:
1. Install where indicated on Drawings and on each side of pieces of equipment to permit easy removal of equipment.
2. Deburr cut edges.

C. Pipe Penetrations: Wire pipe cutout coupon at point of pipe penetration.

D. Pipe and Pipe Fittings:
1. Expansion and Flexibility: Install work with due regard for expansion and contraction to prevent damage to the piping, equipment, building and its contents. Provide piping offsets, loops, approved type expansion joints, sway bracing, wire restraints, vertical restraints, flexible couplings or other means to control pipe movement and to minimize pipe forces.
2. Coordinate support of pipe 4-inches and larger with Structural Engineer.
3. Provide clearances around piping per NFPA 13.
4. Pitch pipe for dry system piping located or passing through warm as well as cold areas.
5. Install welded pipe with welds facing vertically up, or where this is not possible, as close as possible to vertical between 46 degrees and 234 degrees. Intent is to minimize corrosion caused by moisture in the bottom of pipes.

3.3 WALL AND FLOOR PENETRATIONS AND SLEEVES

A. Escutcheons: Install on exposed pipes passing through walls or floors.
1. **Pipe Sleeves:** Lay out work in advance of pouring concrete and furnish and set sleeves necessary to complete work.

2. **Floor Sleeves:** Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1-inch above finished floor. Caulk pipes passing through floor with nonshrinking fire and water resistant grout or equal caulking compound. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements.

3. **Wall Sleeves:** Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with non-shrinking caulking compound. Caulk/seal piping passing through fire-rated building assemblies with UL Listed or FM Approved fire-rated firestopping compound. Provide fire-rated assemblies per local AHJ requirements.

4. **Beam Sleeves:** Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Penetrations must be indicated on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.

5. **Penetrations in Fire-Rated Wall/Floor Assemblies:**
   a. Reference Division 07, Thermal and Moisture Protection.
   b. Coordinate with Drawings location of fire rated walls, ceilings and floors. When these assemblies are penetrated, seal around piping and equipment with approved firestopping material.
   c. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814 and NFPA.
   d. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814.

### 3.4 HANGERS AND SUPPORTS

A. Installation of pipe hangers, inserts and supports to conform to NFPA 13. Provide adjustable hangers, inserts, brackets, clamps, supplementary steel and other accessory materials required for proper support of pipe lines and equipment. Provide supplementary materials for proper support and attachment of hangers.

### 3.5 STRUTS AND STRUT CLAMPS

A. Install per manufacturer's listed orientation.

### 3.6 SWAY BRACES AND RESTRAINTS

A. Locate per orientation and spacing as required by sway brace calculations.

B. Attach sway bracing directly to pipe or equipment being braced.

C. Do not attach sway bracing to bottom of truss members.
3.7 ANCHORS AND ATTACHMENTS

A. In post-tension construction, determine location of post-tension cables and install anchors to avoid contact or interference with post-tension cables. Coordinate with Structural.

B. Do not use powder-driven attachments.

C. Building Attachments and Inserts: Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves and flanges, for sizes NPS 2-1/2 and larger. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

D. Hanger and Support Attachments:
   1. Concrete:
      a. Before Pouring: Support piping and equipment from malleable iron concrete form inserts placed before concrete is poured.
      b. After Pouring:
         1) Where supports in slabs are required after concrete has been poured, provide drilled-in threaded inserts (mechanical-expansion anchors), installed in accordance with manufacturer's recommendations.
         2) Install mechanical-expansion anchors after concrete is completely cured and in accordance with manufacturer's installation instructions.
         3) Where anchors are to be installed in post-tension construction, determine and avoid locations of post-tension cables prior to drilling.
   2. Metal Floor Deck: Support hangers per UL Listing or FM Approval for selected concrete insert before pouring of concrete topping, or from beam clamps fastened to structural steel.
   3. Steel Joists: Support hangers from beam clamps fastened to bar joists or to auxiliary steel between bar joists as required.
   4. C-Clamp Hangers: Do not attach to one side of double-angle bottom members.
   5. Locate and install hangers, supports and attachments connecting to I-joists, structural insulated panels (SIPs), cross laminated timber and similar engineered structural products according to the structural product manufacturer specifications.

E. Make available to the Architect information required to verify the anchorage, sway bracing and restraint of fire protection systems.

END OF SECTION
SECTION 21 13 00

FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Sprinklers

B. Scope:
   1. Wet-Pipe Sprinkler System.
   2. Revision and extension of existing system to new and remodeled areas.

C. Coordinate location and type of tamper, flow and pressure switches and fire alarm system.

D. Provide electrical connections and wiring as required for a complete and operable system. Includes but is not limited to bells, air compressors, sump pumps, fire pumps, jockey pumps and pump controllers.

1.2 RELATED SECTIONS

A. Contents of Division 21, Fire Suppression and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. Division 22, Plumbing
   2. Division 23, Heating, Ventilating and Air-Conditioning
   3. Division 26, Electrical
   4. Division 28, Electronic Safety
   5. Section 21 00 00, Fire Suppression Basic Requirements
   6. Section 21 05 00, Common Work Results for Fire Suppression

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Hydraulic calculations.
   2. Sway brace calculations.
   3. Details of sway bracing.
   4. Details of interval and end of branch line restraints.
5. Details of flexible sprinkler hose fitting assembly, including number and radius of bends, corresponding to equivalent feet used in hydraulic calculations. Provide details of sign to be installed at each flexible sprinkler hose fitting assembly.

6. Details of oversized ceiling penetrations and oversized sprinkler escutcheons.

7. Trapeze hanger details and calculations, including size, length and material. Additionally, provide size, weight and number of pipes to be carried on the trapeze.

8. On submittal and As-Built drawings, provide text of sprinkler list to be installed in the spare sprinkler cabinet.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.7 SYSTEM DESCRIPTION

A. Provide coverage for building areas as indicated. Field verify field conditions prior to submittal of bid. Adjust bid to provide protection features in accordance with applicable codes and interpretations by AHJ. Provide design and installation based on more stringent requirements if this specification and AHJ requirements differ from Code.

B. Design Parameters:
   1. Increase remote design area for dry systems per NFPA 13.
   2. Building Area: Classrooms.
      a. Occupancy Classification: Light.
      b. Inside Hose Allowance: 0 GPM.
      c. Outside Hose Allowance: 100 GPM.
      a. Occupancy Classification: Ordinary Group 1.
      b. Inside Hose Allowance: 0 GPM.
      c. Outside Hose Allowance: 100 GPM.

C. Sprinkler system design to include a 10 percent pressure and flow cushion between system demand point and available water supplies.

D. Extend hydraulic calculations from hydraulically most remote design area back to location of pressure hydrant of flow test or effective point of water supply where characteristics of water supply are known.

E. Develop cost-effective designs that may include use of extended coverage sprinklers and design area reductions as allowed by NFPA 13.

1.8 EXTRA STOCK

A. Provide extra sprinklers per code.
B. Provide suitable wrenches for each sprinkler type and metal storage cabinet in riser room.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Sprinklers:
   1. Finished Areas:
      a. Tyco
      b. Or equal.
   2. Nonfinished Areas:
      a. Tyco
      b. Or equal.

2.2 SPRINKLERS

A. Finished Areas:
   1. Type: Glass-Bulb
   2. Style: Concealed
   3. Response: Quick-Response
   4. Finish: White Polyester
   5. Escutcheon: White Polyester
   6. Coverplate for Concealed Sprinklers:
      a. Flat Plate
      b. White

B. Nonfinished Areas:
   1. Type: Glass-Bulb
   2. Response: Quick-Response
   3. Finish: Brass

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install per manufacturer's requirements and recommendations.

3.2 SPRINKLERS

A. Center sprinklers in center or quarter points of suspended ceiling tile.

B. Align sprinklers with architectural column lines, lighting, diffusers and other ceiling features. In unfinished ceilings, route piping to minimize visual impact. Sprinklers and piping not so aligned are to be removed and replaced at no additional cost to Owner.

C. Install dry sprinklers in a manner which does not trap water.

END OF SECTION
SECTION 22 00 00
PLUMBING BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Work included in 22 00 00, Plumbing Basic Requirements applies to Division 22, Plumbing work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of plumbing systems for proposed project.

B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.

C. Definitions:
   1. Provide: To furnish and install, complete and ready for intended use.
   2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
   3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
   4. Or equal: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
   5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.2 RELATED SECTIONS

A. Contents of Section applies to Division 22, Plumbing Contract Documents.

B. Related Work:
   1. Additional conditions apply to this Division including, but not limited to:
      a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
      b. Drawings
      c. Addenda
      d. Owner/Architect Agreement
      e. Owner/Contractor Agreement
      f. Codes, Standards, Public Ordinances and Permits
1.3 REFERENCES AND STANDARDS

A. References and Standards per Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, individual Division 22, Plumbing Sections and those listed in this Section.

B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
   1. State of California:
      a. CBC - California Building Code
      b. CEC - California Electrical Code
      c. CEC T24 - California Energy Code Title 24
      d. CFC - California Fire Code
      e. CMC - California Mechanical Code
      f. CPC - California Plumbing Code
      g. CSFM - California State Fire Marshal
      h. DSA - Division of State Architect Regulations and Requirements

C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
   1. ABA - Architectural Barriers Act
   2. ADA - Americans with Disabilities Act
   3. AHRI - Air-Conditioning Heating & Refrigeration Institute
   4. ANSI - American National Standards Institute
   5. ASCE - American Society of Civil Engineers
   6. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
   7. ASHRAE Guideline 0, the Commissioning Process
   8. ASME - American Society of Mechanical Engineers
   9. ASPE - American Society of Plumbing Engineers
   10. ASSE - American Society of Sanitary Engineering
   11. ASTM - ASTM International
   12. AWWA - American Water Works Association
   13. CFR - Code of Federal Regulations
   14. CISPI - Cast Iron Soil Pipe Institute
   15. ETL - Electrical Testing Laboratories
   16. EPA - Environmental Protection Agency
   17. FM - FM Global
   18. IAPMO - International Association of Plumbing and Mechanical Officials
   19. GAMA - Gas Appliance Manufacturers Association
   20. HI - Hydraulic Institute Standards
   21. ISO - International Organization for Standardization
   22. MSS - Manufacturers Standardization Society
   23. NEC - National Electric Code
   24. NEMA - National Electrical Manufacturers Association
   25. NFGC - National Fuel Gas Code
   26. NFPA - National Fire Protection Association
   27. NRCA - National Roofing Contractors Association
   28. NSF - National Sanitation Foundation
29. OSHA - Occupational Safety and Health Administration
30. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
31. TEMA - Tubular Exchanger Manufacturers Association
32. TIMA - Thermal Insulation Manufacturers Association
33. UL - Underwriters Laboratories Inc.

D. See Division 22, Plumbing individual Sections for additional references.

E. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.

F. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

G. Piping Insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

H. All potable water system components, devices, material, or equipment containing a weighted average of greater than 0.25 percent lead are prohibited, and shall be certified in accordance with current editions of the Safe Drinking Water Act (SDWA), NSF 61 & NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61.

1.4 SUBMITTALS

A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 22, Plumbing Sections.

B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.

C. In addition:
   1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
   2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one zip file per specification division containing a separate file for each Specification Section. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. Deviations will be returned without review.
   3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 22, Plumbing Sections.
4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
   a. Label submittal to match numbering/references as shown in Contract Documents and schedules. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
   b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference Division 22, Plumbing Sections for specific items required in product data submittal outside of these requirements.
   c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
   d. For vibration isolation of equipment, list make and model selected with operating load and deflection. Indicate frame type where required. Submit manufacturer's product data.
   e. See Division 22, Plumbing Sections for additional submittal requirements outside of these requirements.

5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.

6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.

7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet Section 22 05 48, Vibration and Seismic Controls for Plumbing Piping and Equipment. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.

8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 22, Plumbing Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.

9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.

10. Substitutions and Variation from Basis of Design:
   a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
   b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and
requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of “Submittals”. For any product marked "or equal", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.

11. Shop Drawings: Provide coordinated Shop Drawings which include physical characteristics of all systems, equipment and piping layout plans, and control wiring diagrams. Reference individual Division 22, Plumbing Sections for additional requirements for Shop Drawings outside of these requirements.
   a. Provide Shop Drawings indicating sanitary and storm cleanout locations and type to Architect for approval prior to installation.
   b. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.

12. Samples: Provide samples when requested by individual Sections.

13. Resubmission Requirements:
   a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
      1) Resubmit for review until review indicates no exception taken or "make corrections as noted".
      2) When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.

14. Operation and Maintenance Manuals, Owners Instructions:
   a. Submit, at one time, electronic files (PDF format) on CD/DVD of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
      1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
      2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.
      3) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
      4) Include copy of startup and test reports specific to each piece of equipment.
5) Include copy of final water systems balancing log along with pump operating data.
6) Include commissioning reports.
7) Include copy of pressure, flow, leakage and purity test data and water systems test data, as applicable. Include copy of third-party and state and local jurisdiction inspection reports.
8) Include copy of valve charts/schedules.
9) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
10) Include product certificates of warranties and guarantees.
11) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.

b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 22 00 00, Plumbing Basic Requirements article titled "Demonstration".

c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.

15. Record Drawings:
   a. Maintain at site at least one set of drawings for recording “As-constructed” conditions. Indicate on Drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
   b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
   c. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.
   d. Provide Invert elevations and dimensioned locations for water services, building waste, and storm drainage piping below grade extending to 5-feet outside building line.
   e. See Division 22, Plumbing individual Sections for additional items to include in record drawings.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Work and materials installed to conform with all local, State, Federal and other applicable laws and regulations.

B. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturers equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and
equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

C. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.

D. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.

E. Provide products that are UL listed.

F. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.

G. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

1.6 WARRANTY

A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty in Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.7 COORDINATION DOCUMENTS

A. Prior to construction, prepare and submit coordinated layout drawings (composite drawings) to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, plumbing, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, fire protection, electrical, ceiling suspension, and ceiling tile systems, etc.), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence. Unless otherwise required by Division 00, Procurement and Contracting Requirements and/or Division 01, General Requirements, Division 23, HVAC to combine information furnished by other trades onto master coordination documents.

B. Prepare Drawings as follows:
1. Coordination models/drawings may be created using Revit 3D modeled elements or a 3D CAD software. The modeled elements to be graphically represented within the model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the model elements. Model elements must have the ability to be spatially coordinated with other modeled elements using either Revit, Autodesk Navisworks or Autodesk A360.

2. Drawings in CAD Format. CAD format release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.

3. Review and revise, as necessary, section cuts in Contract Drawings after verification of field conditions.

4. Indicate plumbing system piping including fittings, hangers, access panels, valves, and bottom of pipe elevations above finished floor.

5. Indicate invert and provision for piping that must be graded to have right-of-way over more flexible items. Drawings also to indicate proposed ceiling grid and lighting layout as shown on electrical drawings and architectural reflected ceiling drawings and HVAC equipment, ductwork and piping.

6. Incorporate Addenda items and change orders.

7. Distribute drawings to trades and provide additional coordination as requested by other trades.

C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

D. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.

E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

1.8 WORK INCLUDED

A. Furnish and install sleeves, inserts and anchorage required for the installation, which are embedded in work of other trades. Sleeve, wrap and seal piping in concrete.

B. Electrical: For plumbing trim/devices/equipment, provide, from the line voltage connection by Division 26, the low voltage electrical connections and wiring as required for complete and operable system. Includes, but is not limited to: Low voltage electrical raceway, wiring and accessories, such as step-down transformers as necessary for function of sensors and automatic valve and faucet controls. Supply step-down transformers and size wiring as recommended by manufacturer of plumbing trim/faucets requiring electrical low voltage connection.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide like items from one manufacturer, including but not limited to fixtures, pumps, drains and equipment.

2.2 MATERIALS

A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL approved or have adequate approval or be acceptable by State, County, and City authorities.

B. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.

C. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.

D. Hazardous Materials:
   1. Comply with local, State of California, and Federal regulations relating to hazardous materials.
   2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
   3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

B. Install equipment requiring access (i.e., drain pans, drains, control operators, valves, motors, cleanouts and water heaters) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.

C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.

D. Earthwork:
1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
   a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with the provisions of related earthwork Sections/divisions. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
   b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
   c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

E. Firestopping:
   1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
      a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

F. Pipe Installation:
   1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.
   2. Include provisions for servicing and removal of equipment without dismantling piping.

G. Plenums:
   1. Provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

3.2 SEISMIC CONTROL

A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, Section 22 05 48, Vibration and Seismic Controls for Plumbing Piping and Equipment, and individual Division 22 Plumbing Sections.

B. Piping:

C. Provide means to prohibit excessive motion of plumbing equipment during earthquake.
3.3 REVIEW AND OBSERVATION

A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
   1. Underground piping installation prior to backfilling.
   2. Prior to covering walls.
   3. Prior to ceiling cover/installation.
   4. When main systems, or portions of, are being tested and ready for inspection by AHJ.

C. Bear responsibility and cost to make piping accessible, to expose concealed lines, or to demonstrate acceptability of the system. If Contractor fails to notify Architect at times prescribed above, costs incurred by removal of such work are the responsibility of the Contractor.

D. Final Punch:
   1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Plumbing Precloseout Checklist, complete the checklist confirming completion of systems’ installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer’s acceptance that the plumbing systems are ready for final punch.
   2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 CONTINUITY OF SERVICE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
   1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
   2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping, and wiring to point of connection.
   3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
      a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
   4. Organize work to minimize duration of power interruption.

3.5 CUTTING AND PATCHING

A. Confirm Cutting and Patching requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).

2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.

3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.

4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing piping and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.

5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.6 EQUIPMENT SELECTION AND SERVICEABILITY

A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.7 DELIVERY, STORAGE AND HANDLING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:

1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.

2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.

3. Protect bright finished shafts, bearing housings and similar items until in service.

3.8 DEMONSTRATION

A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field
instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.9 CLEANING

A. Confirm cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

A. Confirm installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.

C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
   1. Do not place equipment in sustained operation prior to initial balancing of plumbing systems.
   2. Provide pump impellers to obtain Basis of Design design capacities.

D. Provide miscellaneous supports/metals required for installation of equipment and piping.

3.11 PAINTING

A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
   1. Ferrous Metal: After completion of plumbing work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt for exterior or black enamel for interior, suitable for hot surfaces.
2. In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
3. See individual equipment Specifications for other painting.
4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
5. Piping: Clean, primer coat and paint exposed piping on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

3.12 ACCEPTANCE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Sections in Division 22, Plumbing and the following:
1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
   a. Testing and Balancing Reports
   b. Cleaning
   c. Operation and Maintenance Manuals
   d. Training of Operating Personnel
   e. Record Drawings
   f. Warranty and Guaranty Certificates
   g. Start-up/Test Document and Commissioning Reports

3.13 FIELD QUALITY CONTROL

A. Confirm Field Quality Control requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

B. Tests:
   1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.
   2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.14 LETTER OF CONFORMANCE

A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that plumbing items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.
3.15  ELECTRICAL INTERLOCKS

A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize plumbing equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

END OF SECTION
SECTION 22 05 19
PLUMBING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Pressure Gauges
   2. Thermometers
   3. Meters, Positive Displacement (Liquid)
   4. Water Hammer Arrestors (Shock Absorbers)
   5. Trap Primers

1.2 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Pressure Gauges:
   1. Dwyer Instruments, Inc.
   2. Moeller Instrument Co., Inc.
   3. Omega Engineering, Inc.
   4. Trerice
   5. Or equal.
B. Thermometers:
   1. Ashcroft
   2. Trerice
   3. Weiss
   4. Marshaltown
   5. Weksler
   6. Or equal.

C. Meters, Positive Displacement (Liquid):
   1. Neptune
   2. Hersey
   3. Badger
   4. Sensus
   5. Or equal.

D. Water Hammer Arrestors (Shock Absorbers):
   1. Piston Type:
      a. PPP
      b. Sioux Chief
      c. Or equal.

E. Trap Primers:
   1. Wade
   2. Zurn
   3. J.R. Smith
   4. PPP
   5. Or equal.

2.2 PRESSURE GAUGES

A. Pressure Gauges: ASME B40.100, phosphor-bronze bourdon type, dry type.
   1. Case: Cast aluminum, stem-mounted, flange less.
   2. Size: 4-1/2-inch diameter.
   5. Scale: White aluminum with black graduation and markings.
   7. Mid-Scale Accuracy: One percent.
   8. Scale: PSI and KPa.
   9. Basis of Design: Trerice Model 600CB.

2.3 THERMOMETERS

A. Thermometers - Adjustable Angle: Red or blue appearing organic liquid in glass, ASTM E 1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
   1. Size: 9-inch scale.
   2. Window: Acrylic.
3. Scale: Aluminum, white background, black graduations and markings.
5. Accuracy: 2 percent, per ASTM E 77.
6. Calibration: 0-160 with 2 Degrees F graduations.

2.4 METERS, POSITIVE DISPLACEMENT (LIQUID)

A. Disc Type Meter: Bronze split casing, magnetic drive, heavy duty gear train, completely sealed, circular meter, totalize cubic feet with sweep hand. Comply with AWWA performance standards.

B. Turbine Type Meter: Bronze housing, inlet and outlet straightening vanes, direct magnetic drive, sealed register with odometer type totalization display in cubic feet, center sweep hand, low flow detector, ceramic magnet, AWWA Standard C701.

C. Compound Type Meter: Positive displacement rotating disc style low flow measuring chamber, turbine measuring chamber and automatic control valve. Permanently sealed registers use magnetic drives, odometer type totalization reading in cubic feet with sweep hand, low flow indicator.

2.5 WATER HAMMER ARRESTORS (SHOCK ABSORBERS)

A. Piston-type, copper, brass or stainless steel with O-ring piston, pressure rated, tested and certified in accordance with PDI WH-201.

2.6 TRAP PRIMERS

A. Electronic trap seal automatic primer valve with integral anti siphon protection and timer. Coordinate quantity, locations and voltage characteristics for control points.

B. Trap seal primer valve (low lead) with integral automatic anti-siphon protection. The priming valve to discharge on both pressure drop and pressure spike. PPP CPO 500.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. For plumbing devices requiring access from access panels (i.e. trap primers, water hammer arrestors and the like) submit location/size of all access panels to Architect for approval prior to purchase and installation of access panel. See Section 22 00 00, General Plumbing Requirements for additional requirements.

B. Temperature Gauges:
   1. Install in vertical upright position, tilted so as to be easily read at floor.
   2. Thermometer Wells: Install in piping in vertical upright position. Fill well with oil or graphite, secure cup.

C. Provide instruments with scale ranges selected according to service with largest appropriate scale.
D. Install per manufacturer recommendations.

3.2 PRESSURE GAUGES

A. Install pressure gauge where exposure to heat and vibration are minimal and where the dial can be easily read. It is also important to install the gauge in a location with undisturbed and continuous flow of the pressure medium.

B. Provide a needle valve or gauge cock, installed between the process and the pressure gauges.

C. General: Install pressure gauges in piping tee with pressure gauge cock, located on pipe at most readable position, visible from floor.

D. Locations: Install in the following locations, and elsewhere as indicated.
   1. At each pump inlet and outlet.
   2. At inlet and discharge of each pressure reducing valve.
   3. At make-up water service outlets.

E. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

F. Pressure Gauge Range/Graduations:

<table>
<thead>
<tr>
<th>System</th>
<th>Pressure (PSI)</th>
<th>Graduations (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Water</td>
<td>0-100</td>
<td>1</td>
</tr>
<tr>
<td>Hot Water</td>
<td>0-100</td>
<td>1</td>
</tr>
<tr>
<td>Compressed Air</td>
<td>0-160</td>
<td>1</td>
</tr>
</tbody>
</table>

G. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

H. Install per manufacturer recommendations.

3.3 THERMOMETERS

A. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2-inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

B. Provide instruments with scale ranges selected according to service with largest appropriate scale.

C. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

D. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

E. Thermometer Range/Graduations:
<table>
<thead>
<tr>
<th>System</th>
<th>Temperature (Degrees F)</th>
<th>Graduations (Degrees F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Water</td>
<td>25-125</td>
<td>1</td>
</tr>
<tr>
<td>Hot Water</td>
<td>30-240</td>
<td>2</td>
</tr>
</tbody>
</table>

F. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

G. Install per manufacturer recommendations.

3.4 METERS, POSITIVE DISPLACEMENT (LIQUID)

A. Where adequate space is not available, use meters specifically designed for short pipe lengths.

B. Install meters in accordance with manufacturer's instructions, and as shown on Drawings. Provide recommended upstream and downstream straight pipe length for accurate reading.

C. Install per manufacturer recommendations.

3.5 WATER HAMMER ARRESTORS (SHOCK ABSORBERS)

A. Locate shock absorbers in supply pipe in accordance with recommendations of Plumbing and Drainage Institute PDI-WH201. Install ahead of solenoid operated valves. Determine size of absorber by fixture unit value of fixture supplied, using PDI symbols to designate sizes. Provide access panel for each shock absorber.

B. Install per manufacturer recommendations.

3.6 TRAP PRIMERS

A. Flush supply line prior to installation.

B. Install valve plumb using caution to not overtighten.

C. Effective operating range 20 to 80 PSIG (138 to 552 kPa).

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Valves, General
   2. Balancing Valves
   3. Ball Valves
   4. Swing Check Valves
   5. Backflow Prevention Assemblies
   6. Pressure Regulating Valve-Domestic Water
   7. Thermostatic Master Mixing Valves (ASSE 1017 Rated)
   8. Thermostatic Point-of-Use Mixing Valves (ASSE 1070 Rated)

1.2 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. NSF 61, Annex G and/or NSF/ANSI 372 for potable water services. Valves must be 3rd-party certified.
   2. ISO 9001 Certified.
   3. IAPMO Certified for Low Lead.

C. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.

D. Model numbers indicated as Basis-of-Design indicate valve characteristics. All valves are to meet code Low Lead/Low Lead Free Standards.
1.6  WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1  MANUFACTURERS

A. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.

B. Valves, General:
   1. Apollo
   2. Armstrong
   3. ASCO
   4. Cla-Val
   5. Conbraco
   6. Crane
   7. Clow
   8. Griswold
   9. Hammond
  10. Hays
  11. Jenkins
  12. Josam
  13. Kennedy
  14. Milwaukee
  15. Mueller
  16. Nibco
  17. Red-White Valve
  18. Smith
  19. Stockham
  20. Tour Anderson
  21. Wade
  22. Watts
  23. Wilkins
  24. Zurn
  25. Or equal.

C. Balancing Valves:
   1. Caleffi
   2. Griswold
   3. Hays
   4. Armstrong CBV
   5. Tour Anderson
   6. Or equal.

D. Ball Valves:
1. See Valves General above.

2. NSF Valves:
   a. Clow
   b. Kennedy
   c. Nibco
   d. Or equal.

E. Swing Check Valves:
   1. See Valves General above.

F. Backflow Prevention Assemblies:
   1. Backflow Preventers:
      a. Apollo
      b. Cla-Val
      c. Conbraco
      d. Watts
      e. Or equal.

   2. Backflow Prevention Assemblies - Reduced Pressure Zone Backflow Preventer (RPBP) for High Hazard Applications - 2-inches and Smaller:
      a. Febco 860-with 650A.
      b. Conbraco 40-210-AGD.
      c. Wilkins 375-XL-SAG.
      d. Watts 919-QT-S valve with 919AGC or 919AGF.
      e. Or equal.

   3. Backflow Prevention Assemblies - Reduced Pressure Zone Backflow Preventer (RPBP) for High Hazard Applications - 2-1/2-inches and Larger:
      a. Febco 860 with 758A.
      b. Conbraco Apollo 40-700 with 758A.
      c. Watts 909-S-NFA-NRS with AGC.
      d. Wilkins 375-FSC.
      e. Or equal.

   4. Backflow Prevention Assemblies - Double Check Valve Assembly (DCVA) for Low Hazard Applications - 2-inches and smaller:
      a. Febco 850-650A
      b. Conbraco Apollo 40-110-T2
      c. Watts 007-QT-FDA-S
      d. Wilkins 350-S-XL
      e. Or equal.

   5. Backflow Prevention Assemblies - Double Check Valve Assembly (DCVA) for Low Hazard Applications - 2-1/2-inches and larger:
      a. Conbraco Apollo 45-11-1
      b. Watts 709-DCDA with 77F-01-FDA-12
      c. Or equal.

   6. Spill Resistant Pressure Vacuum Breaker:
      a. Febco
      b. Conbraco
      c. Watts
      d. Wilkins
7. Atmospheric Vacuum Breakers:
   a. Febeo
   b. Conbraco
   c. Watts
   d. Wilkins
   e. Or equal.

G. Pressure Regulating Valve-Domestic Water:
   1. Cash Acme
   2. Cla-Val
   3. Watts
   4. Wilkins
   5. Or equal.

H. Thermostatic Master Mixing Valves (ASSE 1017 Rated):
   1. Holby Tempering Valve
   2. Lawler Series 66
   3. Leonard Type TM
   4. Powers LFMM430 (Lead Free)
   5. Symmons Temp Control Series 5
   6. Or equal.

I. Thermostatic Point-of-Use Mixing Valves (ASSE 1070 Rated):
   1. Lawler
   2. Leonard
   3. Powers Hydroguard
   4. Or equal.

2.2 VALVES - GENERAL

A. General:
   1. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
   2. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves 6-inches and smaller. Provide gear operators for quarter-turn valves 8-inches and larger and plug valves installed over 5-feet above finished floor.
   3. Valve Identification: Manufacturer's name (or trademark) and pressure rating clearly marked on valve body.

B. Valves in Insulated Piping: With 2-inch stem extension and following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation on valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied.

C. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With thread according to ASME B1.20.1.

D. Valve Bypass and Drain Connections: MSS SP-45.

E. Building Service:
   1. Shutoff and Isolation Valves:
      a. Pipe Sizes 3-inches and Smaller: Ball Valve.
   2. Drain Service: Ball Valves.
   3. Strainer Blow-Off: Ball Valve.

2.3 BALANCING VALVES

A. Maximum 125 PSIG System Working Water Pressure.

B. Manual Set Balancing Valves:
   1. Valves are to be of the "Y" pattern, equal percentage globe-style and provide three functions:
      a. Precise flow measurement.
      b. Precision flow balancing.
      c. Positive drip-tight shut-off.
   2. Valve to provide multi-turn, 360 degree adjustment with micrometer type indicators located on the valve handwheel. Valves have a minimum of five full 360 degree handwheel turns. 90 degree circuit-setter style ball valves are not acceptable. Valve handle to have hidden memory feature, which will provide a means for locking the valve position after the system is balanced. Valves to be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi to have two 1/4-inch threaded brass metering ports with check valves and gasketed caps located on the inlet side of the valve. Valves to be furnished with flow smoothing fins downstream of the valve seat and integral to the forged valve body to make the flow more laminar. The valve body, stem and plug to be brass. The handwheel to be high-strength resin.

2.4 BALL VALVES

A. All ball valves on brazed piping are to be three-piece.

B. 2-1/2-inches and Smaller: MSS SP-110, 400-600 PSI, two-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, brass or stainless steel ball, Teflon seat, brass stem, or extended steel handle. Apollo 77 CLF 100 Series two-piece.

C. 3-inches and Larger: MSS SP-110, 400-600 PSI, three-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, brass or stainless steel ball, Teflon seat, brass stem, or extended steel handle. Apollo 82-100/82A 140 Series three-piece.

D. Full Port Ball Valve: 2- to 4-inch ductile iron, ASTM A536, micro finish steel chrome plated or stainless steel ball and stem. TFE seats, 600 PSI.
2.5 SWING CHECK VALVES

A. 2-inches and Smaller: Class 125, bronze body, horizontal swing, regrinding type, Y-pattern, renewable disc. Nibco 413. MSS SP-80.

B. 2-1/2-inches and Larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat and disc, flanged ends. Nibco F918. MMS SP-71.

C. Rubber Flapper Check Valve: Horizontal or vertical upward flow installation. Working pressure to 175 PSI. Ductile iron or cast iron body. Steel reinforced Buna-N rubber flapper epoxy coating on wetted parts. MSS SP-80.

D. Check Valve: Horizontal installation. Working pressure to 300 PSI. Type 304/302 Stainless Steel conforming to ASTM 167. Ductile body, ASTM A536, and stainless clapper, EPDM, nitrile or optional viton bumper and bonnet seals. Stainless wetted parts.

2.6 BACKFLOW PREVENTION ASSEMBLIES

A. General: Assemblies model numbers listed below are for general comparison. Project specific model numbers to be verified contractor as approved by jurisdiction where project is located.

B. Reduced Pressure Zone Backflow Preventer (RPBP) for High Hazard Applications:
   1. 2-inches and Smaller: Assembly consists of shutoff ball valves in inlet and outlet, and strainer on inlet. Assemblies include test cocks and pressure-differential relief valve located between two positive seating check valves and comply with requirements of ASSE Standard 1013 and AWWA C511. Bronze construction, threaded ends, stainless steel internal parts, FDA strainer, and air gap fitting. Route pipe from air gap fitting to approved waste receptor.
   2. 2-1/2-inches and Larger: Assembly consists of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies include test cocks and pressure-differential relief valve located between two positive seating check valves and comply with requirements of ASSE Standard 1015 and AWWA C511. Epoxy coated cast iron body construction, flanged ends, stainless steel internal parts, bronze seats, and FDA strainer.

C. Double Check Valve Assembly (DCVA) for Low Hazard Applications:
   1. 2-inches and Smaller: Assembly consists of shutoff ball valves in inlet and outlet, and FDS strainer on inlet. Assemblies include test cocks and two positive seating check valves and comply with requirements of ASSE Standard 1015 and AWWA C510. Bronze construction, threaded ends, and stainless steel internal parts.
   2. 2-1/2-inches and Larger: Assembly consists of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies include test cocks and two positive seating check valves and comply with requirements of ASSE Standard 1015 and AWWA C510. Epoxy coat cast iron body construction, strainer flanged ends, and stainless steel internal parts.

D. Spill Resistant Pressure Vacuum Breaker: Watts Model 800MCQT with 777S "Y" strainer.
E. Atmospheric Vacuum Breaker: Assembly consists of a bronze vacuum breaker body with silicone disc, and full size orifice. Device to be IAPMO listed, meet ASSE standard 1001, and ANSI standard A113.1.1 rough chrome plate finish.

2.7 PRESSURE REGULATING VALVE-DOMESTIC WATER

A. Water: Bronze body, diaphragm or piston type, spring actuated, with separate or integral stainless steel strainer, pressure to suit conditions, approved for potable water use, low lead. Provide shutoff valves, pressure relief valves, unions, drain valve and bypass.

B. Water: Automatic control pressure regulating valve, stainless steel seat, stem and spring, diaphragm actuated with brass body, hydraulic control pilots with effluent operating temperature range 32 degrees F to 180 degrees F, FDA and AWWA approved.

C. Water: Bronze body construction, stainless steel strainer screen, thermal expansion bypass with renewable stainless steel seat and high temperature resisting diaphragm.

2.8 THERMOSTATIC MASTER MIXING VALVES (ASSE 1017 RATED)

A. Thermostatic type with bronze body construction, corrosion resistant materials, union end stops, check inlets with strainers, 0-200 degree F dial thermometer and discharge shut-off valve. Mixing valves to meet ASSE 1017.

B. Maximum required delta temperature differential between hot water supply temperature and delivery temperature is 15 degrees F. Set valve outlet temperature per drawing requirements.

C. Flow from the tempered water circulating pump to be split to mixing valve and building hot water heating system.

2.9 THERMOSTATIC POINT-OF-USE MIXING VALVES (ASSE 1070 RATED)

A. Thermostatic type with bronze body construction, corrosion resistant materials, union end stops, check inlets with strainers, 0-200 degree F dial thermometer and discharge shut-off valve. Mixing valves to meet ASSE 1070.

B. Maximum required delta temperature differential between hot water supply temperature and delivery temperature is 15 degrees F. Set valve outlet temperature per drawing requirements.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, and weld ends.
   4. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Inspect the shipping container before unpacking to look for damage that could have occurred during transport, and report it to the transportation company immediately. After visual inspection, remove the valve from the shipping container. Make sure the faces are free of any scratches and that there is not any obvious damage to the actuator assembly or valve body.

D. Make sure to note the valve's model number during the unpacking process. The model number will need to be provided when purchasing replacement parts.

E. Purge and clean all piping to be connected to valve.

F. Install per manufacturer's recommendations.

G. Determine that the valve and its plumbing piping is adequately supported when installed. If a valve is not adequately supported, this could prevent the valve from operating and sealing correctly. Be sure that all mating flanges are in line and parallel to minimize straining on joints and valve body.

H. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

I. Do not attempt to repair defective valves; replace with new valves.

J. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.

K. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose end adapter and cap on chain for each valve that must be installed with stem below horizontal plane. Ensure installation provides full stem movement.

L. Insulation: Where insulation is indicated, install extended stem valves, arranged in proper manner to receive insulation.

M. Mechanical Actuators: Install with chain operators where indicated. Extend chains to 5-feet above floor and hook to clips to clear aisle passage.

N. Stem Selection: Outside screw and yoke stems, except provide inside screw, non-rising stem where space prevents full opening of OS&Y valves.

O. Seats: Renewable seats, except where otherwise indicated.

P. When soldering, use paste flux that are approved by the manufacturer for use with lead free alloys.

Q. If valve applications are not indicated on Drawings, use the following:
1. Shutoff Service: Ball valves.

R. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

S. Valves, except wafer/butterfly types, with the following end connections:
   1. For Copper Tubing, 2-inches and Smaller. Threaded ends except where solder-joint valve-end.
   2. For Copper Tubing, 2-1/2-inches to NPS 4-inches. Flanged ends except where threaded valve-end.
   3. For Copper Tubing: 5-inches and Larger: Flanged ends.
   4. For Steel Piping, 2-inches and Smaller: Threaded ends.
   5. For Steel Piping, 2-1/2-inches to NPS 4-inches: Flanged ends except where threaded valve-end.
   6. For Steel Piping, 5-inches and Larger: Flanged ends.

T. Valve Adjusting and Cleaning:
   1. Inspect valves for leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.
   2. Valve Identification. Tag valves per Section 22 05 53, Identification for Plumbing Piping and Equipment.

3.2 BALANCING VALVES

A. See General Installation Requirements above.

B. Install with flow in the direction of the arrow on the valve body and installed at least five pipe diameters downstream from any fitting, and at least ten pipe diameters downstream from any pump. Two pipe diameters downstream from the balancing valve should be free of any fittings. When installed, easy and unobstructed access to the valve handwheel and metering ports for adjustment and measurement are to be provided. Mounting of valve in piping must prevent sediment build-up in metering ports.

3.3 BALL VALVES

A. See General Installation Requirements above.

3.4 SWING CHECK VALVES

A. See General Installation Requirements above.

B. Swing Check Valve Installation: Install in horizontal position with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow. Only install where there are 10 pipe diameters of straight pipe upstream of valve.

C. Ejector and Sump Pump-Discharge Check Valves:
   1. 2-inches and Smaller: Bronze swing.
   2. 2-1/2-inches and Larger: Rubber flapper swing check valves with lever and weight.

D. Domestic Water and Circulation Pump Discharge Check Valves:
1. 2-inches and Smaller: Bronze body, spring loaded, lead free, lift check.
2. 2-1/2-inches and Larger: Wafer style, silent lift check valve, lead free.

3.5 BACKFLOW PREVENTION ASSEMBLIES

A. See General Installation Requirements above.

B. Install where indicated, and where required by code. Where practical, locate in same room as equipment being protected.

C. Submit product cut sheets to local AHJ for approval prior to purchase and installation.

D. Install as close to wall as possible with clearances for access and maintenance as required by AHJ.

E. Coordinate exact location of installation and type of backflow device serving a particular piece of equipment with AHJ and Architect prior to purchase and installation.

F. Provide wall/floor brackets that are of fully welded, hot dipped galvanized construction, fabricated to meet field conditions. Mount backflow preventer to brackets using cadmium plated "U" type bolts and nuts.

G. Contact local water district/backflow specialist and request backflow installation requirements. Install backflow devices per UPC and local water district/backflow specialist requirements.

H. Route waste piping from air gap waste fitting concealed within walls to point of air gap termination at indirect waste receptor.

I. Follow local codes for installation requirements. Pipe lines should be thoroughly flushed to remove foreign material before installing the unit. Provide a strainer ahead of backflow preventer to prevent disc from unnecessary fouling. Install valve inline with arrow on valve body pointing in the direction of flow. It is important that the valve be easily accessible to facilitate testing and servicing. Do not install in a concealed location.

3.6 PRESSURE REGULATING VALVE-DOMESTIC WATER

A. See General Installation Requirements above.

B. Install valve in the line with arrow on valve body pointing in the direction of flow. This valve should be installed where it is accessible with sufficient clearance for cleaning, service or adjustment. Install the reducing valve before a sill cockline if possible. Before installing the reducing valve hose bibb, flush out the line to remove loose dirt and scale which might damage valve disc and seat.

C. Horizontal installation is recommended. However, valve can be installed in a vertical position. Regulator must be installed in an accessible location to facilitate servicing the regulator.

D. To readjust reduced pressures, loosen adjusting screw nut and turn adjusting screw clockwise to raise reduced pressure and counterclockwise to lower reduced pressure.
E. When reducing valve is used, it makes a closed system; therefore, pressure relief protection must be provided on the downstream side of the reducing valve to protect equipment.

F. Provide pressure relief valve and terminate discharge to indirect waste receiver.

G. Anytime a reducing valve is adjusted, the use of a pressure gauge is recommended to verify correct pressure setting. Do not bottom out adjusting screw or spring cage.

H. Provide inlet and outlet ball valves. Provide pressure gauge on valve outlet.

I. Provide pressure relief valve piped full size to indirect waste receiver or floor drain.

J. Provide factory startup on automatic control valves.

3.7 THERMOSTATIC MASTER MIXING VALVES (ASSE 1017 RATED)

A. See General Installation Requirements above.

B. Install mixing valve per manufacturer's instruction manual.

3.8 THERMOSTATIC POINT-OF-USE MIXING VALVES (ASSE 1070 RATED)

A. See General Installation Requirements above.

B. Install mixing valve per manufacturer's instruction manual.

END OF SECTION
SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Pipe Hangers and Supports for Plumbing Piping and Equipment
   2. Wall and Floor Sleeves
   3. Building Attachments
   4. Flashing
   5. Miscellaneous Metal and Materials

1.2 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   2. Hanger spacing installation and attachment to meet all manufacturer's requirements and MSS SP-58.
   3. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
   4. Install piping per SMACNA's requirements.
   5. ASME B31.9, Building Services Piping

1.4 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   2. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, equipment hangers/supports, and seismic restraint by a qualified Structural Professional Engineer.
a. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

3. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems whose products have been in satisfactory use in similar service for not less than 10 years.

4. Support systems to be supplied by a single manufacturer.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.7 PERFORMANCE REQUIREMENTS

A. General - Provide pipe and equipment hangers and supports in accordance with the following:

1. When supports, anchorages, and seismic restraints for equipment, and supports, anchorages, and seismic restraints for piping are not shown on the Drawings, the contractor is responsible for their design.

2. Connections to structural framing are not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.

B. Engineered Support Systems:

1. Support frames such as pipe racks or stanchions for piping and equipment which provide support from below.

2. Equipment and piping support frame anchorage to supporting slab or structure.

C. Provide channel support systems, for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.

D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.

E. Provide seismic restraint hangers and supports for piping and equipment. See Section 22 05 48.

F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment. See Section 22 05 48.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Pipe Hangers and Supports for Plumbing Piping and Equipment:

1. Pipe Hangers/Supports:

   a. B-Line Systems, Inc.
   b. Anvil International
   c. HOLDRITE
   d. Erico Co., Inc.
2. Channel Support Systems:
   a. B-Line Systems, Inc.
   b. Anvil International, Anvit-Strut
   c. Erico Hanger Co., Inc.; O-Strut Div.
   d. Unistrut Corp.
   e. HOLDRITE EZ-Strut Systems
   f. Or equal.
3. Thermal-Hanger Shield Inserts:
   a. Erico Hanger Co., Inc.
   b. Pipe Shields, Inc.
   c. Rilco Manufacturing Co., Inc.
   d. HOLDRITE Insulation Couplings
   e. Or equal.
4. Freestanding Roof Supports:
   a. Erico Hanger Co., Inc.
   b. Nelson-Olsen Inc.
   c. B-Line
   d. M. Fab
   e. Or equal.
5. Pipe Alignment and Secondary Supports:
   a. HOLDRITE
   b. Starquick
   c. Or equal.

B. Wall and Floor Sleeves:
   1. Below Grade and High Water Table Areas:
      a. Modular Link Sealing System at Pipe Sleeves:
         1) Thunderline Corporation
         2) Or equal.
   2. Pre-Engineered Firestop Pipe Penetration Systems:
      a. HOLDRITE HydroFlame
      b. Proset
      c. Or equal.

C. Building Attachments:
   1. Anchor-It
   2. Gunnebo Fastening Corp.
   3. ITW Ramset/Red Head
   5. Or equal.

D. Flashing:
   1. Fastenal
   2. Or equal.
E. Miscellaneous Metal and Materials:
1. See Miscellaneous Metal and Materials article below.

2.2 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

A. Horizontal Piping Hangers and Supports - Horizontal and Vertical Piping, and Hanger Rod Attachments:
1. Factory fabricated horizontal piping hangers and supports to suit piping systems in accordance manufacturer's published product information.
2. Use only one type by one manufacturer for each piping service.
3. Select size of hangers and supports to exactly fit pipe size for bare piping and to exactly fit around piping insulation with saddle or shield for insulated piping.
4. Provide copper-plated hangers and supports for uninsulated copper piping systems.
5. Provide padded pipe hangers, clamps and supports for thermoplastic piping system.
6. Install no hub cast iron pipe and fittings per CISPI 301-09 Installation Procedures for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain Waste and Vent Piping Applications. Brace hubless cast iron pipe and fittings 5-inch and larger with HOLDRITE No Hub Pipe Restraints or equal.

B. Pipe Hangers, Guides and Channel Systems:
1. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.
2. Hanger Rod Couplings: Malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.
3. Pipe Rings for Hanger Rods: Pipe sizes 2-inch and smaller, MSS SP Type 6 or Type 10, or equal. Pipe sizes 2-1/2-inches and larger, clevis type hangers with adjustable nuts on rod. MSS SP Type 1. Pipe rings to have same finish as hanger rods.
4. Channel Type Pipe Hanging System: Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A570 GR33; one side of channel to have a continuous slot with in-turned lips; framing nut with grooves and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.

C. Pipe Saddles and Shields:
1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).

D. Thermal-Hanger Shield Inserts: 100-PSI (690-kPa) minimum compressive strength insulation, encased in sheet metal shield.
1. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier.
3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
4. For Clevis or Band Hanger: Insert and shield to cover lower 180 degrees of pipe.
5. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.
6. Thermal Hanger Shield Inserts should be provided at the hanger points and guide locations on pipes requiring insulation. The Inserts should consist of Polyisocyanurate (urethane or phenolic insulation) encircling the entire circumference of the pipe with a 360 degree PVC (1.524 mm thick) with a living hinge and J lock and installed during the installation of the piping system.

E. Concrete Inserts:
   1. Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.

F. Continuous Concrete Insert:

G. Beam Clamps:
   1. MSS Type 19 and 23, wide throat, with retaining clip.
   2. Universal Side Beam Clamp: MSS Type 20.

H. Below Ground:
   1. Pipe Hangers: Adjustable Clevis type, Federal Specification WW-H-171 (Type 1), UL listed, stainless steel Type 316. MSS Type 1. If PVC piping to be used, provide Type 1 hanger, coated for PVC piping.
   2. Rod: 5/8-inch stainless steel Type 316.
   3. Eyebolt: Stainless steel Type 316.
   4. Nuts and Washers: Stainless steel Type 316.

I. Hangers for Pipe Size 2-inches and Smaller:
   1. Adjustable swivel ring hanger, UL listed, Type 6 or Type 10.

J. Hangers for Pipe Size 2-1/2-inches and Larger:
   1. Adjustable clevis type, UL listed, Type 1.

K. Riser Clamps:
   1. Steel, UL listed. MSS Type 8.

L. Plumbers Tape:
   1. Not permitted as pipe hangers or pipe straps.

M. Pipe Alignment and Secondary Support Systems:
   1. Secondary Pipe supports for general applications (Non-Acoustical).
      a. Supports will be manufactured in compliance with IAPMO Product Standard PS 42-96. All products provided will be listed by IAPMO for secondary pipe support.
      b. Supports may be used when sound and/or vibration transfer is not a concern.
   2. Secondary pipe supports for sound and vibration attenuation (Acoustical).
      a. Supports will be manufactured in compliance with IAPMO Product Standard PS 42-96. All products provided will be listed by IAPMO for secondary pipe support.
b. Acoustical pipe supports will be manufactured and installed in compliance with International Organization for Standardization (ISO) 3822-1 with current amendments.
c. Supports will be used when sound and/or vibration transfer is a concern. Locations where acoustical supports will be provided and include but are not limited to partition walls between living units, tenant spaces, retail units, mechanical rooms and lobbies.
d. Support Products:
   1) Support to Wall Brace and Wall Stud Penetrations: HOLDRITE #261, #262, #263, and #264, or equal.
   2) Pipe Wrap for Pipe Clamps and Channel-Mounted Pipe Clamps: HOLDRITE #270, or equal.
   3) Pipe Wrap for Pipe Hangers: HOLDRITE #271, #272-2, and #272-4, or equal.
   4) Drop-Ear Fitting Support: HOLDRITE #265, or equal.
   5) Floor Riser Isolation Pads: HOLDRITE #275-T, or equal.
   6) Floor Isolation Pads (General Applications): HOLDRITE #274, #275, #276, and #278, or equal.

N. Freestanding Roof Pipe Supports:
   1. Polyethylene high-density U.V. resistant quick "pipe" block with foam pad.
   2. Recommended installation is for pipe blocks to be freestanding.
   3. Piping 3-inches and larger mounted on block type supports.

2.3 WALL AND FLOOR SLEEVES

A. Below Grade and High Water Table Areas:
   1. Modular Link Sealing System at Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal. Use a modular link sealing system at sleeves to continuously fill the annular space between the pipe and the wall opening. Provide Link-seal Type C unless otherwise noted. OS with S-316 stainless construction for continuous water/tank walls.
   2. Sleeves through concrete foundation walls and floors. Ductile iron pipe. Class 50 or 51 pipe conforming to ANSI/AWWA C151/A21.51, cement lined. Pipe sleeve will extend a minimum of 6-inches beyond outside perimeter of foundation. Final placement of sleeve will be confirmed with project's structural engineer. In areas with a high water table, provide AWWA C900, Class 235 plastic pipe in lieu of ductile iron pipe.

B. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.

C. Insulating Caulking: Eagle or Pitcher Super 66 high temperature cement.

D. Fabricated Accessories:
   1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
   2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide following minimum gauges for sizes indicated:
      a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.
b. Sleeve Sizes 5-inches to 6-inches: 16 gauge.
c. Sleeve Sizes 7-inches and Larger: 14 gauge.
d. Fire-Rated Safing Material:
   1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 lbs./cu.ft. density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.
   2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

2.4 BUILDING ATTACHMENTS

A. General: Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project Structural Engineer. Provide anchor bolts suitable for cracked concrete.

B. Anchor Bolts:
   1. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.
   2. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.

C. Beam Clamps:
   1. MSS Type 19 and 23, wide throat, with retaining clip.
   2. Universal Side Beam Clamp: MSS Type 20.

D. Powder-Actuated Drive Pin Fasteners:
   1. Powder-Actuated Drive-Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

E. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

F. Grout: ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
   1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
   3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

2.5 FLASHING

A. Steel Flashing: 26 gauge galvanized steel.
B. Safes: 8 mil thick neoprene.

C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.

D. Provide hot dipped galvanized components for items exposed to weather.

2.6 MISCELLANEOUS METAL AND MATERIALS

A. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings, that are necessary for completion of the project. The Contractor is responsible for their design.
   1. Fabricate miscellaneous units to size, shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, or welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or equal.

C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.

D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.

E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.

F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods and equipment required for fabrication.

G. Provide hot dipped galvanized components for items exposed to weather.

H. Use straps, threshold rods and wire with sizes required by SMACNA to support piping.

I. Grout: ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
   1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
   2. Properties: Nonstaining, noncorrosive, and non gaseous.
   3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.
PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Examination:
   1. Verify building materials to have hangers and attachments affixed in accordance with
      hangers to be used. Provide supporting calculations.

B. Preparation:
   1. Examine Drawings and coordinate for verification of exact locations of fire and smoke
      rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on
      Record Drawings such locations and label as "1-Hour Wall," "2-Hour Fire/Smoke
      Barrier," and the like. Determine proper locations for piping penetrations. Set sleeves in
      place in new floors, walls or roofs prior to concrete pour or grouting.

C. Install hangers, supports, anchors and sleeves after required building structural work has been
   completed in areas where the work is to be installed. Coordinate with project structural
   engineer proper placement of inserts, anchors and other building structural attachments.

3.2 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

A. Hangers and Supports:
   1. Comply with MSS SP-58. Pipe Hanger and Support Installation: Install hangers,
      supports, clamps, and attachments as required to properly support piping from building
      structure. For horizontally hung grooved-end piping, provide a minimum of 2 hangers
      per pipe section.
   2. Pipe Ring Diameters:
      a. Uninsulated and Insulated Pipe, except where oversized pipe rings are specified:
         Ring inner diameter to suit pipe outer diameter.
      b. Insulated Piping Where Oversized Pipe Rings are Specified and Vibration
         Isolating Sleeves: Ring inner diameter to suit outer diameter of insulation or
         sleeve.
   3. Oversize Pipe Rings: Provide oversize pipe rings of 2-inch and larger size.
   5. Steel Backing in Walls: Provide steel backing in walls to support fixtures and piping
      hung from steel stud walls.
   6. Channel Support System Installation: Arrange for grouping of parallel runs of piping and
      support together on field-assembled channel systems.
      a. Field assemble and install according to manufacturer's written instructions.
   7. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of
      horizontal piping and support together on field-fabricated, heavy-duty trapezes.
      a. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size
         or install intermediate supports for smaller diameter pipes as specified above for
         individual pipe hangers.
      b. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being
         supported. Weld steel according to AWS D-1.1
   8. Group parallel runs of horizontal piping to be supported together on trapeze-type
      hangers.
9. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.
10. Do not support piping from other piping.
11. Fire protection piping will be supported independently of other piping.
12. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.
13. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.
14. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchor, and to facilitate the action of expansion joints, expansion loops, expansion bends and similar units.
15. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
16. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping" is not exceeded.
17. Insulated Piping: (comply with the following)
a. Attach clamps and spacers to piping.
   1) Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   2) Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   3) Do not exceed pipe stress limits according to ASME B31.9.
b. Install MSS SP-58, Type 39 protection saddles, if insulation without a vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
c. Install MSS SP-58, Type 40 protective shields on cold piping having a vapor barrier. Shields to span arc of 180 degrees.
   1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.

d. Shield Dimensions for Pipe, not less than the following:
   1) NPS 1/4 to NPS 3-1/2 (DN8 to DN 90): 12-inches long and 0.048-inch thick.
   2) NPS 4 (DN100): 12-inches long and 0.06-inch thick.
   3) NPS 5 and NPS 6 (DN125 and DN150): 18-inches long and 0.06-inch thick.
   4) NPS 8 to NPS 14 (DN200 to DN350): 24-inches long and 0.075-inch thick.
   5) NPS 16 to NPS 24 (DN400 to DN600): 24-inches long and 0.105-inch thick.
e. Pipes NPS 8 (DN200) and Larger: Include wood inserts.
f. Insert Material: Length at least as long as protective shield.
g. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
18. Equipment Clearances: Do not route equipment or piping through electrical rooms, transformer vaults, elevator equipment rooms, IT rooms, MPOE rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-feet lateral clearance from all sides of electric switchgear
panels. Do not route piping or equipment above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact equipment or pipe routing to provide proper clearance with such items.

19. Pipe supports and hanger spacing (pipe supported from structure or floor-supported) to meet the requirements of References and Standards Article in Part 1 above.

B. Pipe Curb Assemblies:
1. Provide prefabricated units for roof membrane and insulation penetrations related to equipment. Coordinate with roofing system. Set supports on the structural deck. Do not set supports on insulation or roofing. Provide level supports by prefabricated pitch built into the curb.
2. Pipe Curb Assemblies: Provide for piping and electrical conduit which penetrates the structural roof deck to service equipment above the roof level (i.e., piping, electrical power and control wiring). Meet requirements of roof warranty.
3. Piping above roof to be supported with freestanding roof pipe supports unless detailed otherwise. At roofing applications, the adhesion mastic is to be specifically submitted to and approved by the roofing system manufacturer/installer to maintain the integrity of all warranties.
4. At concrete floors, install a polyurethane mastic to the support block and adhere in place.

C. Vertical Piping:
1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.
2. Riser clamps to be directly under fitting or welded to pipe. Provide neoprene pads for all systems except natural gas.
3. Riser to be supported at each floor penetration.
4. Provide structural steel supports at the base of pipe risers. Size supports to carry forces exerted by piping system when in operation.

D. Adjusting and Painting:
1. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping and equipment to proper level and elevations.
2. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.

3.3 WALL AND FLOOR SLEEVES

A. "Link-Seal" Pipe Sleeves: Install at slab on grade floor/below grade piping penetrations. Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations (except for DWV piping at slab on grade). Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations.

B. Fabricated Pipe Sleeves:
1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeve diameter to be determined by local seismic clearance requirement, and by waterproofing requirements.
2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1-inch above floor finish.
3. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.

4. Seal each end airtight with a resilient nonhardening sealer, UL listed and fire rated per ASTM 814.

3.4 BUILDING ATTACHMENTS

A. Install within concrete slabs or attach to structural steel or wood. Attachment to Wood Structure: Provide MSS Type 34 for attachment to wooden beam or approved attachment for a wood structure.

B. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints and at changes in direction of piping.

C. Install concrete inserts before concrete is placed; fasten insert secure to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.

D. Anchor Bolts:
   1. General: Install anchor bolts for mechanical equipment and piping as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment and piping are hung.
   2. Anchor bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.

E. Pipe Anchors:
   1. General: Provide anchors to fasten piping which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.

F. Bolting:
   1. General: Provide bored, drilled or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched or hand sawn holes will not be accepted.

G. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor wall, and through equipment room walls and floors.

H. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
   1. Install fabricated pipe sleeve.
   2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.
   3. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814 sealant.
I. Piping penetrations through Fire-rated (1 to 3 hour) Assemblies:
   1. Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.
   2. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814. Use HOLDRITE HydroFlame or equal.

J. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

K. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

3.5 FLASHING

A. Flash and counterflash where piping passes through weather or waterproofed walls, floors and roofs.

B. Flash vent soil pipes with flashings per Division 01, General Requirements.

C. Flash floor drains over finished areas and roof drains, 10-inches clear on sides, minimum 36-inches x 36-inches sheet size. See Division 01, General Requirements. Fasten flashing to drain with clamping device.

D. Install built up fixtures (mop sinks, shower stalls, shower floors) with water sealing systems/membranes to meet Code and as prescribed by Division 01, General Requirements and Section 22 00 00, Plumbing Basic Requirements. Meet all Code testing requirements. Provide drainage devices with appropriate flanges, clamps, etc. to meet these installation requirements and ensure a water-tight installation.

3.6 MISCELLANEOUS METAL AND MATERIALS

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Avoid cutting concrete reinforcing when drilling for inserts. Reference structural drawings and reinforcing shop drawings and determine locations of stirrups prior to drilling into concrete.

C. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete masonry or similar construction.
D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

   1. Set loose leveling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.
   2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

F. Fabrication:
   1. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates and similar devices. Hot dip galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.
   2. Finishes:
      a. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with 1 coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas with primer of same material before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
      b. Metal in contact with Concrete, Masonry and Other Dissimilar Materials:
         1) Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
      c. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

G. Metal Fabrication:
   1. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
   2. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
3. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of weld and methods used in correcting welding work, and with the following:
   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. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
4. Provide hot dipped galvanized components for items exposed to weather.

END OF SECTION
SECTION 22 05 48

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Vibration Isolation
   2. Seismic Bracing/Restraint Devices/Systems for Equipment and Piping

1.2 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.
   1. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
   2. Section 22 30 00 - Plumbing Equipment

1.3 REFERENCES AND STANDARDS

A. References and standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Vibration Isolation:
      a. Product Data: Provide catalog data indicating size, type, load and deflection of each isolator; and percent of vibration transmitted based on lowest disturbing frequency of equipment.
      b. Shop Drawings: Showing complete details of construction for steel and concrete bases including:
         1) Equipment mounting holes.
         2) Dimensions.
         3) Isolation selected for each support point.
         4) Details of mounting brackets for isolator.
         5) Weight distribution for each isolator.
         6) Details of seismic snubbers.
         7) Code number assigned to each isolator.
   2. Seismic Restraint:
      a. Shop Drawings: Show compliance with requirements of Quality Assurance article of this Section.
1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Vibration Isolation:
      a. Except for packaged equipment with integral isolators, single manufacturer will select and furnish isolation required.
      b. Deflections indicated will be minimum actual static deflections for specific equipment supported.
      c. Isolator Stability:
         1) Size springs of sufficient diameter to maintain stability of equipment being supported with minimum horizontal to vertical stiffness ratio not less than 1:1. Spring diameters will be not less than 0.8 of the compressed height at rated load.
         2) Springs will have minimum additional travel to solid equal to 50 percent of the rated deflection.
         3) Springs will support 200 percent of rated load when fully compressed without deformation or failure.
      d. Maximum Allowable Vibration Levels: Peak vibration velocities not to exceed 0.08 in/sec. correct equipment operating at vibration velocities that exceed this criteria.
   2. Seismic Restraint:
      a. Seismic restraint and anchorage of permanent equipment and associated systems listed below to building structure will be designed to resist total design seismic force prescribed in local building code:
         1) Floor- or roof-mounted equipment weighing 400 pounds or greater.
         2) Suspended, wall-mounted or vibration isolated equipment weighing 20 pounds or greater.
         3) Housekeeping slabs: provide reinforcement and anchorage to building structure.
      b. Where required, seismic sway bracing of suspended piping will meet the following:
         1) Pipe runs requiring seismic bracing will have a minimum of two traverse braces and one longitudinal brace. A longitudinal (or a traverse) brace at 90 degree change in direction may act as traverse (or longitudinal) brace if located within 2-feet of change in direction.
         2) Seismic bracing may not pass through seismic separation joint. Pipe runs that pass through seismic separation joints must be restrained within 5-feet of both sides of the separation.
         3) Seismic brace assembly spacing will not exceed 40-feet transverse and 80-feet longitudinal.
      c. Seismic sway bracing of suspended piping will be performed for the following:
         1) Piping 4-inches nominal diameter and larger, all cast iron and PVC piping and trapeze systems with total aggregate weight of 10 pounds/foot or greater.
d. Seismic restraints may be omitted from suspended piping if the following conditions are satisfied:
   1) For piping supported by individual rod hangers 12-inches or less in length from top of pipe to bottom of structural support. Top connections to structure will have swivel joints, eye bolts, or vibration isolation hangers for the entire length of the system run.
   2) Lateral motion of the system will not cause damaging impact with surrounding systems or cause loss of system vertical support.
   3) System must be welded steel pipe, brazed copper pipe, or similar ductile material with ductile connections.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Vibration Isolation:
   1. Amber-Booth.
   2. California Dynamics Corporation.
   3. Mason Industries, Inc.
   5. Vibro-Acoustics.
   6. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
   7. Or equal.

B. Seismic Bracing/Restraint Devices/Systems for Equipment and Piping:
   1. Amber-Booth.
   2. California Dynamics Corporation.
   3. Cooper B-Line, Inc.
   4. Hilti, Inc.
   5. Mason Industries, Inc.
   7. Unistrut.
   8. ISAT, Inc.
   9. Or equal.

2.2 VIBRATION ISOLATION

A. Type 1 - Neoprene Pad: Rubber or neoprene waffle pads, single layer, 5/16-inch thick with pattern repeating on 1/2-inch centers; 40 to 50 durometer hardness; maximum loading 50 PSI, 1/4-inch thick steel load distribution plate. Mason Type SWM.

B. Type 2 - Neoprene Mount: Double-deflection type, with steel or ductile-iron housing containing two separate and opposing, oil-resistant rubber or neoprene elements,
factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Minimum static deflection of 0.20-inches. Mason Type BR.

C. Type 3 - Spring: Freestanding, laterally stable, open-spring isolators, factory drilled for bolting to structure and bonded to 1/4-inch thick rubber isolator pad attached to baseplate underside, mounts with leveling bolts. Mason Type SLFH.

D. Type 4 - Spring with Restraints: Laterally stable, open-spring isolators, factory drilled for bolting to structure and bonded to 1/4-inch thick rubber isolator pad attached to baseplate underside; mounts with leveling bolts; steel or cast iron housing for directional seismic snubbing with resilient vertical-limit stops. Mason Type SLR or SSLFH.

E. Type 5 - Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression; designed for 30-degree angular movement before hanger-rod misalignment without binding; seismic rebound washer; 1-inch minimum deflection. Mason Type PC30N.

F. Seismic Snubbers: Directional interlocking steel members restrained by one-piece molded neoprene bushing, minimum of 3/4-inch thick with minimum 1/8-inch air gap in all directions, capable of withstand 3 times the rated load capacity. Mason Type Z-1225.

2.3 SEISMIC BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT AND PIPING

A. General Requirements for Restraint Components: Rated strengths, features, and applications will be as defined in reports by agency acceptable to authorities having jurisdiction.

B. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components will be at least four times the maximum seismic forces to which they will be subjected.

C. Anchor bolts for attaching to concrete will be seismic-rated, drill-in, and stud-wedge or female-wedge type. Provide anchor bolts suitable for cracked concrete.

D. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

E. Maximum 1/4-inch air gap, and minimum 1/4-inch thick resilient cushion.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Vibration isolators and seismic restraint systems must be installed in strict accordance with manufacturers written instructions and certified submittal data.
   2. Set floor-mounted equipment on 4-inch-high concrete housekeeping pads. Extend pad 6-inches beyond footprint of equipment in each direction.
   3. Provide mounts for equipment installed outdoors for wind loads of 30 lbs. psf applied to any exposed surface of isolated equipment.
4. Do not install equipment or pipe which makes rigid contact with building slabs, beams, studs, walls, etc.

5. Anchor baseplate to floor or structure. Provide rubber grommets and washers to isolate bolt from base plate. Under no circumstances will isolation efficiency be destroyed when bolting the isolators to floor.

6. Building Penetrations: Isolate water piping penetrating wall, ceilings, floors or shafts from the structure by piping isolator or by 3/8-inch thick foamed rubber insulation. Install units flush with finished structure face, using one for each side as required. Cut units to length if longer than structure thickness. Caulk around pipe at equipment room wall.

7. Pipe Hangers in Equipment Rooms: Support water and gas piping connected to rotating equipment within equipment rooms on spring and neoprene hangers. The first three hangers from a piece of vibrating equipment are to have a minimum of 1/2 static deflection of equipment isolators. Other isolators should have a minimum of 1/4 static deflection of equipment isolators.

3.2 VIBRATION ISOLATION EQUIPMENT INSTALLATION

A. Install isolation as indicated on Drawings by type and location and where indicated below.

B. Isolation Mounts:
1. Position vibration isolation hanger elements as high as possible in hanger rod assembly but not in contact with building structure. Install hangers so that hanger housing may rotate full 360 degrees about rod axis without contacting any object.

2. Where parallel running pipes are hung together on a trapeze which is isolated from the building, provide isolator deflections for largest determined by provisions for pipe isolation. Do not mix isolated and non-isolated pipes in the same trapeze.

3. Install Type 3 and 4 isolators such that installed and operating heights of vibration isolated equipment is identical. Install limit stops so that they are out of contact during normal operation.

4. Adjust leveling bolts and hanger rod bolts so isolated equipment is level and in proper alignment with connecting pipes.

C. Isolating Pipe Hangers:
1. Install on compressed air and water piping connected to rotating equipment in the mechanical rooms. Provide isolating hanger supports for each piece of isolated equipment outside of mechanical rooms and where indicated.

2. Isolated equipment items include base mounted pumps and line mounted pumps.

D. Other Inertia Bases: Unless otherwise indicated, provide a minimum operating clearance of 1-inch between structural steel frames and the concrete housekeeping pad or floor beneath equipment. Position isolator mounting brackets so that the required clearance is maintained.

E. Vibration isolators must not cause change of position of equipment or piping which would stress piping connections or misalign shafts or bearings.

F. Vibration isolators and seismic restraint systems must be installed in strict accordance with manufacturers written instructions and certified submittal data.
G. Anchor baseplate to floor or structure. Provide rubber grommets and washers to isolate bolt from base plate. Under no circumstances will isolation efficiency be destroyed when bolting the isolators to floor.

H. Anchorage: Adequately anchor or brace plumbing equipment and piping to resist displacement due to seismic action, include snubbers on equipment mounted on spring isolators, pumps and the like.

3.3 SEISMIC RESTRAINTS

A. General:
   1. Install and adjust seismic restraints so that equipment and piping supports are not degraded by restraints.
   2. Restraints must not short circuit vibration isolation systems or transmit objectionable vibration or noise.

B. Supported Equipment: Each vibration isolation frame for supported equipment will have a minimum of four seismic snubbers mounted as close as possible to vibration isolators and/or frame extremities.

C. Bracing of Pipes: Branch lines may not be used to brace main lines.

D. Suspended Equipment and Piping Cable Method:
   1. Cables will be adjusted to the degree of slackness approved by Structural Engineer of Record.
   2. Uplift and downward restraint nuts and washers for Type 5 spring hangers will be adjusted so that there is a minimum 1/4-inch clearance.

E. Vibration isolators and seismic restraint systems must be installed in strict accordance with manufacturers written instructions and certified submittal data.

END OF SECTION
SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Plastic Nameplates
   2. Tags
   3. Plastic Pipe Markers

1.2 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

   B. In addition, submit Valve Schedule for each piping system, in tabular format using Microsoft Word or Excel software. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shutoff and similar special uses by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals. Provide schedules organized as follows:
      1. Equipment Type:
         a. Identification:
         b. Background:
            1) Size:
            2) Color:
         c. Lettering:
            1) Size:
            2) Color:

   C. For renovations or expansions of existing systems, coordinate with Owner and develop valve schedule on existing schedule naming and format.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
B. In addition, meet the following:
   1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
   2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 22, Plumbing Sections. Where more than a single type is specified for application, provide single selection for each product category.

B. Plastic Nameplates:
   1. Brady Corporation
   2. Or equal.

C. Tags:
   1. Brady Corporation
   2. Brimer
   3. Champion America Inc.
   4. Craftmark
   5. Seton Identification Products
   6. Or equal.

D. Plastic Pipe Markers:
   1. Brady Corporation
   2. Brimer
   3. Champion America Inc.
   4. Craftmark
   5. Seton Identification Products
   6. Or equal.

2.2 PLASTIC NAMEPLATES

A. Description: Engraving stock melamine plastic laminate 1/8-inch thick, engraved with engraver's standard letter style of the sizes and wording indicated.
   2. Letter Height: 1/2 inch (13 mm).
   4. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
5. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.

6. Signage for hot water outlets on 140 degree F hot water systems not protected by ASSE 1070 mixing valves; hose bibs, janitor sinks, and fixtures used by trained personnel.
   a. Manufacturer's standard 1/8-inch thick engraved plastic laminate signage 4 by 4-inches.
   b. Letter Color: Red.
   c. Letter Height: 1/2 inch (13 mm).
   d. Background Color: White.
   e. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.3 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2-inch diameter.

B. Metal Tags: Polished Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.

C. Valve designations to be coordinated with existing valve identifications to ensure no repetitive designations are utilized.

D. Chart/Schedules: Valve Schedule Frames. For each page of a valve schedule, provide glazed display frame with removable mounting as appropriate for wall construction upon which frame is to be mounted. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

E. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.

F. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7-inches.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

2.4 PLASTIC PIPE MARKERS


B. Plastic Pipe Markers (for external diameters of 6-inches and larger including insulation): Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
C. Plastic Tape Pipe Markers (for external diameters less than 6-inches including insulation): Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Minimum information indicating flow direction arrow and identification of fluid being conveyed.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Lettering and Graphics:
   1. General: Coordinate names, abbreviations and other designations used in plumbing identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
   2. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).

B. Preparation: Degrease and clean surfaces to receive adhesive for identification materials.

C. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

D. Install valve schedule at each mechanical room.

E. Access Doors: Provide markers on each access door and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions.

3.2 PLASTIC NAMEPLATES

A. Identify pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates riveted to equipment body.

B. Identify control panels and major control components outside panels with plastic nameplates riveted to equipment body.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners.

3.3 TAGS

A. Small devices, such as in-line pumps, may be identified with tags. Use metal tags on piping 3/4-inch diameter and smaller.

B. Identify valves in main and branch piping with metal tags. Indicate valve function and the normally open or closed positions on the valve tag.
C. Coordinate with the facility maintenance personnel to ensure consistency with the existing tagging system.

D. Tag balancing valves with balanced GPM or CFM indicated after balancing is completed and accepted.

E. Install tags with corrosion resistant chain.

3.4 PLASTIC PIPE MARKERS

A. Install plastic pipe markers in accordance with manufacturer's instructions.

B. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

C. For exterior underground piping installations, install underground plastic pipe markers with tracer wire 6 to 8-inches below finished grade directly above buried pipe.

D. Identify piping, concealed or exposed, with plastic tape pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20-feet (reduced to 10-feet in congested areas and mechanical equipment rooms) on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Locate near branches, valves, control devices, equipment connections, access doors, floor/wall penetrations.

END OF SECTION
SECTION 22 05 93

TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Balancing water flow within distribution systems of all Division 22, Plumbing Sections, including sub-mains, branches, and terminals, to indicated quantities according to specified tolerances.
   2. Adjusting plumbing systems to provide indicated quantities.
   3. Verifying that automatic control devices are functioning properly.
   4. Reporting results of the activities and procedures specified in this Section.

1.2 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Acceptable Balance Firm:
      a. General:
         1) Procure services of independent Testing, Adjusting, and Balancing (TAB) agency to balance, adjust and test water circulating. Minimum Experience: 5 years.
      b. Industry Standards: Testing and Balancing will conform to NEBB, American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), and American National Standards Institute (ANSI) as follows:
         2) ASHRAE: Comply with recommendations pertaining to measurements, instruments, and TAB.
c. Test Observation: If requested, conduct tests in the presence of the Architect or the Architect's representative.

2. Provide proof of testing agency having successfully completed at least five projects of similar size and scope.

3. Code Compliance: Perform tests in the presence of the Authority Having Jurisdiction (AHJ) where required by the Authority Having Jurisdiction (AHJ).

4. Owner Witness: Perform tests in the presence of the Owners representative.

5. Engineer Witness: The engineer or engineer's representative reserves the right to observe tests or selected tests to assure compliance with the specifications.

6. Simultaneous Testing: Test observations by the Authority Having Jurisdiction (AHJ), the Owner's representative and the engineer's representative need not occur simultaneously.

7. Do not perform TAB work until plumbing equipment has been completely installed and is operating continuously as required.

8. Conduct TAB with clean filters in place. Clean strainers prior to performing TAB.

9. Agent Qualifications: Engage a TAB Agent certified by AABC or NEBB.

10. TAB Conference: Meet with the Owner's and the Architect's representatives on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, controls Installer, and other support personnel. Provide 7 days advance notice of scheduled meeting time and location.

a. Agenda Items: Include at least the following:
   1) Submittal distribution requirements.
   2) TAB plan.
   3) Work schedule and Project site access requirements.
   4) Coordination and cooperation of trades and subcontractors.
   5) Coordination of documentation and communication flow.

11. Certification of TAB Reports: Certify the TAB field data reports. This certification includes the following:

a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

b. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

12. TAB Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."


14. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.

15. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

16. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.
1.6 **WARRANTY**

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.7 **DEFINITIONS**

A. Adjust: To regulate fluid flow rate at the equipment.

B. Balance: To proportion flows within the distribution system, including sub mains, branches, and terminals, according to design quantities.

C. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

D. Report Forms: Test data sheets for recording test data in logical order.

E. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

F. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

G. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

H. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

I. TAB: Testing, Adjusting, and Balancing.

J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

K. Test: A procedure to determine quantitative performance of a system or equipment.

L. Testing, Adjusting, and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.


O. CTI: Cooling Tower Institute.

P. NEBB: National Environmental Balancing Bureau.

Q. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.
1.8 **COORDINATION**

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, controls installers, and other mechanics to operate systems and equipment to support and assist TAB activities.

B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on piping distribution systems have been satisfactorily completed.

**PART 2 - PRODUCTS - NOT USED**

**PART 3 - EXECUTION**

3.1 **PROJECT CONDITIONS**

A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire TAB period. Cooperate with the Owner during TAB operations to minimize conflicts with the Owner's operations.

B. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during TAB operations to minimize conflicts with the Owner's operations.

C. Non-Owner Occupancy: Complete balancing of building systems prior to Substantial Completion and owner occupancy.

3.2 **EXAMINATION**

A. Examine Contract Documents to become familiar with project requirements and existing building record documents (if available) to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
   1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
   2. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of Plumbing systems and equipment.

C. Examine equipment performance data including pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

E. Examine system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

G. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

H. Examine equipment for installation and for properly operating safety interlocks and controls.

I. Examine automatic temperature system components to verify the following:
   1. Valves, and other controlled devices operate by the intended controller.
   2. Valves are in the position indicated by the controller.
   3. Integrity of valves for free and full operation and for tightness of fully closed and fully open positions.
   4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
   5. Sensors are located to sense only the intended conditions.
   6. Sequence of operation for control modes is according to the Contract Documents.
   7. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.

J. Report deficiencies discovered before and during performance of TAB procedures.

K. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:
   1. Permanent electrical power wiring is complete.
   2. Systems are filled, clean, and free of air.
   3. Automatic temperature-control systems are operational.
   4. Isolating and balancing valves are open and control valves are operational.

C. Hold a pre-balancing meeting at least one week prior to starting TAB work.
   1. Attendance is required by installers whose work will be tested, adjusted, or balanced.

D. Provide instruments required for TAB operations. Make instruments available to Architect to facilitate spot checks during testing.
3.4 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform TAB procedures on each system according to the procedures contained in AABC national standards or NEBB’s "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation for pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

C. Mark equipment settings with paint or other suitable, permanent identification material, including control positions, valve indicators and similar controls and devices, to show final settings.

3.5 ADJUSTMENT TOLERANCES

A. Piping Systems: Adjust to within plus or minus 10 percent of design.

3.6 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
   1. Running log of events and issues.
   2. Discrepancies, deficient or uncompleted work by others.
   4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on drawings locations where other critical measurements were taken and cross reference location in final report.

3.7 FUNDAMENTAL PROCEDURES FOR PIPING SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 10 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare systems for TAB according to the following, in addition to the general preparation procedures specified above:
   1. Open manual valves for maximum flow.
   2. Check expansion tank liquid level, or air charge if bladder type.
   3. Check makeup-water-station pressure gauge for adequate pressure.
   4. Check flow-control valves for specified sequence of operation and set at design flow.
5. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3.8 FINAL REPORT

A. General: Computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into Sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified TAB engineer.
   1. Include a list of the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the certified field report data, include the following:
   1. Pump curves.
   2. Field test reports prepared by system and equipment installers.
   3. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of TAB Agent.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   9. Signature of TAB Agent who certifies the report.
   10. Summary of contents, including the following:
        a. Design versus final performance.
        b. Notable characteristics of systems.
        c. Description of system operation sequence if it varies from the Contract Documents.
   11. Nomenclature sheets for each item of equipment.
   12. Notes to explain why certain final data in the body of reports vary from design values.

E. Pump Test Reports: For pumps, include the following data. Calculate impeller size by plotting the shutoff head on pump curves.
   1. Unit Data: Include the following:
      a. Unit identification.
      b. Location.
      c. Service.
      d. Make and size.
      e. Model and serial numbers.
      f. Water flow rate in gpm (L/s).
      g. Water pressure differential in feet of head or PSIG (kPa).
      h. Required net positive suction head in feet of head or PSIG (kPa).
      i. Pump rpm.
      j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.

END OF SECTION
SECTION 22 07 00
PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Type 1, Glass Wool Pipe Insulation
   2. Type 2, Flexible Elastomeric Insulation
   3. Type 5, Glass Wool Equipment Insulation
   4. Type 7, ADA Accessible Lavatory/Sink Insulation Kit
   5. Accessories
   6. Pipe Fitting Insulation Covers

1.2 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Piping insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.4 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Installer qualifications.
   2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
   3. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.
   4. Installer Certificate: Signed by the Contractor certifying that installers comply with requirements.
   5. Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.
B. In addition, meet the following:
1. Formaldehyde Free: Should be third-party certified with UL Environment Validation.
2. Recycled Content: A minimum of 40 percent post-consumer recycled glass content certified and UL validated.
3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
4. Installer to have minimum 5 years' experience in the business of installing insulation.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.7 FIRE HAZARD CLASSIFICATION

A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.

B. Test pipe insulation in accordance with requirements of current edition of UL "Pipe and Equipment Coverings".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Type 1, Glass Wool Pipe Insulation:
1. Owens-Corning
2. Johns Manville
3. Or equal.

B. Type 2, Flexible Elastomeric Insulation:
1. Glue:
   a. Armacell LLC Armaflex Low VOC Adhesive
   b. Halstead
   c. Or equal.
2. Paint:
   a. Armacell LLC Armaflex
   b. Halstead
   c. Or equal.

C. Type 5, Glass Wool Equipment Insulation:
1. Knauf
2. Owens-Corning
3. Johns Manville
4. Or equal.

D. Type 7, ADA Accessible Lavatory/Sink Insulation Kit:
2.2 **TYPE 1, GLASS WOOL PIPE INSULATION**

A. Glass Fiber: ASTM C547 Type I and IV; rigid molded, noncombustible.
   1. Thermal Conductivity Value: 0.27 BTU*in/(hr*ft*F) at 75 degrees F.
   2. Maximum Service Temperature: 850 degrees F to 1000 degrees F.
   3. Vapor Retarder Jacket: White Kraft paper reinforced with glass fiber and bonded to aluminum foil, with self-sealing longitudinal laps and butt strips or vapor barrier mastic.

2.3 **TYPE 2, FLEXIBLE ELASTOMERIC INSULATION**

A. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
   1. Thermal Conductivity Value: 0.25 BTU*in/(hr*ft*F) at 75 degrees F.
   2. Maximum Service Temperature of 220 degrees F.
   4. Maximum Smoke Developed: 50 (3/4-inch thick and below).
   5. Connection: Waterproof vapor retarder adhesive as needed.
   6. UV Protection: UV outdoor protective coating per manufacturer’s requirements.

B. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam.

C. Paint: Nonhardening high elasticity type, specifically manufactured as a protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather.

2.4 **TYPE 5, GLASS WOOL EQUIPMENT INSULATION**

A. Flexible Glass Wool Blanket: ASTM C612; flexible.
   1. Thermal Conductivity Value: 0.24 BTU*in/(hr*ft*F) at 75 degrees F.
   2. Maximum Service Temperature: 450 degrees F.

2.5 **TYPE 7, ADA ACCESSIBLE LAVATORY/SINK INSULATION KIT**

A. P-traps, trap arms, tail pieces, hot water and cold water insulating guards. Molded closed cell insulation with vinyl cover and nylon fasteners, paintable. Thermal conductivity; \( K = 1.17 \) (BTU*in/(hr*ft*F) at 75 degrees F mean temperature. Provide accessories as required for
complete installation covering all exposed waste piping, water piping, stops and supplies. Color white.

2.6 ACCESSORIES

A. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

B. Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories, i.e., adhesives, mastics, cements and tape to have same flame and smoke component ratings as insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide non-water soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

2.7 PIPE FITTING INSULATION COVERS


PART 3 - EXECUTION

3.1 GENERAL INSTALLATION INFORMATION

A. Verification of Conditions:
   1. Do not apply insulation until pressure testing and inspection of piping has been completed.
   2. Examine areas and conditions under which insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Preparation: Clean and dry surfaces to be insulated.

C. Installation:
   1. Insulation: Continuous through walls, floors and partitions except where noted otherwise.
   2. Piping and Equipment:
      a. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.
      b. Cover insulation on pipes above ground, outside of building, with aluminum jacketing. Position lap on bottom of pipe.

D. Provide accessories as required. See Part 2 Article "Accessories" above.
E. Protection and Replacement: Protect installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

F. Labeling and Marking: Provide labels, arrows and color coding on piping. Attach labels and flow direction arrows to jacketing per Section 22 05 53, Identification for Plumbing Piping and Equipment.

G. Piping Surfaces to be Insulated:

<table>
<thead>
<tr>
<th>Item to be Insulated</th>
<th>System Insulation Type</th>
<th>Pipe Size</th>
<th>Insulation Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Water Piping Above Grade (105°F to 140°F)</td>
<td>1</td>
<td>&lt;1-inch</td>
<td>1-inch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>=&gt;1-inch</td>
<td>1-1/2-inch</td>
</tr>
<tr>
<td>Hot Water Circulation Piping Above Grade (105°F to 140°F)</td>
<td>1</td>
<td>&lt;1-inch</td>
<td>1-inch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>=&gt;1-inch</td>
<td>1-1/2-inch</td>
</tr>
<tr>
<td>Water Piping Exposed to Weather</td>
<td>1, 2</td>
<td>All</td>
<td>1-1/2-inch</td>
</tr>
<tr>
<td>Piping with Heat Tracing</td>
<td>1, 2</td>
<td>&lt;=&lt;1-1/2-inch</td>
<td>1-inch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;1-1/2-inch</td>
<td>1-1/2-inch</td>
</tr>
<tr>
<td>ADA Accessible Lavatory/Sink</td>
<td>7</td>
<td>All</td>
<td>As Listed</td>
</tr>
<tr>
<td>Condensate Drain Piping</td>
<td>1, 2</td>
<td>All</td>
<td>1/2-inch</td>
</tr>
</tbody>
</table>

3.2 TYPE 1, GLASS WOOL PIPE INSULATION

A. See General Installation Requirements above.

B. Lap seal insulation with waterproof adhesive. Do not use staples or other methods of attachment which would penetrate vapor barrier. Apply fitting covers with seated tacks and vapor barrier tape.

C. Apply insulation to pipe and seal with self-sealing lap. Use self-sealing butt strips to seal butt joints. Insulate fittings, valves and unions with single or multiple layers of insulation and cover to match pipe or use preformed PVC molded insulation covers.

D. Above Grade Roof Drain/Overflow Drain Piping: Cover all roof drain piping and overflow drain piping with sectional pipe covering.

E. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe
directly. Provide 18-inch long, noncompressible insulation section at insulation shields for
lines 1-1/2-inches and larger (hot and cold piping).

F. Install in accordance with manufacturer's instructions for below grade installation.

3.3 TYPE 2, FLEXIBLE ELASTOMERIC INSULATION

A. See General Installation Requirements above.

B. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive.
Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and undergrade with
two coats of finish as recommended by manufacturer.

C. Above Grade Roof Drain/Overflow Drain Piping: Cover all roof drain piping and overflow
drain piping with sectional pipe covering.

D. Flexible Elastomeric Tubing: Slip insulation over piping or if piping is already installed, it
should be slit and snapped over piping. Joints and butt ends must be adhered with 520
adhesive.

E. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for
cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe
directly. Provide 18-inch long, noncompressible insulation section at insulation shields for
lines 1-1/2-inches and larger (hot and cold piping).

F. Install in accordance with manufacturer's instructions for below grade installation.

3.4 TYPE 5, GLASS WOOL EQUIPMENT INSULATION

A. See General Installation Requirements above.

B. Apply insulation and accessories to roof drain underbodies per manufacturer's
recommendations.

C. Roof Drain/Overflow Drain Underbodies: Cover underside of drain body with glass wool
insulation; attached with adhesive and supported externally with 26 gauge galvanized flat
strapping anchored to structure.

D. Storage Tanks: Cover with glass wool, 2-inches thick. Finish with canvas jacket and adhesive.
Overlap joints minimum of 4-inches. Apply two coats latex paint; color selected by Architect.

3.5 TYPE 7, ADA ACCESSIBLE LAVATORY/SINK INSULATION KIT

A. See General Installation Requirements above.

B. Install in accordance with manufacturer's instructions.

C. Provide lavatory/sink insulation kit. Install on waste fittings, hot and cold water stops and
supplies.
3.6 ACCESSORIES
A. See General Installation Requirements above.
B. Install in accordance with manufacturer's instructions.
C. Provide and install accessories for all insulation types listed in this Section.

3.7 PIPE FITTING INSULATION COVERS
A. See General Installation Requirements above.
B. Install in accordance with manufacturer's instructions.

END OF SECTION
SECTION 22 10 00

PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
1. Sanitary, Drainage (Rain/Stormwater) DWV Piping, Buried Within 5-feet of Building
2. Sanitary, Drainage (Rain/Stormwater) DWV Piping, Above Grade
3. Pump Waste Pressure Piping (Pumped Discharge)
4. Water Piping, Buried Within 5-feet of Building
5. Hot and Cold Domestic Water Above Grade
6. Condensate Piping
7. Primer Piping
8. Piping Specialties
9. Cleanouts

1.2 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
1. NSF 61, Annex G.
2. Steel pipe to conform to ASTM and ANSI Standards as specified in this Section.
3. Copper piping to conform to ASTM B88, B306 and B208 and the standards of Copper Development Association (CDA), and American Welding Society, (AWS).
5. Manufacturer's Standards Society (MSS) for valving and support reference standard.
6. American Water Works Association (AWWA) for Valving Assembly Standards.
7. American Society of Sanitation Engineers (ASSE) for Valving Standards.
8. American National Standards Institute (ANSI) for Piping Standards.

1.4 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. See component manufacturers listed in individual articles below.

B. Cerro

C. Dodge Phelps

D. Tyler

E. Charlotte

F. Spears

G. Nibco

H. American-USA

I. Sioux Chief

J. Or equal.

K. Cleanouts:
   1. J.R. Smith
   2. Zurn
   3. Wade
   4. Watts
   5. Sioux Chief
   6. Or equal.

L. Firestopping Penetrations in Fire Rated Wall Floor Assemblies:
   1. Hilti
   2. Proset
   3. Or equal.

2.2 GENERAL

A. Provide pipe, tube and fittings of the same type, fitting requirements, grade, class and the size and weight indicated or required for each service, as indicated in other Division 22, Plumbing Specifications. Where type, grade, or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards.
B. Manufactured materials delivered, new to the project site and stored in their original containers.

C. Product Marking: Each item to be furnished with legible markings indicating name brand and manufacturer, manufacturing process, heat number and markings as required per ASTM and UL/FM Standards.

2.3 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, BURIED WITHIN 5- FEET OF BUILDING

   1. Fittings: Cast iron.
   2. Coupling Assembly:

2.4 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, ABOVE GRADE

   1. Fittings: Cast iron.
   2. Coupling Assembly:

B. Copper Tube: ASTM B 306, DWV

2.5 PUMP WASTE PRESSURE PIPING (PUMPED DISCHARGE)

A. Above Grade: Type "L" copper with solder joints.

B. Below Grade: Type "L" copper with brazed joints.

2.6 WATER PIPING, BURIED WITHIN 5- FEET OF BUILDING

A. Copper Pipe: ASTM B88, hard drawn, Type K (A).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.

   1. Fittings: Ductile or gray iron, standard thickness.

2.7 HOT AND COLD DOMESTIC WATER ABOVE GRADE

A. Copper Tube: 3-inches and above. ASTM B88 (ASTM BA88m), Type L (B), Drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

B. Copper Tube: 2-1/2-inches and smaller. ASTM B88 (ASTM B88M), Type L (B), Drawn.
1. Fittings: ASME B16.18 copper.

2.8 CONDENSATE PIPING

A. Copper Tube: ASTM B 88 (ASTM B898M), Type L (B) or M (C)

B. Piping for drainage of condensate from combustion fuel sources (such as condensing boilers and water heaters) is to be chemical resistant piping as noted in this Section for area of application.

2.9 PRIMER PIPING

A. Above Ground: Type L hard-drawn copper tubing with wrought sweat fittings and soldered joints.

B. Belowground: Type L soft annealed copper tubing with wrought sweat fittings and brazed joints.

2.10 PIPING SPECIALTIES

A. Pipe Escutcheons:
   1. Provide pipe escutcheons as specified with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime zinc base paint finish for unoccupied areas.
   2. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide stainless steel, cast brass or sheet brass escutcheons, solid or split hinged.
   3. Pipe Escutcheons for Dry Areas: Provide stainless steel escutcheons, solid or split hinged.

B. Low Pressure Y-Type Pipeline Strainers:
   1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 percent of the working pressure of piping system with Type 304 stainless steel screens made with 8mm perforations at 233 perforations per square millimeter.
   2. Threaded Ends, 2-inch and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with plus.
   3. Flanged Ends, 2-1/2-inch and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with hose bibb.

C. Air Vent with Valves:
   1. Install automatic air vents in all closed and open-loop water systems at high points and at any other point necessary to free system of air. A shut-off valve to be provided in riser to each automatic vent valve to facilitate servicing. Manual type vent may be used in lieu of automatic type, where specifically shown on the Drawings.
2. Manufacturer: Hoffman #79.

D. Dielectric Waterways:
   1. Provide standard products recommended by manufacturers in service indicated, which effectively isolate ferrous from non-ferrous piping (eliminating electrical conductance) to prevent galvanic action and stop corrosion.
   2. Provide dielectric waterways or brass nipple fitting for transitions between dissimilar metal piping.

E. Unions:
   1. Unions to comply with the following schedule:
      a. Black Steel, 2-inch and smaller: 150 PSI screwed malleable iron, ground joint, brass to iron seat.
      b. Black Steel, 2-1/2-inch and larger: 150 PSI cast iron screwed flanged, flat faced, full faced gasket.
      c. Soldered Copper or Brass Pipe, 2-inch and smaller: 150 PSI cast bronzed or copper, ground joint, non-ferrous seat with soldered ends.
      d. Screwed Copper or Brass Pipe, 2-inch and smaller: 150 PSI cast brass, ground joint, brass to brass seat, threaded ends.
      e. Flanged Copper or Brass Pipe, 2-1/2-inch and larger: Two 150 PSI cast bronze flanges.
      f. Manufacturer: EPCO, Mueller or Stanley G. Flagg or Watts or equal.

F. Flexible Piping Connectors - Expansion Loops or Seismic Joints:
   1. Provide flexible expansion loops of size and material noted on Drawings. Flexible loops to be designed to impart no thrust loads on the anchors. The loop consists of two flexible sections of hose and braid, two 90 degree elbows, and a 180 degree return. Loops to be installed in a neutral, precompressed, or preextended condition as required for the application. Loops installed hanging down to have a drain plug. Loops installed straight up may be fitted with an automatic air release valve to purge air from the high point of the loop. Loops installed in any position other than hanging down must have the 180 degree return supported.
   2. Copper Pipe: Copper fittings, bronze hose and braid sweat solder ends, Metraloop Series MLS 8000.
   3. Steel Pipe: Schedule 40 carbon steel fittings, stainless steel hose and braid,
   4. Threaded Eds: Metraloop Series MLT 80000
   5. Flanged Ends: Metraloop Series MLF 80000
   6. Welded Ends: Metraloop Series MLW 80000
   7. Grooved Ends: Metraloop Series MLG 80000
   8. Gas Lines, CSA Approved: Metraloop - Gas MLT or MLF Series.
   9. Vertical and horizontal straight run hot water and domestic hot water recirculation piping exceeding 1,000-feet to be provided with expansion joints by Mason, Flexionics or Shur Fit. Installation to be per manufacturer's installation directions.

2.11 CLEANOUTS

A. General: Locate cleanouts as shown on Drawings and as required by local code. Cleanouts same size as pipe except that greater than 4-inches will not be required. Plastic components not allowed, except unless specifically noted.
B. Types:
3. Concrete Floor Cleanout (General): J. R. Smith 4020 with round heavy-duty nickel bronze top, taper thread and ABS plug with standard screws.
4. Parking, Drives and Concrete Floor Cleanouts (Heavy Load): J. R. Smith 4100 with round heavy-duty nickel bronze top, taper thread and ABS plug with standard screws.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Underground Piping Systems Examination:
1. Verify that excavations are to required grade, dry, and not over-excavated.

B. General:
1. Perform necessary excavation and backfill required for installation of plumbing work. Repair piping or other work at no expense to Owner.
2. Water: Keep excavations free of standing water. Reexcavate and fill back excavations damaged or softened by water or frost to original level with sand, crushed rock or other approved material at no expense to Owner.
3. Tests: During progress of work for compacted fill, Owner reserves right to request compaction tests made under direction of testing laboratory.
4. Trench Excavation: Excavate trenches to necessary depth and width, removing rocks, unstable soil (muck, peat), roots and stumps. Excavation material is classified as "base fill" and "native." Base fill excavation material consisting of placed crushed rock may be used as backfill above "Pipe Zone." Remove and dispose off site native excavation material. Adequate width of trench for proper installation of piping or conduit.
5. Support Foundations:
   a. Foundations: Excavate trenches located in unstable ground areas below elevation required for installation of piping to depth which is determined by Architect as appropriate for conditions encountered. Place and compact approved foundation material in excavation up to "Bedding Zone." Dewatering, placement, compaction and disposal of excavated materials to conform to requirements contained in other Sections of Specifications or Drawings.
   b. Over-Excavations: Where trench excavation exceeds required depths, provide, place and compact suitable bedding material to proper grade or elevation at no additional cost to Owner.
c. Foundation Material: Where native material has been removed, place and compact necessary foundation material to form base for replacement of required thickness of bedding material.

| Material Passing  | Class A |  | Class B |  |
|-------------------|---------|  |---------|  |
| 3/4-inch Square Opening | 27      | 47  | 0       | 1  |

d. Bedding Material: Full bed piping on sand, pea gravel, or 3/4-inch minus crushed rock. Place minimum 4-inch deep layer of sand, pea gravel, or crushed rock on leveled trench bottom for this purpose. Remove bedding to necessary depth for piping bells and couplings to maintain contact of pipe on bedding for its entire length. Provide additional bedding in excessively wet, unstable, or solid rock trench bottom conditions as required to provide firm foundation.

6. Backfilling:
   a. Following installation and successful completion of required tests, backfill piping in lifts.
      1) In "Pipe Zone“ place backfill material and compact in lifts not to exceed 6-inches in depth to height of 12-inches above top of pipe. Place backfill material to obtain contact with entire periphery of pipe, without disturbing or displacing pipe.
      2) Place and compact backfill above "Pipe Zone“ in layers not to exceed 12-inches in depth.
   b. Backfill Material:
      1) Backfill Material in "Pipe Zone": 3/4-inch minus crushed rock, sand or pea gravel.
      2) Crushed rock, fill sand or other backfill material approved elsewhere in Specifications may be used above "Pipe Zone."

7. Compaction of Trench Backfill:
   a. Where compaction of trench backfill material is required, use one of following methods or combination thereof:
      1) Mechanical tamper,
      2) Vibratory compactor, or
      3) Other approved methods appropriate to conditions encountered.
   b. Architect to have right to change methods and limits to better accommodate field conditions. Compaction sufficient to attain 95 percent of maximum density at optimum moisture content unless noted otherwise on Drawings or elsewhere in Specifications. Water "puddling" or "washing" is prohibited.

C. General Installation:
   1. Work performed by experienced journeyman plumbers. No exceptions.
   2. Provide access panels for concealed valves, shock arrestors, trap primers and the like.
   3. Install pipes and pipe fittings in accordance with recognized industry practices and manufacturer's recommendations.
5. Locate piping runs, as indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2-inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1-inch clearance outside insulation. Whenever possible in finished and occupied spaces, conceal piping from view by locating it in column enclosures, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as indicated.

a. Do not run piping through transformer vaults, telephone, elevator, electrical or electronic equipment spaces or enclosures unless indicated on Drawings.

b. Concealed Piping Above Suspended Ceiling: Plan and coordinate to avoid interferences; install to maintain suspended ceiling heights shown on Architectural Drawings. Allow sufficient space above removable ceiling panels for panel removal. Locate piping so that valves are visible and accessible within 24-inches horizontally and vertically from point of access to the ceiling space. Provide plenum rated materials for ceiling spaces which are being used as plenums.

c. Exposed Work: Run pipes parallel to the closest wall unless otherwise shown on Drawings; maintain maximum headroom; avoid light fixtures.

d. Insulation Space Allowance: In piping work, allow space for pipe insulation and jackets. If interferences occur, move the piping to accommodate insulation thickness specified.

e. Pipe Lengths: Do not use short lengths or nipples at locations where a full length of pipe will fit.

f. Alignment Prior to Supporting and Anchoring: Place piping in proper alignment and position prior to connection to anchors, expansion loops, and equipment. Furnish jacking devices, temporary steel structural members, and assembled structures as necessary. Remove temporary equipment and structures supplied by contractor at completion; such items to remain Contractor property.

g. Valve and Equipment Connections: Piping not to place undue stress on flanged valves and equipment connections. Mating flange faces to be true and parallel to each other and not to require springing of piping for assembly. Pipe hangers and supports to carry the full weight of the pipe and fluid.

h. Piping Leaks: Correct immediately; use new materials; leak-sealing compounds or peening not permitted.

i. Pressure Ratings of Fittings, Valves, and Devices in Piping Systems: Pressure rating to be equal to or greater than the maximum working pressure of the system.

j. Equipment Vents and Drains: Provide for coils and vessels which contain water. Provide isolation valves and outlet valves at piping high and low points to permit venting and draining of the vessel without venting and draining connected piping. Provide hose connections and caps on drain lines.

k. Escutcheon Plates: Where exposed insulated and uninsulated piping passes through walls, floors or ceilings; provide spring clip type. Provide plates on both sides of wall or floor.
D. Testing:
   1. General:
      a. Provide temporary equipment for testing, including pumps, compressors, tanks, and gauges, as required. Test piping systems before insulation (if any) is installed and remove or disengage control devices before testing. Where necessary, test sections of each piping system independently, but do not use piping valves to isolate sections where test pressures exceed local valve operating pressure rating. Fill each section with water, compressed air, or nitrogen and pressurize for the indicated pressure and time.
      b. Notify Architect and local Plumbing Inspector 2 days before tests.
      c. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
      d. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
      e. Send test results to Architect for review and approval and include in Operation and Maintenance Manual.
   2. Testing of Pressurized Systems:
      a. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
      b. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
   3. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.

E. Corrosive Soil Conditions:
   1. Wrap steel, iron, copper or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per manufacturer's recommendations.
   2. Obtain and review project soils report for verification of requirements concerning corrosive soils.

F. Protection:
   1. Keep pipe openings closed by means of plugs or caps to prevent entrance of foreign matter. Protect piping, ductwork, fixtures, equipment and apparatus against dirty water, chemical or mechanical damage both before and after installation. Restore to its original condition or replace fixtures, equipment or apparatus damaged prior to final acceptance of work.

G. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
   1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
H. Piping to be cut squarely, free of rough edges and reamed to full bore. Piping to be fully inserted into fittings.

I. Provide joints of type indicated in each piping system.

J. Thread pipe in accordance with ANSI/ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Remove excess cutting oil from piping prior to assembly. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

K. Sleeves:
   1. Pipe Sleeves:
      a. Layout work in advance of pouring concrete, furnish, and set sleeves necessary to complete work.
      b. Floor Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1-inch above finished floor. Caulk pipes passing through floor with non-shrinking grout or approved caulking compound (Except DWV Piping penetrating a concrete Slab set on Finish Grade), provide "Link-Seal" sleeve sealing system for concrete/slab penetrations which are below grade. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements
      c. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with non-shrinking caulking compound. Provide modular link sealing system for concrete penetrations which are below grade. Caulk/seal piping passing through fire-rated assemblies per local AHJ requirements.
      d. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Indicate penetrations on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Plumbing Drawings are diagrammatic. Offset piping as required to meet these limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.
   2. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
      a. Install fabricated pipe sleeve.
      b. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification.
      c. Seal each end airtight with a resilient nonhardening seal per code.
   3. Piping penetrations through fire-rated (1 to 3 hour) assemblies:
      a. Select and install pre-engineered pipe penetration system in accordance with UL listing and manufacturer's recommendation.
      b. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E84.
3.2 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, BURIED WITHIN 5- FEET OF BUILDING

A. Excavation and Backfill:
   1. See 3.01B. above.

B. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.

C. Corrosive Soil Conditions:
   1. Wrap steel, iron, copper or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per manufacturer's requirements.

D. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.

E. Sanitary and Storm Drainage:
   1. Piping to be graded at a uniform pitch of 2 percent unless otherwise noted on Drawings.
   2. Indirect Waste or Drain Piping: Extend piping to discharge as shown on Drawings. Maintain minimum air gap. Provide traps on direct waste or drain piping exceeding 60-inches.
   3. Fixture Carriers: Concealed fixture carriers for wall hung plumbing fixtures are specified in Section 22 40 00.
   4. Drains:
      a. Install drains to suit finished floor or roof surface. Install drains and components per manufacturer's instructions. Arrange for flooring to be sloped to floor drain or sink a minimum of 1/2-inch below finished floor elevation.
      b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of the same materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.
   5. Wall Access Panel: Secure to wall framing and install so that flange forms a close fitting joint with the finished wall surface.
   6. Heat trace and insulate P-traps exposed to freezing conditions. Provide heat trace and electronic components to Division 26 for installation.
   7. Insulate horizontal branch lines from floor sinks, receptors and drains receiving cold discharge from equipment and appliances.

3.3 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, ABOVE GRADE

A. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size
within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.

B. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
   1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.

C. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and Copper Development Association recommended procedures. Joints to be cleaned by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meets CDA standard test method 1.0 and ASTM B813-91. Solder to be applied until a full fillet is present around the joint. Solder and flux not to be applied in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.

D. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.

E. Sanitary and Storm Drainage:
   1. Piping to be graded at a uniform pitch of 2 percent unless otherwise noted on Drawings.
   2. Indirect Waste or Drain Piping: Extend piping to discharge as shown on Drawings. Maintain minimum air gap. Provide traps on direct waste or drain piping exceeding 60-inches.
   3. Fixture Carriers: Concealed fixture carriers for wall hung plumbing fixtures are specified in Section 22 40 00.
   4. Drains:
      a. Install drains to suit finished floor or roof surface. Install drains and components per manufacturer's instructions. Arrange for flooring to be sloped to floor drain or sink a minimum of 1/2-inch below finished floor elevation.
      b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of the same materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.
   5. Wall Access Panel: Secure to wall framing and install so that flange forms a close fitting joint with the finished wall surface.
   6. Heat trace and insulate P-traps exposed to freezing conditions. Provide heat trace and electronic components to Division 26 for installation.
   7. Insulate horizontal branch lines from floor sinks, receptors and drains receiving cold discharge from equipment and appliances.

3.4 PUMP WASTE PRESSURE PIPING (PUMPED DISCHARGE)

A. Excavation and Backfill:
   1. See 3.01 B. above.

B. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size
within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.

C. Testing of Pressurized Systems:
   1. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
   2. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.

D. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
   1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.

E. Braze copper tube and fitting socket with BCUP series filler metal without flux. Listed brazing flux to be used for joining of copper tube to brass or bronze fittings and will meet AWS FB3A or FB3C. "Shock" cooling is prohibited. a continuous fillet is to be visible around the completed joint. After cooling, flux residue to be thoroughly removed with warm water and a brush prior to testing. Do not use BCUP filler on copper alloys containing over 10 percent nickel. Piping is to be capped or plugged during construction to prevent entry of foreign material.

F. Welders performing work under this Contract to be certified and qualified in accordance with tests prescribed by the National Certified Welding Bureau (NCWB) or by other approved test procedures using methodology and procedures covered in the ASME Boiler and Pressure Vessel Code, Section IX, "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators". Installation to conform to ANSI 31.1 "Power Piping".
   1. Submit for approval the names, identification, and welder's assigned number, letter or symbol for welders assigned to this project.
   2. The assigned identification symbol to be used to identify the work of each welder and to be indelibly stamped immediately upon completion of each weld.
   3. Welders to be tested and certified for all positions.
   4. Submit identifying stenciled test coupons made by each operator.
   5. Welders may be required to retake welding certification tests without additional expense.
   6. When so requested, a welder will not be permitted to work as a welder on this project until he has been recertified in accordance with NCWB.
   7. Recertification of the welder to be made after the welder has taken and passed the required tests.

G. Weld pipe joints in accordance with recognized industry practice and as follows:
   1. Weld pipe joints only when ambient temperature is above 0F.
   2. Bevel pipe ends at a 37.5 degree angle where possible, smooth rough cuts, and clean to remove slag, metal particles, and dirt.
   3. Use pipe clamps or tack-weld joints with 1-inch long welds, 4 welds for pipe sizes to 10-inches, 8 welds for pipe sizes 12-inches to 20-inches.
   4. Build up welds with a stringer-bead pass, followed by a hot pass, followed by a cover or filler pass. Eliminate valleys at center and at edges of each weld. Weld by procedures
which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes, and non-metallic inclusions.

5. Do not weld out piping system imperfections by tack-welding procedures. Re-fabricate to comply with requirements.

6. At Installer's option, install forged branch-connection fittings whenever branch pipe is indicated, or install a regular T-fitting.

H. Sanitary and Storm Drainage:
   1. Piping to be graded at a uniform pitch of 2 percent unless otherwise noted on Drawings.
   2. Indirect Waste or Drain Piping: Extend piping to discharge as shown on Drawings. Maintain minimum air gap. Provide traps on direct waste or drain piping exceeding 60-inches.
   3. Fixture Carriers: Concealed fixture carriers for wall hung plumbing fixtures are specified in Section 22 40 00.
   4. Drains:
      a. Install drains to suit finished floor or roof surface. Install drains and components per manufacturer's instructions. Arrange for flooring to be sloped to floor drain or sink a minimum of 1/2-inch below finished floor elevation.
      b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of the same materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.
   5. Wall Access Panel: Secure to wall framing and install so that flange forms a close fitting joint with the finished wall surface.
   6. Heat trace and insulate P-traps exposed to freezing conditions. Provide heat trace and electronic components to Division 26 for installation.
   7. Insulate horizontal branch lines from floor sinks, receptors and drains receiving cold discharge from equipment and appliances.

3.5 WATER PIPING, BURIED WITHIN 5-FEET OF BUILDING

A. Excavation and Backfill:
   1. See 3.01 B. above.

B. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.

C. Domestic Water:
   1. "Piping" to include pipes, fittings, nipples, valves and accessories connected thereto.
   2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts, flues, conduits and work of other trades, and as close to ceiling or other construction as practical, free of unnecessary traps or bends.
   3. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.
   4. Piping connections to equipment to be made up with unions.
   5. Provide sufficient elbows, swings and offsets to permit free expansion and contraction.
   6. Use reducers or increasers. Use no bushings.
7. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageways.
8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report on final water quality results.
9. Exposed connections to equipment to be installed with special care, showing no tool marks or threads at fittings and piping. No bowed or bent piping to be permitted.
10. Ferrous to non-ferrous connections to be made by means of dielectric fittings.
11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2-inches. Use no close nipples. Use only shoulder-type nipples.
12. Through-Wall Pipes: Type 'L' copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-bolts to steel back-up plates or steel angles anchored in the wall. Provide wrought copper elbow which securely anchors ears in wall at through-wall pipes.
13. Provide drain valves at base of risers and at low points on the system.

D. Sterilization of Domestic Water System:
1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.
2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. After retention, drain, refill and return system to service.
4. Provide water line disinfections performed by a D1 Water Operator licensed in the State of California.

E. Buried Preinsulated Pipe Installation:
1. Installation and Testing: Install and test products in accordance with manufacturer’s installation instructions.
2. Manufacturer’s installation instructions shall describe the following:
   a. Storage and handling of pipes.
   b. Trench preparation.
   c. Installing pipe.
   d. Installing accessories.
   e. Installing fittings.
   f. Building penetrations.
   g. Field insulation kits.
   h. Testing.

3.6 HOT AND COLD DOMESTIC WATER ABOVE GRADE

A. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.

B. Testing of Pressurized Systems:
1. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
2. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.

C. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.

D. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
   1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.

E. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and Copper Development Association recommended procedures. Joints to be cleaned by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meets CDA standard test method 1.0 and ASTM B813-91. Solder to be applied until a full fillet is present around the joint. Solder and flux not to be applied in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.

F. Braze copper tube and fitting socket with BCUP series filler metal without flux. Listed brazing flux to be used for joining of copper tube to brass or bronze fittings and will meet AWS FB3A or FB3C. "Shock" cooling is prohibited. a continuous fillet is to be visible around the completed joint. After cooling, flux residue to be thoroughly removed with warm water and a brush prior to testing. Do not use BCUP filler on copper alloys containing over 10 percent nickel. Piping is to be capped or plugged during construction to prevent entry of foreign material.

G. Domestic Water:
   1. "Piping" to include pipes, fittings, nipples, valves and accessories connected thereto.
   2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts, flues, conduits and work of other trades, and as close to ceiling or other construction as practical, free of unnecessary traps or bends.
   3. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.
   4. Piping connections to equipment to be made up with unions.
   5. Provide sufficient elbows, swings and offsets to permit free expansion and contraction.
   6. Use reducers or increasers. Use no bushings.
   7. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageways.
   8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report on final water quality results.
   9. Exposed connections to equipment to be installed with special care, showing no tool marks or threads at fittings and piping. No bowed or bent piping to be permitted.
   10. Ferrous to non-ferrous connections to be made by means of dielectric fittings.
11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2-inches. Use no close nipples. Use only shoulder-type nipples.

12. Through-Wall Pipes: Type ‘L’ copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-bolts to steel back-up plates or steel angles anchored in the wall. Provide wrought copper elbow which securely anchors ears in wall at through-wall pipes.

13. Provide drain valves at base of risers and at low points on the system.


H. Sterilization of Domestic Water System:
   1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.
   2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. After retention, drain, refill and return system to service.
   4. Provide water line disinfections performed by a DI Water Operator licensed in the State of California.

3.7 CONDENSATE PIPING

A. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
   1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.

3.8 PRIMER PIPING

A. Excavation and Backfill:
   1. See 3.01 B. above.

B. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.

3.9 PIPING SPECIALTIES

A. Excavation and Backfill:
   1. See 3.01 B. above.

B. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size
within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.

3.10 CLEANOUTS

A. Install in aboveground piping and building drain piping as indicated, as required by code; at each change in direction of piping greater than 135 degrees; at minimum intervals of 100-feet; and at base of each vertical soil or waste stack. Install floor and wall cleanout covers for concealed piping. Select type to match adjacent building finish. Provide shop drawings to Architect to coordinate locations and types of cleanouts with Architect prior to installation.

B. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.

C. Corrosive Soil Conditions:
   1. Wrap steel, iron, copper or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per manufacturer's requirements.
   2. Provide epoxy coated cast iron pipe and fittings for drainage systems.

D. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.

END OF SECTION
SECTION 22 30 00
PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Commercial Light Duty Electric Storage Type Water Heaters
   2. Domestic Expansion Tanks Non-ASME
   3. Domestic Circulation Pump
   4. Grease Interceptors

1.2 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Seismic anchor details and calculations signed and stamped by licensed California structural engineer with equipment data.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. NSF 61, Annex G compliant.
   2. ISO 9001 Certified.
   3. IAPMO Low Lead Certification

C. Products approved for installation by state authorizing agency, no exceptions.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Commercial Light Duty Electric Storage Type Water Heaters:
   1. Hubbell Series E
   2. A.O. Smith
   3. Bradford White
   4. Bock
   5. State
   6. Or equal.

B. Domestic Expansion Tanks Non-ASME:
   1. Bell and Gossett Series PT
   2. American Wheatley
   3. Amtrol
   4. Armstrong
   5. Watts
   6. Or equal.

C. Domestic Circulation Pumps:
   1. Bell and Gossett Series PL
   2. Armstrong
   3. Grundfoss
   4. Paco
   5. Taco
   6. Or equal.

D. Grease Interceptors:
   1. Zurn Series 1171-1170
   2. Thermaco
   3. Rockford
   4. Highland
   5. Smith
   6. Josam
   7. Wade
   8. Watts
   9. Or equal.

2.2 GENERAL

A. Reference drawings for capacities and specific model numbers.

2.3 COMMERCIAL LIGHT DUTY ELECTRIC STORAGE TYPE WATER HEATERS

A. System: Domestic Hot Water

B. Entire unit is to be delivered complete with operating controls and require only plumbing and electrical service connections.
C. Tank welded steel commercial construction designed for 150 PSI. Tank is to be lined with seamless Hydrastone cement to minimum thickness of 1/2-inch on 100 percent of interior tank surfaces, and not require any type of anodic protection. Tank designed and fabricated with non-ferrous copper-silicon threaded tapings and non-ferrous inlet and outlet piping for maximum corrosion resistance. Steel tank tappings will not be acceptable. Entire tank is to be insulated with minimum of 2-inches thick polyurethane foam insulation and exceed latest ASHRAE standard for stand-by heat loss. Complete heater supplied with high impact colorized composite protective jacket which cannot rust or corrode and does not require painting.

D. Cold water inlet 3/4-inch Female NPT (1-1/2-inch Male NPT) and include non-corrosive strata-flow diffuser which prevents incoming cold water from mixing too rapidly with hot water in tank. 3/4-inch hose connection drain is supplied. Hot water outlet 3/4-inch Male NPT (1-1/2-inch Male NPT) and includes factory installed built-in heat trap to prevent water from radiating through piping during stand-by periods. Separate 3/4-inch Female NPT tapping is to be provided for relief valve installation. An ASME rated automatic reseating combination temperature and pressure safety relief valve set at 150 PSI and 210 degrees F factory supplied.

2.4 DOMESTIC EXPANSION TANKS NON-ASME

A. Welded steel, constructed, tested and stamped in accordance with IAPMO Standards for working pressure of 125 PSI. Support floor mounted tanks with steel legs or base. Provide single flexible diaphragm securely sealed into tank to separate air charge from system water, to maintain design expansion capacity. Provide pressure gauge and air-charging fitting, and drain fitting. Diaphragm: Removable and replaceable in line.

2.5 DOMESTIC CIRCULATION PUMPS

A. System: Domestic water.

B. Provide in-line factory tested pumps, cleaned, and painted with enamel prior to shipment. Pumps to be rated for domestic water. Provide pumps of same type by same manufacturer.

C. Type: Horizontal, oil-lubricated, designed for 150 PSI working pressure, 225 F continuous water temperature.

D. Body: Bronze or Stainless steel construction.

E. Shaft: Stainless or Carbon steel, ground and polished, integral thrust collar.

F. Bearings: Two horizontal sleeve sealed steel bearings permanently lubricated designed to circulate oil.

G. Seal: Mechanical, with carbon seal face rotating against ceramic seat.

H. Face plate: Stainless steel.

I. Motor: Nonoverloading at any point on pump curve, open, drip-proof, sleeve bearings, quiet operating, rubber mounted construction, built-in thermal overload protection.

J. Elastomers: EPDM.
K. Provide Honeywell 115 volt immersion aquastat set at 115 or 118 degrees F.

L. Option. Pump may be operated from Building Automation System. Coordinate installation of additional devices with controls contractor.

2.6 GREASE INTERCEPTORS

A. Interior and exterior acid resistant coated, steel or stainless steel, grease interceptor, gasketed nonskid locking cover. Cascade bottom. Internal air relief, visible double wall trap, removable baffles. Clamping ring and anchor flange. Grease draw-off piping, flexible hose and valve Zurn Z1108/Z1108-L remote in line, flow control fitting. Provide extension where required by structural features or depth of piping.

B. Interceptor installed flush with finish floor unless specifically directed otherwise by Architect or as detailed on Drawings.

PART 3 - EXECUTION

3.1 GENERAL

A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

C. Orient so controls and devices needing service and maintenance have adequate access.

D. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.

E. Connect water piping to units with shutoff valves and unions.

F. Equipment Rigging: Heavy duty rigging eye bolts for Crosby Group swivel hoist rings installed over pump access covers for removal or maintenance.

G. Equipment Start-Up:
   1. Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls.
   2. Start-up performed by authorized manufacturer's representative or agent. Provide credentials of start-up personnel to Architect and Owner's Representative for approval.
   3. Remove and replace filters when start-up testing is executed.
   4. Manufacturer adjusts operating parameters of equipment to compensate to elevation of 500-feet above sea level.
   5. Architect, Commissioning Agent, and Owner's Representative will be notified 10 days prior to start-up and will be present at start-ups.
   6. Provide written report from manufacturer's representative on results of start-up within 48 hours.
7. Technical Training of maintenance staff includes two hours minimum per each piece of equipment.
8. Seismic Verification:
   a. Contractor will retain structural engineer who will submit stamped and signed anchoring and restraint details on plumbing equipment with submittal data in accordance with Division 22, Plumbing requirements.
   b. Contractor’s Structural Engineer will test and verify in writing that seismic restraints have been installed in accordance with their details.

3.2 COMMERCIAL LIGHT DUTY ELECTRIC STORAGE TYPE WATER HEATERS

A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
B. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
C. Orient so controls and devices needing service and maintenance have adequate access.
D. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.
E. Connect water piping to units with shutoff valves and unions.

3.3 DOMESTIC EXPANSION TANKS NON-ASME

A. Precharge tank per manufacturers recommendation.
B. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
C. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
D. Orient so controls and devices needing service and maintenance have adequate access.
E. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.
F. Connect water piping to units with shutoff valves and unions.

3.4 DOMESTIC CIRCULATION PUMPS

A. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
B. Orient so controls and devices needing service and maintenance have adequate access.
C. Connect water piping to units with shutoff valves and unions.

D. Provide lift check valves 5 diameters downstream of pump discharge for circulating pumps piped in a parallel configuration.

E. Equipment Start-Up:
   1. Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls.
   2. Architect, Commissioning Agent, and Owner's Representative will be notified 10 days prior to start-up and will be present at start-ups.
   3. Seismic Verification:
      a. Contractor will retain structural engineer who will submit stamped and signed anchoring and restraint details on plumbing equipment with submittal data in accordance with Division 22, Plumbing requirements.
      b. Contractor's Structural Engineer will test and verify in writing that seismic restraints have been installed in accordance with their details.

3.5 GREASE INTERCEPTORS

A. Provide and install per local ordinances/FOG programs and manufacturer's recommendations.

END OF SECTION
SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. General Plumbing Fixtures:
      a. China Fixtures, White Only
      b. Faucet Fittings
      c. Fiberglass Fixtures, White Only
      d. Hose Reels
      e. Molded Resin or Stone Fixtures
      f. Stainless Steel Fixtures
      g. Thermostatic Mixing Valves
      h. Trench Drains
   2. Carriers
   3. Drinking Fountains
   4. Electric Water Coolers
   5. Emergency Showers/Eyewash
   6. Fixture Trim
   7. Floor Drains
   8. Floor Sinks
   9. Flushometers - Water Closet/Urinal
   10. Hose Bibbs
   11. Hub Drains
   12. Water Closet Seats
   13. Water Supply Boxes

1.2 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
B. In addition, meet the following:
   1. Comply with lead free (less than or equal to 0.25 percent) products in drinking water systems.
   4. IAPMO Low Lead Certification.
   5. Provide fixtures, faucets and accessories to meet barrier free requirements of the governing code with respect to plumbing fixtures provided for the physically handicapped.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. "Or equal" as defined in 22 00 00, General Plumbing Requirements. Substitution process requirements apply to equal products.

B. General Plumbing Fixtures; See Schedule on Drawings for type.
   1. China Fixtures - White Only:
      a. American Standard
      b. Briggs
      c. Crane
      d. Eljer
      e. Kohler
      f. Or equal.
   2. Faucet Fittings:
      a. Private:
         1) Chicago
         2) Delta Commercial
         3) Moen
         4) Speakman
         5) Symmons
         6) T&S Brass
         7) Or equal.
      b. Public:
         1) American Standard
         2) Chicago
         3) Delta Commercial
         4) Moen Commercial
         5) Sloan
         6) Symmons
         7) T & S Brass
         8) Or equal.
3. Fiberglass Fixtures - White Only:
   a. Aqua-Glass
   b. Briggs
   c. Crane
   d. Comfort Designs
   e. Hytec
   f. Mustee
   g. Universal-Rundle
   h. Or equal.

4. Hose Reels:
   a. Balcrank
   b. Lincoln
   c. Or equal.

5. Molded Resin or Stone Fixtures:
   a. Fiat
   b. Mustee
   c. Stern Williams
   d. Or equal.

6. Stainless Steel Fixtures:
   a. Elkay
   b. Haws
   c. Just
   d. Or equal.

7. Thermostatic Mixing Valves:
   a. Bradley
   b. Powers
   c. Symmons
   d. Holby
   e. Or equal.

8. Trench Drains:
   a. Channel-Slope
   b. JR Smith
   c. PolyDrain
   d. Polycast
   e. Quazite
   f. Zurn
   g. Or equal.

C. Carriers:
   1. JR Smith
   2. Zurn
   3. Or equal.

D. Drinking Fountain:
   1. Elkay
   2. Halsey-Taylor
   3. Haws
   4. Oasis
   5. Sunroc
6. Or equal.

E. Electric Water Coolers:
   1. Elkay
   2. Halsey-Taylor
   3. Haws
   4. Oasis
   5. Sunroc
   6. Or equal.

F. Emergency Showers/Eyewash:
   1. Bradley
   2. Encon
   3. Guardian
   4. Haws
   5. Speakman
   6. Or equal.

G. Fixture Trim:
   1. McGuire
   2. Dearborn Brass
   3. Oatey
   4. Or equal.

H. Floor Drains:
   1. Mifab
   2. Sioux Chief
   3. Smith
   4. Wade
   5. Watts
   6. Zurn

I. Floor Sinks:
   1. Commercial Enameling
   2. Mifab
   3. Sioux Chief
   4. Smith
   5. Wade
   6. Watts
   7. Zurn
   8. Or equal.

J. Flushometers - Water Closet/Urinal:
   1. Sloan
   2. Zurn
   3. Or equal.

K. Hose Bibbs:
   1. Chicago
   2. JR Smith
3. Mifab
4. Wade
5. Woodford
6. Zurn
7. Or equal.

L. Hub Drains:
1. JR Smith
2. Zurn
3. Or equal.

M. Water Closet Seats:
1. Bemis
2. Or equal.

N. Water Supply Boxes:
1. Sioux Chief
2. Or equal.

2.2 GENERAL PLUMBING FIXTURES

A. Review substitution request requirements in Division 01, General Requirements and 22 00 00, Plumbing General Requirements.

B. Reference Architectural Details for mounting height and location of fixtures.

C. Provide factory fabricated fixtures of type, style and material indicated on the plumbing fixture connection schedule shown on the Drawings. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by manufacturer, or required for complete installation. Where more than one type is indicated, selection is installer’s option; but, fixtures of same type must be furnished by a single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations.

D. Provide fixtures complete with fittings, supports, fastening devices, bolt caps, faucets, valves, traps, stops and appurtenances.

E. Plumbing Fixture Flow Rates:
1. Water Closets: Single flush at 1.28 GPF.
2. Lavatories in public core areas to be set for a maximum of 0.5 GPM flow. Other lavatories to be 1.0 GPM flow.
3. Sinks to be set for a maximum of 1.5 GPM flow.
4. Showers factory set at a maximum of 1.8 - 2 GPM flow.

F. Plumbing Fixture Thermostatic Mixing Valves:
1. Lavatories provide ASSE 1070 compliant mixing valves or multiple lavatories served by a single ASSE 1070 compliant mixing valve.
2. Sinks serviced with a single ASSE 1070 mixing valve or multiple sinks served by a single ASSE 1070 mixing valve.
3. Commercial kitchen handsinks provide ASSE 1070 mixing valves.
4. Janitor sinks or process/maintenance type sinks do not require ASSE 1070 mixing valves if operated by trained personnel. Provide signage per Section 22 05 53, Identification for Plumbing Piping and Equipment.

5. Hot water hose bibbs do not require ASSE 1070 mixing valves if operated by trained personnel. Provide signage per Section 22 05 53, Identification for Plumbing Piping and Equipment.

2.3 CARRIERS

A. Wall Hung Water Closets:

B. Wall Hung Urinal: Zurn Z-1218-WS. (JR Smith 913). Coupling type or plate type with bearing plate 300 lb. capacity.

C. Wall Hung Lavatory: Zurn Z-1231 (D). (JR Smith 700). Concealed arm, 250 lb. capacity.


E. Wall Hung Drinking Fountain: Z-1225-BL (JR Smith 834-97-98). Plate type.

F. 750 lb. Carrier for Water Closet:
   1. Adjustable vertical type.
   2. Adjustable horizontal type.

2.4 DRINKING FOUNTAINS

A. See Schedule on Drawings for type.

2.5 ELECTRIC WATER COOLERS

A. See Schedule on Drawings for Type.

2.6 EMERGENCY SHOWERS/EYEWASH

A. Provide emergency showers/eyewash products that are compliant with ANSI Z358.1, Standards for Emergency Eyewashes and Shower Equipment.

2.7 Fixture Trim

A. Traps: Provide heavy duty commercial grade traps on fixtures except fixtures with integral traps. Exposed traps will be chromium plated cast brass or 17 gauge chromium plated brass tubing.
   1. Sink: McGuire 8912-C-DF.
   2. Lavatory: McGuire 8902-C-DF.
B. Supplies and Stops: Lead free heavy duty commercial grade, chrome plated with brass stems. Stops: T-handle or Loose Key type.
   1. Lavatory: McGuire LFH 2165 CK
   2. Sink: McGuire LFH 2167 LK
   3. Water Closets: McGuire

C. Lavatory Grid Strainer: McGuire 155A.

D. Sink Grid Strainer: McGuire 152N.


F. Sink Basket Strainer: McGuire 151.

G. Trim barrier-free wrap for P-traps and supplies by McGuire, Pro-Wrap, Plumberex or True-bro.

H. Escutcheons: McGuire wrought brass deep bell.

I. Wax Rings and Toilet Bolts: WM Harvey No Seep No. 1 053065-N.

2.8 FLOOR DRAINS

A. See Schedule on Drawings for types.

2.9 FLOOR SINKS

A. See Schedule on Drawings for types.

B. Plastic components are not allowed.

2.10 FLUSHOMETERS - WATER CLOSET/URINAL

A. See Schedule on Drawings for types.

2.11 HOSE BIBBS

A. See Schedule on Drawings for types.

2.12 HUB DRAINS

A. See Schedule on Drawings for type.

2.13 WATER CLOSET SEATS

A. See Schedule on Drawings for type.

2.14 WATER SUPPLY BOXES

A. See Schedule on Drawings for Type.
B. Provide fire rated ASTM E-84 rated boxes where required by building construction.

PART 3 - EXECUTION

3.1 GENERAL PLUMBING FIXTURE INSTALLATION INFORMATION

A. Verification of Conditions:
1. Examine rough-in work of water supply and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping and other unsatisfactory conditions for installation of plumbing fixtures.
2. Examine walls, floors and cabinets for suitable conditions where fixtures are to be installed.
3. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer’s written instructions, rough-in drawings and pertinent codes and regulations, design and referenced standards.
4. Fasten plumbing fixtures securely to supports or building structure. Secure supplies behind or within wall construction to provide rigid installation.
5. Install a stop valve in a readily accessible location in water connection to each fixture.
6. Install escutcheons at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
7. Seal fixtures to walls and floors using silicone sealant Dow Corning No. 780 or equal. Match sealant color to fixture color.
8. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.
9. Inspect each unit for damage prior to installation. Replace damaged fixtures.
10. Replace washers or cartridges of leaking or dripping faucets and stops.
11. Clean fixtures, trim and strainers using manufacturer’s recommended cleaning methods and materials.
12. During construction, cover installed fixtures, drains, sinks and water coolers with cardboard and wrap with sheet plastic.
13. Provide trap primers for floor drains, floor sinks, trench drains and hub drains.
14. Install roof and overflow roof drains per architectural details. Cover drains during roof construction to protect drain. Provide offsets or expansion joints at each roof/overflow drain.
15. Do not use lead flashing.

B. Owner Furnished Equipment:
1. Rough-in and make final connections to Owner furnished equipment. Provide necessary items to complete installation.
2. Comply with requirements of this Section and Drawings for installation procedures.

C. Adjusting and Cleaning: Clean plumbing fixtures, trim, and strainers of dirt and debris upon completion of installation. Adjust water pressure at drinking fountains, faucets, shower valves and flush valves to provide proper flow stream and specified GPM. Repair leaks at faucets and stops.
D. Extra Stock: Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner.

E. Field Quality Control: Upon completion of installation of plumbing fixtures, test fixtures to demonstrate capability and compliance with Specifications. Correct or replace malfunctioning units at site, then retest to demonstrate compliance.

F. Protection: Protect fixtures and equipment from damage. Cover finished fixtures with cardboard and sheet plastic. Fixtures are not to be used during construction. Replace damaged items with new.

G. Signage: For fixtures that do not have ASSE 1070 mixing valve protection for hot water temperature, provide signage per Section 22 05 53, Identification for Plumbing Piping and Equipment.

3.2 CARRIERS INSTALLATION

A. Install components in accordance with manufacturer's instructions and approved product data submittals.

B. Set plumb, level and rigid.

C. Coordinate wall thickness so carrier has adequate depth to be concealed.

3.3 DRINKING FOUNTAIN INSTALLATION

A. Install components in accordance with manufacturer's instructions and approved product data submittals.

B. Set plumb, level and rigid.

3.4 ELECTRIC WATER COOLER INSTALLATION

A. Install components in accordance with manufacturer's instructions and approved product data submittals.

B. Set plumb, level and rigid.

3.5 EMERGENCY SHOWERS/EYEWASH INSTALLATION

A. Install components in accordance with manufacturer's instructions and approved product data submittals.

B. Set plumb, level and rigid.

3.6 FIXTURE TRIM INSTALLATION

A. Install components in accordance with manufacturer's instructions and approved product data submittals.

B. Set plumb, level and rigid.
3.7 FLOOR DRAINS INSTALLATION
A. Install components in accordance with manufacturer's instructions and approved product data submittals.
B. Set plumb, level and rigid.

3.8 FLOOR SINK INSTALLATION
A. Install components in accordance with manufacturer's instructions and approved product data submittals.
B. Set plumb, level and rigid. Set fixture rim/grate flush with surrounding finish surface unless specifically noted otherwise.

3.9 FLUSHOMETERS - WATER CLOSET/URINAL INSTALLATION
A. Install components in accordance with manufacturer's instructions and approved product data submittals.
B. Set plumb, level and rigid. Set fixture rim/grate flush with surrounding finish surface unless specifically noted otherwise.

3.10 HOSE BIBB INSTALLATION
A. Install components in accordance with manufacturer's instructions and approved product data submittals.
B. Set plumb, level and rigid.

3.11 HUB DRAINS INSTALLATION
A. Install components in accordance with manufacturer's instructions and approved product data submittals.
B. Set plumb, level and rigid.

3.12 WATER CLOSET SEAT INSTALLATION
A. Install components in accordance with manufacturer's instructions and approved product data submittals.
B. Set plumb, level and rigid.

3.13 WATER SUPPLY BOX INSTALLATION
A. Install components in accordance with manufacturer's instructions and approved product data submittals.
B. Set plumb, level and rigid.

END OF SECTION
SECTION 23 00 00

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Work included in 23 00 00, HVAC Basic Requirements applies to Division 23, HVAC work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of heating, ventilating and air conditioning systems for proposed project.

B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.

C. Definitions:
   1. Provide: To furnish and install, complete and ready for intended use.
   2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
   3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work provided.
   4. Or Equal: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
   5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.2 RELATED SECTIONS

A. Contents of Section applies to Division 23, HVAC Contract Documents.

B. Related Work:
   1. Additional conditions apply to this Division including, but not limited to:
      a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
      b. Drawings
      c. Addenda
      d. Owner/Architect Agreement
      e. Owner/Contractor Agreement
      f. Codes, Standards, Public Ordinances and Permits
1.3 REFERENCES AND STANDARDS

A. References and Standards per Division 01, General Requirements, individual Division 23, HVAC Sections and those listed in this Section.

B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
   1. State of California:
      a. CBC - California Building Code
      b. CEC - California Electrical Code
      c. CEC T24 - California Energy Code Title 24
      d. CFC - California Fire Code
      e. CMC - California Mechanical Code
      f. CPC - California Plumbing Code
      g. CSFM - California State Fire Marshal
      h. DSA - Division of State Architect Regulations and Requirements

C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
   1. ABA - Architectural Barriers Act
   2. ABMA - American Bearing Manufacturers Association
   3. ADA - Americans with Disabilities Act
   4. AHRI - Air-Conditioning Heating & Refrigeration Institute
   5. AMCA - Air Movement and Control Association
   6. ANSI - American National Standards Institute
   7. ASCE - American Society of Civil Engineers
   8. ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers
   9. ASHRAE Guideline 0, The Commissioning Process
   10. ASME - American Society of Mechanical Engineers
   11. ASPE - American Society of Plumbing Engineers
   12. ASSE - American Society of Sanitary Engineering
   13. ASTM - ASTM International
   14. AWWA - American Water Works Association
   15. CFR - Code of Federal Regulations
   16. CISPI - Cast Iron Soil Pipe Institute
   17. EPA - Environmental Protection Agency
   18. ETL - Electrical Testing Laboratories
   19. FM - FM Global
   20. HI - Hydraulic Institute Standards
   21. IAPMO - International Association of Plumbing & Mechanical Officials
   22. ISO - International Organization for Standardization
   23. MSS - Manufacturers Standardization Society
   24. NEC - National Electric Code
   25. NEMA - National Electrical Manufactures Association
   26. NFPA - National Fire Protection Association
   27. NFGC - National Fuel Gas Code
   28. NRCA - National Roofing Contractors Association
29. NSF - National Sanitation Foundation
30. OSHA - Occupational Safety and Health Administration
31. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
32. TEMA - Tubular Exchanger Manufacturers Association
33. TIMA - Thermal Insulation Manufacturers Association
34. UL - Underwriters Laboratories, Inc.

D. See Division 23, HVAC individual Sections for additional references.

E. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.

F. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

G. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.4 SUBMITTALS

A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 23, HVAC Sections.

B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.

C. In addition:
   1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.

   2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one zip file per specification division containing a separate file for each Specification Section. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. Deviations will be returned without review.

   3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 23, HVAC Sections.

   4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered
during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.

a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.

b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 23, HVAC Specification Sections for specific items required in product data submittal outside of these requirements.

c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.

d. For vibration isolation of equipment, list make and model selected with operating load and deflection.

e. See Division 23, HVAC individual Sections for additional submittal requirements outside of these requirements.

5. Maximum of two reviews of submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer’s hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.

6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer’s comments. Identify Engineer’s comments and provide an individual response to each of the Engineer’s comments. Cloud changes in the submittals and further identify changes which are in response to Engineer’s comments.

7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer’s installation and support requirements to meet Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.

8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required by Division 23, HVAC Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.

9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.

10. Substitutions and Variation from Basis of Design:
   a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
   b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide
compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or equal", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.

11. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, equipment, ductwork and piping layout plans, and control wiring diagrams. Reference individual Division 23, HVAC Specification Sections for additional requirements for shop drawings outside of these requirements.
   a. Provide Shop Drawings indicating access panel locations for items that require Code or maintenance access, size and elevation for approval prior to installation.

12. Samples: Provide samples when requested by individual Sections.

13. Resubmission Requirements:
   a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
      1) Resubmit for review until review indicates no exception taken or make "corrections as noted".
      2) When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.

14. Operation and Maintenance Manuals, Owners Instructions:
   a. Submit, at one time, electronic files (PDF format) on CD/DVD of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
      1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
      2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.
      3) Include Warranty per Division 00. Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Sections.
      4) Include product certificates of warranties and guarantees.
      5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
      6) Include copy of startup and test reports specific to each piece of equipment.
7) Include copy of final air and water systems balancing log along with pump, fan and distribution system operating data.
8) Include commissioning reports.
9) Include copy of valve charts/schedules.
10) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.

b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 23 00 00, HVAC Basic Requirements Article titled "Demonstration".

c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.

15. Record Drawings:
   a. Maintain at site at least one set of drawings for recording “As-constructed” conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
   b. Record Drawings are to include equipment and fixture/connection schedules, control dampers, fire smoke dampers, fire dampers, valves, bottom of pipe, duct and equipment elevations and dimensioned locations for all distribution systems (hydronic and air). Invert elevations and dimensioned locations for underground systems below grade to 5-feet outside building that accurately reflect "as constructed or installed" for project.
   c. At completion of project, input changes to original project CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.
   d. See Division 23, HVAC individual Sections for additional items to include in record drawings.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Work and materials installed to conform with all local, State, Federal and other applicable laws and regulations.

B. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
C. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.

D. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.

E. Provide products that are UL listed.

F. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.

G. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

1.6 WARRANTY

A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.7 COORDINATION DOCUMENTS

A. Prior to construction, prepare and submit coordinated layout drawings (composite drawings), to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, plumbing, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, fire protection, electrical, ceiling suspension, and ceiling tile systems, etc.), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence. Unless otherwise required by Division 00, Procurement and Contracting Requirements and/or Division 01, General Requirements, Division 23, HVAC to combine information furnished by other trades onto master coordination documents.

B. Prepare Drawings as follows:
   1. Coordination models/drawings may be created using Revit 3D modeled elements or a 3D CAD software. The modeled elements to be graphically represented within the model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information.
Non-graphic information may also be attached to the model elements. Model elements must have the ability to be spatially coordinated with other modeled elements using either Revit, Autodesk Navisworks or Autodesk A360.

2. Drawings in CAD Format. CAD format release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.

3. Review and revise, as necessary, section cuts in Contract Drawings after verification of field conditions.

4. Indicate hydronic and air distribution system piping including fittings, hangers, access panels, valves, and bottom of pipe and duct elevations above finished floor.

5. Indicate inverts and provision for piping that must be graded to have right-of-way over more flexible items. Drawings also to indicate proposed ceiling grid and lighting layout as shown on electrical drawings and architectural reflected ceiling drawings and HVAC equipment, ductwork and piping.

6. Incorporate Addenda items and change orders.

7. Distribute drawings to trades and provide additional coordination as requested by other trades.

C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

D. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.

E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide like items from one manufacturer, including but not limited to pumps, fans, valves, control devices, air handlers, vibration isolation devices, etc.

2.2 MATERIALS

A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL approved or have adequate approval or be acceptable by State, County, and City authorities.

B. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.

C. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.

D. Hazardous Materials:
1. Comply with local, State of California, and Federal regulations relating to hazardous materials.
2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Install equipment having components requiring access (i.e., drain pans, drains, control operators, valves, motors and vibration isolation devices) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.

C. Install equipment and products complete as directed by manufacturer's installation instructions including all appurtenances recommended in manufacturer's installation instructions, at no additional charge to Owner. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.

D. Earthwork:
   1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
      a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork Sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
      b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
      c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

E. Firestopping:
   1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
      a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material

F. Pipe Installation:
1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building, as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, seismic flexible joints, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.
2. Include provisions for servicing and removal of equipment without dismantling piping.

G. Plenums:
1. Plenums: Materials within plenums shall be noncombustible or shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723. Immediately notify Architect / Engineer of any discrepancy.

3.2 SEISMIC CONTROL

A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment, and individual Division 23 HVAC Sections.

B. Piping and Ductwork:

C. Provide means to prohibit excessive motion of mechanical equipment during earthquake.

3.3 REVIEW AND OBSERVATION

A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
1. Underground system installation prior to backfilling.
2. Prior to covering walls.
3. Prior to ceiling cover/installation.
4. After major equipment is installed.
5. When main systems, or portions of, are being tested and ready for inspection by AHJ.

C. Final Punch:
1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Mechanical Precloseout Checklist, complete the checklist confirming completion of systems’ installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer’s acceptance that the mechanical systems are ready for final punch.
2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 CONTINUITY OF SERVICE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping and ductwork, and wiring to point of connection. Where existing systems are being utilized, clean existing distribution systems (ductwork, piping, fans, air handlers) prior to connecting new ductwork or piping.
3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
   a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
4. Organize work to minimize duration of power interruption.

3.5 CUTTING AND PATCHING

A. Confirm Cutting and Patching requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of
this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.

5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.6 EQUIPMENT SELECTION AND SERVICEABILITY

A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

B. Maintain design intent where equipment other than as shown as Basis of Design in Contract Documents is provided. Where equipment requires ductwork or piping arrangement, controls/control diagrams, or sequencing different from that indicated in Contract Documents, provide at no additional cost to Owner.

3.7 DELIVERY, STORAGE AND HANDLING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
   1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage to be replaced before installation.
   2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
   3. Protect bright finished shafts, bearing housings and similar items until in service.

3.8 DEMONSTRATION

A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.
D. Training and Demonstration per Section 01 91 13, General Commissioning Requirements and Section 23 08 00, Commissioning of HVAC.

3.9 CLEANING

A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.

C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
   1. Do not place equipment in sustained operation prior to initial balancing of HVAC systems.

D. Provide miscellaneous supports/metal required for installation of equipment, piping and ductwork.

3.11 PAINTING

A. Confirm Painting requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
   1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces in mechanical rooms, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
   2. After acceptance by Authority Having Jurisdiction (AHJ), In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
   3. See individual equipment Specifications for other painting.
   4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
5. Piping and Ductwork: Clean, primer coat and paint exposed piping and ductwork on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.

6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

3.12 ACCEPTANCE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:

1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
   a. Testing and Balancing Reports
   b. Cleaning
   c. Operation and Maintenance Manuals
   d. Training of Operating Personnel
   e. Record Drawings
   f. Warranty and Guaranty Certificates
   g. Start-up/Test Document
   h. Commissioning Reports

3.13 FIELD QUALITY CONTROL

A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Tests:
   1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in Operation and Maintenance Manuals.
   2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.14 LETTER OF CONFORMANCE

A. Provide Letter of Conformance, copies of manufacturers’ warranties and extended warranties with a statement that HVAC items were installed in accordance with manufacturer’s recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers’ warranties and extended warranties in Operation and Maintenance Manuals.
3.15 ELECTRICAL INTERLOCKS

A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

END OF SECTION
SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Starters
   2. Shaft Grounding
   3. Motors

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. NEMA Premium Efficiency
   2. Energy Policy Act (EPACT), latest applicable version(s) for minimum motor efficiencies.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Field Installed Motors: Installed motors to be of single type, from one source and from a single manufacturer.
   2. Electrical components and materials to be UL and ETL listed/labeled as suitable for location and use.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Starters:
   1. Cerus
   2. Eaton Electrical
   3. General Electric
   4. Siemens
   5. Schneider Electric/Square D
   6. Or equal.

B. Shaft Grounding:
   1. Shaft Grounding Inc.
   2. Aegis SGR Bearing Protection Ring
   3. Or equal.

C. Motors:
   1. Lincoln Motor
   2. Century Electric Motors (formerly A.O. Smith Electrical Products)
   3. Baldor Electric
   4. General Electric
   5. Toshiba
   6. Exception: Motors integral to equipment efficiency listing (EER, COP, etc.) per listing agency.
   7. Or equal.

2.2 STARTERS

A. Starters up to Size 8 to be suitable for the addition of a minimum of three external auxiliary contacts (normally open or normally closed). Contactor, coils, and relays to perform the control functions of the associated equipment and control sequence.

B. Three Phase Motors up to and Including 15 HP:
   1. Provide enclosed type magnetic across-the-line starter with thermal overload and undervoltage protection.
   2. Operator: "Start-Stop" pushbutton, except where automatic control is indicated on Drawings or specified. Then provide "Hand-Off-Auto" selector switch.
   3. Starters for 3-phase motors to have overload protection in each of the three legs, with external manual reset.
   4. Unless indicated on Drawings or in Specifications, furnish motor starters with a neon pilot light. Neon lights are required for exhaust fan switches.
   5. Equip starters with integral transformer and coil for control circuit. Coordinate coil voltage with control voltage.

2.3 SHAFT GROUNDING

A. Variable Speed Motor Shaft Grounding: Shaft grounding ring; solid ring type.
B. Provide shaft grounding assembly on motors controlled by variable frequency drive. Shaft grounding device to be in the form of brush that resides on the motor shaft. Brush assembly shall be capable of tolerating misalignment and maintaining rotating contact throughout the motors life.

C. Material: Material used in the grounding assembly shall be stable material commonly used within industry that is not believed to constitute a hazardous material under Occupational Safety & Health Administration (OSHA) regulations.

D. Brushes: Specifically developed carbon compounds of sustained performance with wear life expectancy of 3 years minimum.

E. Seals: Sealed type to keep contaminants from entering the shaft grounding system in wet or severe environment applications.

F. Shaft Grounding Assembly: For clean room air handling systems, use the type that contains the wear products within a special enclosure within the shaft grounding system.

2.4 MOTORS

A. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 40 degrees C environment.
   3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
   4. Built-in thermal overload protection or externally protected with separate over-load with low-voltage release or lock-out. Quick trip device on hermetically sealed motors.
   5. Service Factor: 1.15 for poly-phase motors except 1.25 for motors associated with shaft pressurization system fans and 1.35 for single phase motors.
   7. Motors used in conjunction with variable speed drives: Variable torque type matched for the full operating range of the variable frequency drive. As a minimum, motors to have Class F insulation, winding insulation rated for 1000 Volts and insulated bearings to prevent high frequency ground path. Loads not-to-exceed 80 percent of nameplate rating

B. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

C. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Coordinate conductor sizes with Division 26, Electrical. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

D. Three Phase Power. Squirrel Cage Motors:
   1. Starting Torque: Between 1 and 1-1/2 times full load torque.
2. Starting Current: Six times full load current.
3. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
5. Insulation System: NEMA Class B or better. Use class F insulation when motors are controlled by a VFD.
6. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
7. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
8. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter.
9. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
10. Sound Power Levels: To NEMA MG 1.
11. Weatherproof Epoxy Treated Motors: Epoxy coat windings with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
12. Nominal Efficiency: Meet or exceed NEMA Premium Efficiency rating when tested in accordance with IEEE 112.
13. Nominal Power Factor: Minimum at full load and rated voltage when tested in accordance with IEEE 112.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Coordinate location of disconnect and starter or motor controller. Combination starter/disconnects may be used in lieu of separate items.

B. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.

C. Provide inverter ready motors per NEMA MG1-30 for variable speed drive or soft-start starter use. Provide shaft grounding for motors over 2 HP serving variable speed drives. Provide shaft grounding and insulated bearings on motors 25 HP and larger serving variable speed drives. Shielded cable required for power wiring from variable speed drive to motor connection.

D. Unless otherwise indicated, motors 1-HP and larger to meet/exceed NEMA Premium Efficiency and latest EPACT.

E. Vertical in-line pump motors per NEMA MG1 vertical motor requirements.
F. Exception: Motors less than 250 watts, for intermittent service, motors furnished with equipment manufacturer's standard package equipment need not conform to these specifications.

G. Single phase motors for air compressors and pumps: Capacitor start type.

H. Motors located in exterior locations or wet air streams are to be of totally enclosed type.

I. Motors located wet/wash-down locations: Totally enclosed weatherproof epoxy-sealed type.

J. Disconnects: Provided by Division 26, Electrical unless specified otherwise.

K. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

3.2 STARTER INSTALLATION

A. Install starters in accordance with manufacturer's instructions.

B. Coordinate disconnect requirements and location with Division 26, Electrical if not integral to starter. If starter is installed out of line of sight of motor, provide additional disconnect at motor per code.

C. Provide NEMA housing appropriate to installation location.

D. Provide supports and install securely, in neat and workmanlike manner, as specified in NECA 1.

E. Meet mounting height and accessible location requirements per local code.

F. Provide fuses for fusible switches.

G. Select and install overload heater elements in motor starters to match installed motor characteristics.

H. Single phase 120 Volt starter: if not furnished as single packaged controller/disconnect, provide contactors, relays, wiring and devices necessary to match sequence of operation for equipment.

3.3 SHAFT GROUNDING INSTALLATION

A. Shaft grounding assembly installation not to affect the motor manufacturer warranty. Where the severe environment conditions require application of the shaft grounding types that are screwed into the motor shaft, the installation of the shaft grounding system performed either by the motor manufacturer or by the motor manufacturer authorized facility.

B. Bond the brush to the closest ground point using code sized green insulated stranded copper conductor per manufacturer instructions.
C. Test and verify the performance of the assembly to ensure that under no conditions the shaft exceeds 3 volts.

D. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

E. Check line voltage and phase and ensure agreement with nameplate.

F. Verify motor rotation.

3.4 MOTOR INSTALLATION

A. Electrical Service: Power wiring from source to motor termination under Division 26, Electrical.

B. Install in accordance with manufacturer's instructions. Coordinate with starter or variable speed controller with control sequence to provide necessary starter accessories.

C. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

D. Check line voltage and phase and ensure agreement with nameplate.

E. Verify motor rotation.

F. Field Quality Control:
   1. Prepare for acceptance tests as follows:
      a. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
      b. Test interlocks and control features for proper operation.
      c. Verify that current in each phase is within nameplate rating.
   2. Testing: Perform the following field quality-control testing:
      a. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
      b. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
      a. Inspect field-assembled components, equipment installation, and piping and electrical connections for compliance with requirements.
      b. Test and adjust controls and safetyes. Replace damaged and malfunctioning controls and equipment.
      c. Verify bearing lubrication.
      d. Verify proper motor rotation.
      e. Test Reports: Prepare a written report to record the following test procedures used:
         1) Test results that comply with requirements.
         2) Test results that do not comply with requirements and corrective action taken to achieve compliance.

G. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.
H. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION
SECTION 23 05 19

METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Pressure Gauges
   2. Thermometers
   3. Separable Sockets
   4. Duct Thermometer Support Flanges
   5. Differential and Filter Pressure Gauges
   6. Pressure-Gauge Fittings
   7. Test Plugs

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Maintenance Materials:
      a. Extra gauge Oil for Inclined Manometers: One Bottle
      b. Extra Pressure Gauges: One

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Pressure Gauges:
1. Trerice Model 600CB.
2. Dwyer Instruments, Inc.
3. Moeller Instrument Co., Inc.
4. Omega Engineering, Inc.
5. Or equal.

B. Thermometers:
1. Trerice Model BX9.
2. Ashcroft
3. Weiss
4. Marshalltown
5. Weksler
6. Or equal.

C. Separable Sockets:
1. Kimray
2. Weiss
3. Trerice
4. Or equal.

D. Duct Thermometer Support Flanges:
1. Trerice
2. Ashcroft
3. Weiss
4. Marshalltown
5. Weksler
6. Or equal.

E. Differential and Filter Pressure Gauges:
1. Orange Gauges
2. Midwest
3. Or equal.

F. Pressure-Gauge Fittings:
1. Omega
2. Weiss
3. Trerice
4. Or equal.

G. Test Plugs:
1. Petes Plug
2. Or equal.

2.2 PRESSURE GAUGES

A. ASME B40.100, phosphor-bronze bourdon type, dry type.
1. Case: Cast aluminum, stem-mounted, flangeless.
2. Size: 4-1/2 inch (115 mm) diameter.
5. Scale: White aluminum with black graduation and markings.
7. Mid-Scale Accuracy: One percent.
8. Scale: Psi.

2.3 THERMOMETERS

A. Adjustable Angle: Red-or blue-appearing organic liquid in glass; ASTM E 1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
   1. Size: 9-inch scale.
   2. Window: Acrylic.
   3. Scale: Aluminum, white background, black graduations and markings.
   5. Accuracy: 2 percent, per ASTM E 77.

2.4 SEPARABLE SOCKETS

A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
   1. Material: Brass, for use in copper piping.
   4. Insertion Length: To extend to center of pipe.
   5. Cap: Threaded, with chain permanently fastened to socket.
   6. Heat Transfer Fluid: Oil or graphite.

2.5 DUCT THERMOMETER SUPPORT FLANGES

A. Description: Flanged fitting bracket for mounting in hole of duct, with threaded end for attaching thermometer.
   1. Extension Neck Length: Nominal thickness of 2-inches, but not less than thickness of exterior insulation.
   2. Insertion-Neck Length: Nominal thickness of 2-inches, but not less than thickness of insulation lining.

2.6 DIFFERENTIAL AND FILTER PRESSURE GAUGES

A. Service: Air and non-combustible, compatible gases (Natural Gas option available.)
B. Wetted Materials: Consult factory.
C. Housing: Die cast aluminum case and bezel, with acrylic cover. Exterior finish is coated gray to withstand 168 hour salt spray corrosion test.
D. Accuracy: Plus or minus 2 percent of full scale throughout range at 70 degrees F.
E. Pressure Limits: Minus 20 Hg to 15 PSIG.
F. Overpressure: Relief plug opens at approximately 25 PSIG standard gauges only.

G. Temperature Limits: 20 to 140 degrees F.

H. Size: 4-inch diameter dial face.

I. Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientation.

J. Process Connections: 1/8-inch female NPT duplicate high and low pressure taps, one pair side and one pair back.

K. Standard Accessories: Two 1/8-inch NPT plugs for duplicate pressure taps, two 1/8-inch pipe thread to rubber tubing adapter and three flush mounting adapters with screws.

2.7 PRESSURE-GAUGE FITTINGS

A. Valves: NPS 1/4 (DN8) brass or stainless-steel needle type.

B. Syphons: NPS 1/4 (DN8) coil of brass turbine with threaded ends.

C. Snubbers: ASME B40.5, NPS 1/4 (DN8) brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

2.8 TEST PLUGS

A. Description: Nickel-plated, brass-body test plug in NPS 1/2 (DN15) fitting.

B. Body: Length as required to extend beyond insulation.

C. Pressure Rating: 500 PSIG (3450 kPa) minimum.

D. Core Inserts: One or two self-sealing valves, suitable for inserting 1/8-inch OD probe from dial-type thermometer or pressure gauge.

E. Core Material for Air, Water, Oil and Gas: 20 to 200 degrees F (Minus 7 to plus 93 Degrees Celsius), chlorosulfonated polyethylene synthetic rubber.

F. Test Plug Cap: Gasketed and threaded cap, with retention chain or strap.

G. Test Kit: Pressure gauge and adapter with probe, two bimetal dial thermometers, and carrying case.
   1. Pressure Gauge and Thermometer Ranges: Approximately two times the system's operating conditions.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Provide instruments with scale ranges selected according to service with largest appropriate scale.
3.2 PRESSURE GAUGES

A. Install pressure gauges in piping tee with pressure gauge cock, located on pipe at most readable position, visible from floor.

B. Locations: Install in the following locations as a minimum, and elsewhere as indicated.
   1. At each pump inlet and outlet.
   2. At inlet and discharge of each pressure reducing valve.
   3. At makeup water service outlets.
   4. At inlet and discharge of each chiller and boiler.

C. Install in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

D. Adjust to final angle, clean windows and lenses, and calibrate to zero.

E. Pressure Gauge Range/Graduations:

<table>
<thead>
<tr>
<th>System</th>
<th>Pressure (PSI)</th>
<th>Graduations (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled Water</td>
<td>0-100</td>
<td>1</td>
</tr>
<tr>
<td>Heating Water</td>
<td>0-100</td>
<td>1</td>
</tr>
<tr>
<td>Steam</td>
<td>0-30</td>
<td>0.2</td>
</tr>
</tbody>
</table>

3.3 THERMOMETERS

A. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2-inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

B. Install in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

C. Adjust to final angle, clean windows and lenses, and calibrate to zero.

D. Thermometer Range/Graduations:

<table>
<thead>
<tr>
<th>System</th>
<th>Temperature (degree F)</th>
<th>Graduations (degrees F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled Water</td>
<td>25-125</td>
<td>1</td>
</tr>
<tr>
<td>Heating Water</td>
<td>30-240</td>
<td>2</td>
</tr>
</tbody>
</table>

3.4 SEPARABLE SOCKETS

A. Inspect the openings in the vessel for foreign material and clean the connection ports to remove scale, chips and debris.

B. Install thermostats with separable sockets. Install the separable socket using good piping practice. Be sure to use TFE tape or pipe thread sealant on external pipe threads.
C. Never stand directly over or in front of a valve or controller when the system is pressurized.

D. Assure the separable socket is completely submerged in liquid or flow stream. Partial submersion will give erratic temperature transfer to thermostat.

E. Pack separable socket full with high temp bearing grease. This helps in heat transfer and prevents air space.

3.5 DUCT THERMOMETER SUPPORT FLANGES

A. Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.

3.6 DIFFERENTIAL AND FILTER PRESSURE GAUGES

A. Install pressure gauge where exposure to heat and vibration are minimal and where the dial can be easily read. It is also important to install the gauge in a location with undisturbed and continuous flow of the pressure medium.

B. Provide a needle valve or gauge cock, installed between the process and the pressure gauges.

C. General: Install pressure gauges in piping tee with pressure gauge cock, located on pipe at most readable position, visible from floor.

D. Locations: Install in the following locations, and elsewhere as indicated.
   1. At each pump inlet and outlet.
   2. At inlet and discharge of each pressure reducing valve.
   3. At make-up water service outlets.

E. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

3.7 PRESSURE-GAUGE FITTINGS

A. Install per manufacturer's instructions and recommendations.

B. Reference "Pressure Gauges" Article above.

3.8 TEST PLUGS

A. Locate test plugs adjacent to thermometers and thermometer sockets, adjacent to pressure gauges and pressure gauge taps, adjacent to control device sockets, or where indicated.

END OF SECTION
SECTION 23 05 23

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Balancing Valves
   2. Ball Valves
   3. Butterfly Valves

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.

B. Valves, General:
   1. Apollo
   2. Armstrong
   3. ASCO
   4. Cla-Val
   5. Conbraco
   6. Crane
   7. Clow
8. Griswold
9. Hammond
10. Hays
11. Jenkins
12. Josam
13. Kennedy
14. Milwaukee
15. Mueller
16. Nibco
17. Red-White Valve
18. Smith
19. Stockham
20. Tour Anderson
21. Wade
22. Watts
23. Wilkins
24. Zurn
25. Or equal.

C. Balancing Valves:
1. Griswold
2. Hays
3. Armstrong CBV
4. Tour Anderson
5. Or equal.

D. Ball Valves:
1. See Valves General above.
2. NSF Valves:
   a. Clow
   b. Kennedy
   c. Nibco
   d. Or equal.

E. Butterfly Valves:
1. See Valves General above.

### 2.2 VALVES - GENERAL

A. General:
1. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
2. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves 6 inches and smaller. Provide gear operators for quarter-turn valves 8 inches and larger and plug valves 5 inches and larger. Provide chain-operated sheaves and chains for overhead valves installed over 5 feet above finished floor.
3. Valve Identification: Manufacturer's name (or trademark) and pressure rating clearly marked on valve body.

B. Valves in Insulated Piping: With 2-inch stem extension and following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied.
   a. Basis of Design Product: Subject to compliance with requirements. Provide NIBCO NIB-SEAL handle extension or comparable product by one of the following.
      1) Conbraco Industries, Inc.: Apollo Div.

C. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves, ASME B16.5 for steel valves.
2. Grooved: With grooves according to AWWA C606.

D. Valve Bypass and Drain Connections: MSS SP-45.

E. Building Service:
1. Shutoff and Isolation Valves:
   a. Pipe Sizes 3 Inches and Smaller: Ball valve.
   b. Pipe Sizes 4 Inches and Larger: Butterfly valve. Gate valve acceptable if allowed by Owner.
2. Drain Service: Ball valves.
4. Check Valves: Swing or Wafer.

2.3 BALANCING VALVES

A. Maximum 125 PSIG System Working Water Pressure.

B. Manual Set Balancing Valves:
1. Valves are to be of the “Y” pattern, equal percentage globe-style and provide three functions:
   a. Precise flow measurement.
   b. Precision flow balancing.
   c. Positive drip-tight shutoff.
2. Valve to provide multi-turn, 360 degree adjustment with micrometer type indicators located on the valve handwheel. Valves have a minimum of five full 360 degree handwheel turns. 90 degree style ball valves are not acceptable. Valve handle to have hidden memory feature, which will provide a means for locking the valve position after the system is balanced. Valves to be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi to have two 1/4-inch threaded brass metering ports with check valves and gasketed caps located on the inlet side of the valve. The valve body, stem and plug to be brass. The handwheel to be high-strength resin.
3. 2-1/2 Inches and Larger: Valve body to be either cast iron with integrated cast iron flanges (2-1/2-inch to 12-inch) or ductile iron with industrial standard grooved ends (2-1/2-inch to 12-inch). Valve stem and plug disc to be bronze with handwheel that permits multi-turn adjustments. Sizes 2-1/2-inch and 3-inch: five turns; sizes 4-inch to 6-inch: 6
2.4 BALL VALVES

A. Ball valves on brazed piping are to be three-piece.

B. 2-1/2 Inches and Smaller: MSS SP-110, 400-600 PSI, two-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, brass or stainless steel ball, Teflon seat, brass stem, or extended steel handle. Apollo 77CLF 100 Series two-piece.

C. 3 Inches and Larger: MSS SP-110, 400-600 PSI, three-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, brass or stainless steel ball, Teflon seat, brass stem, or extended steel handle. Apollo 82-100/82A 140 Series three-piece.

D. Full Port Ball Valve: 2- to 4-inch ductile iron, ASTM A536, micro finish steel chrome plated or stainless steel ball and stem. TFE seats, 600 PSI.

2.5 BUTTERFLY VALVES

A. Select lug type valves.


PART 3 - EXECUTION

3.1 GENERAL VALVE INSTALLATION REQUIREMENTS

A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set angle valves closed to prevent rattling.
4. Set ball open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Inspect the shipping container before unpacking to look for damage that could have occurred during transport, and report it to the transportation company immediately. After visual inspection, remove the valve from the shipping container. Make sure the faces are free of any scratches and that there is not any obvious damage to the actuator assembly or valve body.

C. Make sure to note the valve's model number during the unpacking process. The model number will need to be provided when purchasing replacement parts.

D. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

E. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

F. Do not attempt to repair defective valves; replace with new valves.

G. Install valves per manufacturer's recommendations.

H. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.

I. Purge and clean piping to be connected to valve.

J. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose end adapter and cap on chain for each valve that must be installed with stem below horizontal plane. Ensure installation provides full stem movement.

K. Determine that the valve and its piping is adequately supported when installed. If a valve is not adequately supported, this could prevent the valve from operating and sealing correctly. Be sure that mating flanges are in line and parallel to minimize straining on joints and valve body.

L. Insulation: Where insulation is indicated, install extended stem valves, arranged in proper manner to receive insulation.

M. Mechanical Actuators: Install with chain operators where indicated. Extend chains to 5-feet above floor and hook to clips to clear aisle passage.

N. Stem Selection: Outside screw and yoke stems, except provide inside screw, nonrising stem where space prevents full opening of OS&Y valves.

O. Seats: Renewable seats, except where otherwise indicated.

P. When soldering, use paste flux that is approved by the manufacturer for use with lead-free alloys.

Q. Boiler isolation valves with adjustable packing gland per CSD-1 requirements.

R. Valve Adjusting and Cleaning:
   1. Inspect valves for leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.
   2. Valve Identification: Tag valves per Section 23 05 53, Identification for HVAC Piping, Ductwork and Equipment.

S. General Requirements for Valve Applications:
   1. If valve applications are not indicated, use the following:
      a. Shutoff Service: Ball or Butterfly valves.
d. Pump-Discharge Check Valves:
   1) 2 Inches and Smaller: Swing or spring-loaded lift check valves with bronze disc.
   2) 2-1/2 Inches and Larger: Swing check valves with lever and weight or with spring or wafer - seat check valves.

e. Provide isolation valve, check valve, automatic flow control valve and balancing valve on discharge side of base mounted centrifugal pumps where indicated. Combination triple duty valves not allowed. Provide isolation valve and strainer on suction side of pump.

2. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

3. Valves, except wafer types, with the following end connections.
   a. For Copper Tubing 2 Inches and Smaller: Threaded ends.
   b. For Copper Tubing 2-1/2 Inches to NPS 4 Inches: Flanged ends.
   c. For Copper Tubing 5 Inches and Larger: Flanged ends.
   d. For Steel Piping 2 Inches and Smaller: Threaded ends.
   e. For Steel Piping 2-1/2 inches to NPS 4 Inches: Flanged ends.
   f. For Steel Piping 5 Inches and Larger: Flanged ends.

3.2 BALANCING VALVE INSTALLATION

A. See General Installation Requirements above.

B. Install with flow in the direction of the arrow on the valve body and install at least five pipe diameters downstream from any fitting, and at least ten pipe diameters downstream from any pump. Two pipe diameters downstream from the balancing valve should be free of any fittings. When installed, easy and unobstructed access to the valve handwheel and metering ports for adjustment and measurement are to be provided. Install devices in accordance with manufacturer's recommendations to automatically balance flow in piping loops as indicated.

C. For venturi valves less than 1-1/2-inch pipe size, provide valve sized for flow to coil. Provide transitions on both inlet and outlet of valve if valve is less than line size.

3.3 BALL VALVE INSTALLATION

A. See General Installation Requirements above.

3.4 BUTTERFLY VALVE INSTALLATION

A. See General Installation Requirements above.

END OF SECTION
SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Hangers and Supports for HVAC Piping, Ductwork and Equipment
   2. Wall and Floor Sleeves
   3. Building Attachments
   4. Flashing
   5. Miscellaneous Metal and Materials

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   2. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
   3. Install ductwork and piping per SMACNA's requirements.
   4. Hanger spacing installation and attachment to meet all manufacturer's requirements and MSS SP-58.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Welding:
      a. Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications".
   2. Welding for Hangers:
      a. Qualify procedures and personnel according to AWS D9.1, Sheet Metal Welding Code for duct joint and seam welding.
   3. Engineering Responsibility:
a. Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, duct support equipment hangers/supports, and seismic restraint by a qualified Structural Professional Engineer.
   1) Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

4. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems, whose products have been in satisfactory use in similar service for not less than 10 years.

5. Support systems to be supplied by a single manufacturer.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 PERFORMANCE REQUIREMENTS

A. Provide pipe, ductwork and equipment hangers and supports in accordance with the following:
   1. When supports, anchorages, and seismic restraints for equipment, and supports, anchorages, and seismic restraints for conduit, piping, and ductwork are not shown on the Drawings, the contractor is responsible for their design.
   2. Connections to structural framing not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.

B. Engineered Support Systems:
   1. Support frames such as pipe racks or stanchions for piping, ductwork, and equipment which provide support from below.
   2. Equipment, ductwork and piping support frame anchorage to supporting slab or structure.

C. Provide channel support systems, for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

E. Provide seismic restraint hangers and supports for piping, ductwork and equipment. See Section 23 05 48.

F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment. See Section 23 05 48.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Hangers and Supports for HVAC Piping, Ductwork and Equipment:
   1. Anvil International
   2. B-Line Systems, Incorporated
   3. Erico Company, Incorporated
   4. Nelson-Olsen Incorporated
   5. Rilco Manufacturing Company, Incorporated
   6. Snappitz Thermal Pipe Shield Manufacturing
   7. Unistrut Corporation
   8. Or equal.

B. Wall and Floor Sleeves:
   1. Thunderline Corporation “Link Seal”.
   2. Or equal.

C. Building Attachments:
   1. Anchor-It
   2. Gunnebo Fastening Corporation
   3. Hilti Corporation
   4. ITW Ramset/Red Head
   5. MasterSet Fastening Systems, Incorporated
   6. Or equal.

2.2 HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

A. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.

B. Hanger Rod Couplings: Anvil Figure 136, B-Line Figure B3220, or equal; malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.

C. Channel Hanging System:
   1. Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A570 GR33, one side of channel to have a continuous slot within turned lips; framing nut with grooves and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.
   2. Concrete Inserts: Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.

D. Continuous Concrete Insert: Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.
E. Pipe Hangers:
   1. Pipe Rings for Hanger Rods:
      a. Pipe Sizes 2-inches and Smaller: Adjustable swivel ring hanger, UL listed. Erico 100 or 101, Anvil Figures 69 or 104, or equal.
      b. Pipe Sizes 2-1/2-inches and Larger: Clevis type hangers with adjustable nuts on rod, UL listed. Anvil figure 260, Erico 400, or equal.
      c. Pipe hangers to have same finish as hanger rods.

F. Pipe Saddles and Shields:
   1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
   2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).

G. Riser Clamps: Steel, UL listed. MSS Type 8. Erico 510 or 511. Copper coated; Erico 368.

H. Pipe Slides: Anvil, reinforced Teflon slide material (3/32-inch minimum thickness) bonded to steel; highly finished steel or stainless steel contact surfaces to resists corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16-inch minimum thickness; attachment to pipe and framing by welding.

I. Pipe Guides:
   1. Furnish and install pipe guides on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides securely to pipe and structure. Contact with chilled water pipe not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.
   2. Furnish and install guides approximately four pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Guides are not to be sued as supports and are in addition to other pipe hangers and supports.

J. Pipe Roller Hangers: Adjustable roller hanger. Black steel yoke, cast iron roller. MSS Type 41.

K. Below Ground Pipe Supports:
   2. Rod: 5/8-inch stainless steel Type 18-8.

L. Thermal Hanger Shield Inserts:
   1. 100-PSI (690-kPa) minimum compressive strength calcium silicate insulation, encased in sheet metal shield or polyisocyanurate rigid foam exceeding the load bearing weight of the pipe at the hanger point with a PVC vapor barrier.
   2. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier or polyisocyanurate rigid foam with a PVC vapor barrier.
3. Material for Hot Piping: Water-repellent-treated ASTM C533, Type 1 calcium silicate or polyisocyanurate rigid foam with a PVC vapor barrier.
4. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
5. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
6. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.
7. Thermal Hanger Shield Insulation Operating Temperature: Meet or exceed fluid temperature in pipe.

M. Freestanding Roof Supports: Polyethylene high-density UV resistant quick "pipe" block with foam pad.

2.3 WALL AND FLOOR SLEEVES

A. Below Grade or High Water Table Areas:
1. "Link-Seal" Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal.
2. Provide Type S unless otherwise noted.

B. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.

C. Fabricated Accessories:
1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide the following minimum gauges for the sizes indicated:
   a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.
   b. Sleeve Sizes 5-6-inches: 16 gauge.
   c. Sleeve Sizes 7-inches and Larger: 14 gauge.
   d. Fire-Rated Safing Material.
      1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 pounds per cubic foot density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.
      2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

2.4 BUILDING ATTACHMENTS

A. Beam Clamps:
1. MSS Type 19 and 23, wide throat, with retaining clip.
2. Universal Side Beam Clamp: MSS Type 20.

B. Powder-Actuated Drive Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

C. Anchor Bolts:
1. Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project structural engineer. Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

2. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.

3. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.


2.5 FLASHING

A. Steel Flashing: 26 gauge galvanized steel.

B. Safes: 8 mil thick neoprene.

C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.

2.6 MISCELLANEOUS METAL AND MATERIALS

A. General:
   1. Provide miscellaneous metal items specified, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on drawings or otherwise not shown on drawings that are necessary for completion of the project. Contractor is responsible for their design.
   2. Fabricate miscellaneous units to size shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or equal.

C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.

D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.

E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.
F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

G. Provide hot dipped galvanized components for items exposed to weather. Use materials compatible with system being supported (i.e. aluminum for aluminum ductwork, stainless steel for stainless steel ductwork).

H. Use straps, threshold rods and wire with sizes required by SMACNA to support ductwork.

I. Grout:
   1. ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
   2. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
   3. Properties: Nonstaining, noncorrosive, and non gaseous.
   4. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Verify building materials to have hangers and attachments affixed in accordance with hangers to be used. Provide supporting calculations.

B. Examine Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall", "2-Hour Fire/Smoke Barrier", and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.

C. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate proper placement of inserts, anchors and other building structural attachments.

D. Equipment Clearances: Do not route ductwork, equipment, or piping through electrical rooms, transformer vaults, elevator equipment rooms, IT rooms, MPOE rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-feet lateral clearance from all sides of electric switchgear panels. Do not route ductwork, equipment, or piping above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact ductwork, equipment or pipe routing to provide proper clearance with such items.

3.2 HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

A. Hang rectangular sheet-metal ducts with a cross sectional area of less than 7 SF with galvanized strips of No. 16 USS gauge steel 1-inch wide, and larger ducts with steel angles and adjustable hanger rods similar to piping hangers. Support at a maximum of 8-feet on center.
B. Support horizontal ducts within 24-inches of each elbow and within 48-inches of each branch intersection.

C. Provide aluminum supports for aluminum ductwork.

D. Provide stainless steel supports for stainless steel ductwork.

E. Support vertical ducts at maximum intervals of 16-feet and at each floor.

F. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

G. Use double nuts and lock washers on threaded rod supports.

H. Floor supports in mechanical rooms to be elevated 1-inch above finish floor and void space filled with masonry grout.

I. Anchor ducts securely to building in such a manner as to prevent transmission of vibration to structure. Do not connect duct hanger straps to roof deck. Do not support ducts from other ducts, piping or equipment.

J. Attach strap hangers installed flush with end of sheet-metal duct run to duct with sheet-metal screws.

K. Construct exterior ductwork or ductwork which is otherwise exposed to weather watertight and slope 1/4-inch per foot to avoid standing water.

L. Exposed ductwork hung in clean areas such as sanitary areas, pharmaceutical areas, wash down areas or food process areas to be installed using double end, food grade trapeze hanger rods suitable for use with food grade strut.

M. Channel Support System Installation:
   1. Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
   2. Field assemble and install according to manufacturer's written instructions.

N. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

O. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

P. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

Q. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping, ductwork and equipment to proper level and elevations.
R. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.

S. Horizontal Piping Hangers and Supports; Horizontal and Vertical Piping, and Hanger Rod Attachments:
1. Factory fabricated horizontal piping hangers and supports complying with MSS SP-58, to suit piping systems and in accordance with manufacturer's published product information.
2. Use only one type by one manufacturer for each piping service.
3. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping.
4. Pipe support spacing (pipe supported in ceiling or floor-supported) to meet latest applicable Code and manufacturer's requirements.
5. Provide copper-plated hangers and supports for uninsulated copper piping systems.

T. Plumber's Tape not permitted as pipe hangers or pipe straps.

U. Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. For horizontally hung grooved-end piping, provide a minimum of 2 hangers per pipe section.

V. Pipe Ring Diameters:
1. Uninsulated and Insulated Pipe, Except Where Oversized Pipe Rings are Specified: Ring inner diameter to suit pipe outer diameter.
2. Insulated Piping Where Oversized Pipe Rings are Specified and Vibration Isolating Sleeves: Ring inner diameter to suit outer diameter of insulation or sleeve.

W. Oversize Pipe Rings: Provide oversize pipe rings of 2-inch and larger size.

X. Pipe Support Brackets: Support pipe with pipe slides.

Y. Steel Backing in Walls: Provide steel backing in walls to support fixtures and piping hung from steel stud walls.

Z. Pipe Guides:
1. Install on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides to pipe structure. Contact with chilled water pipe does not permit heat to be transferred in sufficient quantity to cause condensation on any surface.
2. Install approximately four pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Do not use as supports. Provide in addition to other required pipe hangers and supports.

AA. Heavy-Duty Steel Trapeze Installation:
1. Arrange for grouping of parallel runs of horizontal piping and support together on field fabricated, heavy-duty trapezes.
2. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
3. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

AB. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers. Maximum spacings: MSS SP-58.

AC. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.

AD. Do not support piping from other piping.

AE. Fire protection piping will be supported independently of other piping.

AF. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.

AG. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping" is not exceeded.

AH. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating Below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   2. Do not exceed pipe stress limits according to ASME B31.9.
   3. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   4. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields to span arc of 180 degrees.
   5. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
   6. Shield Dimensions for Pipe, not less than the following:
      a. NPS 1/4 to NPS 3-1/2 (DN8 to DN 90): 12-inches long and 0.048-inch thick.
      b. NPS 4 (DN100): 12-inches long and 0.06-inch thick.
      c. NPS 5 and NPS 6 (DN125 and DN150): 18-inches long and 0.06-inch thick.
      d. NPS 8 to NPS 14 (DN200 to DN350): 24-inches long and 0.075-inch thick.
      e. NPS 16 to NPS 24 (DN400 to DN600): 24-inches long and 0.105-inch thick.
   7. Pipes NPS 8 (DN200) and Larger: Include wood inserts.
      a. Insert Material: Length at least as long as protective shield.
   8. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

AI. Pipe Anchors: Provide anchors to fasten piping which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.

AJ. Pipe Curb Assemblies:
1. Provide prefabricated units for roof membrane and insulation penetrations related to equipment. Coordinate with roofing system. Set supports on the structural deck. Do not set supports on insulation or roofing. Provide level supports by prefabricated pitch built into the curb.

2. Provide for piping and electrical conduit which penetrates the structural roof deck to service equipment above the roof level (i.e., piping, electrical power and control wiring). Meet requirements of roof warranty.

AK. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor walls, and through equipment room walls and floors.

AL. Vertical Piping:
   1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.
   2. Riser clamps to be directly under fitting or welded to pipe.
      a. Riser to be supported at each floor of penetration.
      b. Provide structural steel supports at the base of pipe risers. Size supports to carry forces exerted by piping system when in operation.

AM. Piping above roof to be supported with freestanding roof pipe supports unless detailed otherwise.

### 3.3 WALL AND FLOOR SLEEVES

A. "Link-Seal" Pipe Sleeves: Install at floor/below grade piping penetrations. Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations.

B. Fabricated Pipe Sleeves:
   1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeve diameter to be determined by local seismic clearance requirements, and by waterproofing requirements.
   2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1-inch above floor finish.
   3. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.
   4. Seal each end airtight with a resilient nonhardening sealer, UL listed, fire rated ASTM 814.

C. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
   1. Install fabricated pipe sleeve.
   2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.
   3. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814.

D. Piping Penetrations Through Fire-Rated (One to Three Hour) Assemblies:
1. Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.
2. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814.

3.4 BUILDING ATTACHMENTS

A. Factory fabricated attachments complying with MSS SP-58, selected to suit building substructure conditions and in accordance manufacturer's published product information.

B. Select size of building attachments to suit hanger rods.

C. Install concrete inserts before placing concrete.

D. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

E. Do not use powder-actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4-inches thick.

F. Install within concrete or on structural steel or wood. Attachment to wood structure: Anvil side beam bracket Figure 202 for attachment to wooden beam or approved attachment for a wood structure.

G. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping.

H. Install concrete inserts before concrete is placed; fasten insert secure to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.

I. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-58. Install additional attachments at concentrated loads, including valves, flanges guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

K. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

L. Bolting: Provide bored, drilled or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched or hand sawn holes will not be accepted.

M. Anchor Bolts:
1. Install anchor bolts for mechanical equipment, piping and ductwork as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment, piping and ductwork are hung.

2. Anchor bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.

N. Testing: Test powder-actuated insert attachments with a minimum load of 100 pounds.

3.5 FLAShING

A. Flash and counterflash where piping, ductwork and equipment passes through weather or waterproofed walls, floors, and roofs.

B. Provide 12-inches minimum height curbs for roof-mounted mechanical equipment. Flash and counter flash with galvanized steel, soldered and waterproofed.

3.6 MISCELLANEOUS METAL AND MATERIALS

A. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates, and similar devices. Hot dipped galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.

B. Finishes:

1. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with 1 coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas in primer with same material, before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.

2. Metal in Contact with Concrete, Masonry and Other Dissimilar Materials: Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.

3. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.
C. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Avoid cutting concrete reinforcing when drilling for inserts. Reference structural drawings and reinforcing shop drawings and determine locations of stirrups prior to drilling into concrete.

E. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items, which are to be built into concrete masonry or similar construction.

F. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.


H. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.

I. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

J. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.

K. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

L. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
M. Provide galvanized components for items exposed to weather.

END OF SECTION
SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Vibration Isolation
   2. Seismic Restraint Devices
   3. Factory Finishes

B. General:
   1. Vibration isolation for mechanical ductwork, piping and equipment.
   2. Seismic restraint for mechanical ductwork, piping and equipment.
   3. Seismic Certification for equipment, hangers and systems
   4. Special inspections for systems.

C. Scope of Work:
   1. Vibration isolation and seismic restraint of new equipment and systems within project
      boundary defined in architectural drawings.
   2. Vibration isolation and seismic restraint of new equipment and systems in existing
      buildings to points of connection with existing systems.
   3. Seismic restraint of existing systems and equipment shown on drawings, within project
      boundary defined in architectural drawings.
   4. Provide supplementary structural steel for seismic restraint systems. No hanging from
      roof deck is permitted on this project, unless specifically allowed by Structural Engineer
      of Record in writing prior to bid.

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and
   Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01,
   General Requirements.

B. In addition, provide:
   1. Vibration Isolation:
      a. Product Data: Provide catalog data indicating size, type, load and deflection of
         each isolator; and percent of vibration transmitted based on lowest disturbing
         frequency of equipment.
b. Shop Drawings: Showing complete details of construction for steel and concrete bases including:
   1) Fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment and cantilever loads.
   2) Equipment mounting holes.
   3) Dimensions.
   4) Size and location of concrete and steel bases and curbs.
   5) Isolation selected for each support point.
   6) Details of mounting brackets for isolator.
   7) Weight distribution for each isolator.
   8) Details of seismic snubbers.
   9) Code number assigned to each isolator.

c. Design calculations: Provide calculations for selecting vibration isolators and for designing vibration isolation bases.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Seismic Restraint:
   a. Shop Drawings: Show compliance with requirements of Quality Assurance article of this Section. Shop drawings to be stamped by a professional Structural or Civil Engineer licensed in State of California.
   b. Calculations: Submit seismic calculations indicating restraint loadings resulting from design seismic forces. Include anchorage details and indicate quantity, diameter and depth of penetration of anchors. Calculations certified by professional Structural or Civil Engineer licensed in State of California.

4. Seismic Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter and depth of penetration of anchors.

5. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y and z planes.


7. Equipment Certification: Provide seismic certification for equipment as noted in Seismic Design Summary or schedules on Drawings.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Vibration Isolation:
      a. Except for packaged equipment with integral isolators, single manufacturer selects and furnishes isolation required.
      b. Deflections indicated on drawings are minimum actual static deflections for specific equipment supported.
c. Isolator Stability:
   1) Size springs of sufficient diameter to maintain stability of equipment being supported. Spring diameters not less than 0.8 of compressed height at rated load.
   2) Springs have minimum additional travel to solid equal to 50 percent of rated deflection.
   3) Springs support 200 percent of rated load, fully compressed, without deformation or failure.

d. Maximum Allowable Vibration Levels: Peak vibration velocities not exceed 0.08 in/sec. Correct equipment operating at vibration velocities that exceed this criteria.

2. Seismic Restraint:
   a. Code and Standard Requirements:
      1) Seismic restraint of equipment, piping and ductwork to be in accordance with latest enacted version of CBC Chapter 16.
   b. Confirm Seismic Control requirements in Division 01, General Requirements and Structural documents.
   c. Certification: See Seismic Design Table or schedules on Drawings for equipment, systems and seismic-restraint devices designated to have seismic certification/qualification. Horizontal and vertical load testing and analysis performed according to ASCE 7-10. Anchorage systems to bear anchorage preapproval number from an agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing or calculations, if preapproved ratings are not available. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be sealed by qualified licensed professional engineer in State of California. Testing and calculations must include both shear and tensile loads and one test or analysis at 45 degrees to weakest mode.
   d. Seismic restraint and anchorage of permanent equipment and associated systems listed below to building structure be designed to resist total design seismic force prescribed in local building code:
      1) Floor- or roof-mounted equipment weighing 400 pounds or greater.
      2) Suspended, wall-mounted or vibration isolated equipment weighing 20 pounds or greater.
      3) In-line duct devices connected to ductwork weighing 75 pounds or greater.
      4) Housekeeping slabs: provide reinforcement and anchorage to building structure.
   c. Where required, seismic sway bracing of suspended duct and piping meet following:
      1) Pipe and duct runs requiring seismic bracing have minimum of two traverse braces and one longitudinal brace. Longitudinal (or traverse) brace at 90 degree change in direction may act as traverse (or longitudinal) brace if located within 2-feet of change in direction.
      2) Seismic bracing may not pass through seismic separation joint. Pipe or duct runs that pass through seismic separation joint must be restrained within 5-feet of both sides of separation.
      3) Seismic brace assembly spacing not to exceed 40-feet transverse and 80-feet longitudinal.
f. Seismic restraints may be omitted from suspended piping and duct if following conditions are satisfied:
   1) For piping or ducts supported by rod hangers 12-inches or less in length from top of duct to bottom of structural support. Top connections to structure have swivel joints, eye bolts, or vibration isolation hangers for entire length of system run.
   2) Lateral motion of system will not cause damaging impact with surrounding systems or cause loss of system vertical support.
   3) System must be welded steel pipe, brazed copper pipe, sheet metal duct or similar ductile material with ductile connections.

C. Seismic restraints, including anchors to building structure, be designed by registered professional Structural or Civil Engineer licensed in State of California. Design includes:
   1. Number, size, capacity and location of anchors for floor- or roof-mounted equipment. For curb-mounted equipment, provide design of attachment of both unit to curb and curb to structure.
   2. Number, size, capacity and location of seismic restraint devices and anchors for vibration-isolation and suspended equipment. Provide calculations and test data verifying horizontal and vertical ratings of seismic restraint devices.
   3. Number, size, capacity and location of braces and anchors for suspended piping and ductwork on as-built plan drawings.
   4. Maximum seismic loads to be indicated on drawings at each brace location. Drawings bear stamp and signature of registered professional Structural Engineer who designed layout of braces.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Seismic Snubber Units: Furnish replacement neoprene inserts for snubbers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Vibration Isolation:
   1. The VMC Group
   2. B-Line Systems, Inc.
   4. Mason Industries Inc.
   5. M.W. Sausse - Vibrex
   6. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
7. Or equal.

B. Seismic Restraint Devices:
1. The VMC Group
2. B-Line Systems, Inc.
3. Hilti, Inc.
5. Mason Industries, Inc.
6. California Dynamics Corporation
7. Cooper B-Line Toledo.
8. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
9. M.W. Sausse - Vibrex
10. Or equal.

C. Factory Finishes:
1. Kynar 500 Fluoropolymer Coating
2. Or equal.

D. Seismic-Bracing/Restraint Devices/Systems for Equipment, Piping and Ductwork:
1. The VMC Group
2. California Dynamics Corporation
3. Cooper B-Line, Inc.
4. Hilti, Inc.
5. Mason Industries, Inc.
7. Unistrut
8. ISAT, Inc.
9. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
10. Or equal.

2.2 VIBRATION ISOLATION

A. Type 1 - Neoprene Pad: Natural rubber waffle pads, arranged in single or multiple layers, 3/4-inch thick per layer with pattern repeating on ½-inch centers; 50 durometer hardness; maximum loading 60 PSI. 1/4-inch thick steel load distribution plate between layers and between pad and equipment, factory cut to sizes matching requirements of supported equipment. Molded bridge with neoprene anchor bolt bushing and flat washer face to prevent metal to metal contact. Number of layers required for equipment scheduled. Mason Type: Super WMH.

B. Type 2 - Neoprene Mount: Double-deflection type, with ductile-iron housing containing two separate and opposing, oil-resistant natural rubber or bridge bearing neoprene elements, factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Neoprene elements to prevent metal to metal contact during normal operation. Minimum static deflection of 0.20-inches. Mason Type: BR.

C. Type 3 - Spring: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
2. Minimum Additional Travel: 50 percent of required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, natural rubber or bridge bearing neoprene isolator pad attached to baseplate underside. Baseplates limit floor load to 100 PSIG (690 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
7. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
8. Mason Type: SLFH.

D. Type 4a - Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
   1. Housing: Steel with resilient vertical-limit stops (out of contact during normal operation) to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch thick, natural rubber or bridge bearing neoprene isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation. Restraining bolts have large rubber grommets to provide cushioning in vertical and horizontal directions. A minimum clearance of 3/8-inch maintained around restraining bolts so as not to interfere with spring action.
   2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
   3. Minimum Additional Travel: 50 percent of required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
   7. Mason Type: SLRH.

E. Type 4b - Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
   1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint with neoprene acoustical cup, spring inspection ports and rebound adjustment ports.
   2. Base: Factory drilled for bolting to structure.
   3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel before contacting a resilient collar.
   4. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
   5. Mason Type: SSLFH.

F. Type 5a - Restrained Elastomeric Hangers: Double-deflection type, with molded, oil-resistant natural rubber or bridge bearing neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity
range. Seismic rebound steel and bonded LDS rubber washer to limit upward seismic movement. Mason Type: RWHD.

G. Type 5c - Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 15 degrees of angular hanger-rod misalignment from vertical without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
   3. Minimum Additional Travel: 50 percent of required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
   7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
   8. Mason Type: RW30.

H. Type FC-1, Flexible duct connectors. See Specification Section 23 33 00 Air Duct Accessories.

I. Type FC-2A, Flexible Pipe Connector, Steel:
   1. 321 stainless steel, close pitch, annular corrugated hose.
   2. Exterior Sleeve: 304 stainless steel, braided.
   3. Pressure Rating: 125 PSI at 70 degrees F for 12-inch and smaller pipe.
   5. Size: Use pipe sized units.
   6. Minimum Allowable Offset: 3/4-inch on each side of installed center line.
   7. Basis of Design: Metraflex Model MLP.

J. Type FC-2B, Flexible Pipe Connector, Copper:
   1. Inner Hose: Bronze, close pitch, annular corrugated hose.
   2. Exterior Sleeve: Braided bronze (for piping over 2-inches, to be 3 pound braided stainless steel).
   3. Minimum Allowable Pressure Rating: 125 PSI at 70 degrees F.
   5. Size: Use pipe sized units.
   7. Basis of Design: Metraflex Model BBS.

K. Type FC-2C, Flexible Pipe Connector, Gas:
   1. Inner Hose: 304 stainless steel.
   2. Exterior Sleeve: Braided, 304 stainless steel.
   3. Minimum Allowable Pressure Rating: 150 PSI at 70 degrees F up to 4-inch pipe.
   5. Minimum Allowable Offset: 3/4-inch on each side of installed center line.
   6. Basis of Design: Metraflex GASCT.
L. Type FC-3, Flexible Compensator, Double Sphere:
   1. Body: Molded twin spherical type. Neoprene with internal cord or wire.
   2. Minimum Pressure Rating, Sizes 2-inch to 12-inch: 225 PSI at 170 degrees F.
   3. Minimum Pressure Rating, Sizes 14-inch to 20-inch: 125 PSI at 170 degrees F.
   8. Joint: Steel flanges.
   9. Accessories: Galvanized aircraft-type cable or control rods to prevent over extension.

2.3 SEISMIC RESTRAINT DEVICES

A. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.

B. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts and replaceable resilient isolation washers and bushings. Snubber load rating to match equipment size. Mason Type: Z-1011 or Z-1225.
   1. Anchor bolts for attaching to concrete be seismic-rated, drill-in and stud-wedge or female-wedge type.
   2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5.

C. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement. Mason Type: SCB.

D. Anchor Bolts: Seismic-rated, drill-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

2.4 FACTORY FINISHES

A. Provide manufacturer's standard prime-coat finish ready for field painting. Units mounted outdoors exposed to weather: Epoxy powder coated, with 1000 hour salt spray rating per ASTM B-117. For high levels of corrosion protection utilize:
   1. Conform to AAMA 605.2.
   2. Apply coating following cleaning and pretreatment.
   3. Cleaning: AA-C12C42R1X.
   4. Dry system before final finish application.
   5. Total Dry Film Thickness: Approximately 1.2 mils, when baked at 450 degrees F for 10 minutes.

B. Finish:
   1. Manufacturer's standard paint applied to factory-assembled and factory-tested equipment before shipping.
2. Powder coating on springs and housings.
3. Hardware be electrogalvanized. Hot-dip galvanize metal components for exterior use.
4. Baked enamel for metal components on isolators for interior use.
5. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

2.5 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT, PIPING AND DUCTWORK

A. General Requirements for Restraint Components: Rated strengths, features and applications to be as defined in reports by agency acceptable to authorities having jurisdiction.

B. Structural Safety Factor: Allowable strength in tension, shear and pullout force of components be at least four times maximum seismic forces to which they will be subjected.

C. Anchor bolts for attaching to concrete to be seismic-rated, drill-in and stud-wedge or female-wedge type.

D. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

E. Maximum 1/4-inch air gap and minimum 1/4-inch thick resilient cushion.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Set floor-mounted equipment with steel base rails on 4-inch-high concrete housekeeping pads. Extend pad 6-inches beyond footprint of equipment in each direction.

B. Provide mounts for equipment installed outdoors for wind loads of 30 lbs. psf applied to any exposed surface of isolated equipment.

C. Do not install equipment or pipe which makes rigid contact with building slabs, beams, studs, walls, etc.

D. Anchor baseplate to floor or structure. Provide rubber grommets and washers to isolate bolt from base plate. Under no circumstances is isolation efficiency to be destroyed when bolting isolators to floor.

E. Building Penetrations: Isolate water piping and ductwork penetrating wall, ceilings, floors or shafts from structure by piping isolator or by 3/8-inch thick foamed rubber insulation. Install units flush with finished structure face, using one for each side as required. Cut units to length if longer than structure thickness. Caulk around pipe or duct at equipment room wall.

F. Provide roof curbs, equipment supports and roof penetrations. Work to maintain roof warranty. Coordinate location, size, structural connections/requirements and flashing prior to installation.

G. Install Type 6 horizontal thrust restraints at centerline of thrust, symmetrical on either side of equipment.
H. Vibration isolators must not cause change of position of equipment or piping which would stress piping connections or misalignment shafts or bearings. Isolated equipment is to be level and in proper alignment with connecting ducts and pipes.

I. Pipe Hangers in Equipment Rooms: Support water and gas piping connected to rotating equipment within equipment rooms on spring and neoprene hangers. The first three hangers from a piece of vibrating equipment are to have a minimum of 1/2 static deflection of equipment isolators. Other isolators should have a minimum of 1/4 static deflection of equipment isolators.

J. Examination:
   1. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances and other conditions affecting performance.
   2. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

K. Testing: Perform following field quality-control testing:
   1. Isolator seismic-restraint clearance.
   2. Isolator deflection.
   3. Snubber minimum clearances.

L. Adjusting:
   1. Adjust snubbers according to manufacturer's written recommendations.
   2. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

M. Cleaning: After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt and debris.

N. Demonstration: Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain air-mounting systems. Reference Division 01, General Requirements.

3.2 VIBRATION ISOLATION

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Vibration isolators must be installed in strict accordance with manufacturer's written instructions and certified submittal data.

D. Install isolation as indicated on drawings by type and location and where indicated below.

E. Equipment Vibration Isolation Schedule:
<table>
<thead>
<tr>
<th>Equipment</th>
<th>Size</th>
<th>Vibration Isolator Type</th>
<th>Minimum Deflection (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chillers/Heat Pumps: Reciprocating, Water or Air-Cooled</td>
<td>All</td>
<td>Type 4A or 4B, FC-3</td>
<td>2.5</td>
</tr>
<tr>
<td>Chillers/Heat Pumps: Centrifugal, Screw or Scroll, Water or Air-Cooled</td>
<td>All</td>
<td>Type 4A or 4B, FC-3</td>
<td>1.5</td>
</tr>
<tr>
<td>Cooling Towers</td>
<td>All</td>
<td>B-1, Type 4A, FC-3</td>
<td>3.5</td>
</tr>
<tr>
<td>Boilers</td>
<td>All</td>
<td>Type 1 or 2, FC-2</td>
<td>0.2</td>
</tr>
<tr>
<td>Base-Mounted Pumps</td>
<td>0 to 5 HP</td>
<td>B-1, Type 1, FC-3</td>
<td>0.2</td>
</tr>
<tr>
<td>Base-Mounted Pumps</td>
<td>7.5+ HP</td>
<td>B-2, Type 1, FC-3</td>
<td>1.5</td>
</tr>
<tr>
<td>Inline Pumps</td>
<td>All</td>
<td>Type 4A, 4B, 5B, or 5C, FC-2</td>
<td>1.5</td>
</tr>
<tr>
<td>Fan-coils, Unit Heaters, Fan-Powered Terminal Units</td>
<td>All</td>
<td>Type 5B, or 5C, FC-1,2</td>
<td>0.75</td>
</tr>
<tr>
<td>Condensing Units</td>
<td>0 to 4.5 tons</td>
<td>Type 1 or 2</td>
<td>0.2</td>
</tr>
<tr>
<td>Condensing Units</td>
<td>5+ tons</td>
<td>Type 4A</td>
<td>2.5</td>
</tr>
<tr>
<td>Rooftop Air Handlers, AC, Heat Pump Units</td>
<td>0 to 19.5 tons</td>
<td>RC-1, FC-1,2</td>
<td>0.75</td>
</tr>
<tr>
<td>Rooftop Air Handlers, AC, Heat Pump Units</td>
<td>20+ tons</td>
<td>RC-2, FC-1,2</td>
<td>1.5</td>
</tr>
<tr>
<td>Axial, Cabinet, Centrifugal Inline Fans</td>
<td>0 to 23.5-inch diameter</td>
<td>Type 3, 4A, 4B, 5B, or 5C, FC-1</td>
<td>0.75</td>
</tr>
<tr>
<td>Axial, Cabinet, Centrifugal Inline Fans</td>
<td>24-inch+ diameter</td>
<td>Type 3, 4A, 4B, 5B, or 5C, FC-1</td>
<td>1.5</td>
</tr>
<tr>
<td>Propeller Fans</td>
<td>All</td>
<td>Type 2 or Type 5A, FC-1</td>
<td>0.25</td>
</tr>
</tbody>
</table>

**F. Isolation Mounts:**
1. Install minimum of four seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts.
3. Provide flexible piping connection and flexible ductwork connection to equipment with isolation mounts or bases.

**G. Isolating Hangers:**
1. Support piping and ductwork connected to isolated equipment within equipment rooms on isolating hangers as scheduled on drawings. Unless otherwise noted, first three hangers from isolated equipment to have a minimum of 1/2 static deflection of equipment isolators. Other isolating hangers to have a minimum of 1/4 static deflection of equipment isolators.
2. Position isolating hanger elements as high as possible in hanger rod assembly, but not in contact with building structure. Install hangers so that hanger housing may rotate full 360 degrees about rod axis without contacting any object.
3. Unless otherwise noted, air supply units with internally isolated fans do not require isolating hangers for connecting pipes and ductwork.
4. Where parallel running pipes are hung together on an isolated trapeze, provide isolator deflections for largest determined by provisions for pipe isolation. Do not mix isolated and non-isolated pipes in same trapeze.
5. Install limit stops so they are out of contact during normal operation.

H. Adjusting:
   1. Adjust isolators after piping systems have been filled and equipment is at operating weight.
   2. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
   3. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.

3.3 SEISMIC RESTRAINT DEVICES

A. Reference 3.01, General Installation Requirements.

B. Install in strict accordance with manufacturer's written instructions and certified submittal data.

C. Install and adjust seismic restraints so equipment, piping and ductwork supports are not degraded by restraints.

D. Restraints must not short circuit vibration isolation systems or transmit objectionable vibration or noise.

E. Install restraining cables at each trapeze, individual pipe hanger and hanging vibration isolated equipment. Provide restraining cables in each of the four directions of movement. Install restraining cables no less than 45 Degrees from vertical. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.

F. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackles piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.

3.4 FACTORY FINISHES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Finishes to be factory-applied. No field patching or holidays allowed.
3.5 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT, PIPING AND DUCTWORK

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION
SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Plastic Nameplates
   2. Tags
   3. Plastic Pipe Markers
   4. Ceiling Tags
   5. Plastic Duct Markers

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Schedules:
      a. Submit valve schedule for each piping system, in tabular format using Microsoft Word or Excel software. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shutoff and similar special uses by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals.
      b. For renovations or expansions of existing systems, coordinate with Owner and develop valve schedule on existing schedule naming and format.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
   2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.
1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23, HVAC Sections. Where more than a single type is specified for application, provide single selection for each product category.

B. Plastic Nameplates:
   1. Brady Corporation
   2. Brimar
   3. Champion America
   4. Craftmark
   5. Seton
   6. Or equal.

C. Tags:
   1. Brady Corporation
   2. Brimar
   3. Champion America
   4. Craftmark
   5. Seton
   6. Or equal.

D. Plastic Pipe Markers:
   1. Brady Corporation
   2. Brimar
   3. Champion America
   4. Craftmark
   5. Seton
   6. Or equal.

E. Ceiling Tags:
   1. Brady Corporation
   2. Brimar
   3. Champion America
   4. Craftmark
   5. Seton
   6. Or equal.

F. Plastic Duct Markers:
   1. Brady Corporation
   2. Brimar
3. Champion America
4. Craftmark
5. Seton
6. Or equal.

2.2 PLASTIC NAMEPLATES

A. Description: Engraving stock melamine plastic laminate in the size and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color), punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Provide 1/8-inch thick material.
   2. Letter Height: 1/2-inch.
   4. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
   5. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.

2.3 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 2-inch diameter.

B. Metal Tags: Polished Brass with stamped letters; tag size minimum 2-inch diameter with smooth edges.

C. Valve designations to be coordinated with existing valve identifications to ensure no repetitive designations are utilized.

D. Chart/Schedules: Valve Schedule Frames. For each page of a valve schedule, provide glazed display frame with removable mounting as appropriate for wall construction upon which frame is to be mounted. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

E. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.

F. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7-inches.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

2.4 PLASTIC PIPE MARKERS

B. Plastic Pipe Markers (for external diameters of 6-inches and larger including insulation): Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers (for external diameters less than 6-inches including insulation): Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Lettering:
   1. 3/4-inch to 1-1/4-inch Outside Diameter of Insulation or Pipe: 8-inch long color field, 1/2-inch high letters.
   2. 1-1/2-inch to 2-inch Outside Diameter of Insulation or Pipe: 8-inch long color field, 3/4-inch high letters.
   3. 2-1/2-inch to 6-inch Outside Diameter of Insulation or Pipe: 12-inch long color field, 1-1/4-inch high letters.
   4. 8-inch to 10-inch Outside Diameter of Insulation or Pipe: 24-inch long color field, 2-1/2-inch high letters.
   5. Over 10-inch Outside Diameter of Insulation or Pipe: 32-inch long color field, 3-1/2-inch high letters.

2.5 CEILING TAGS

A. Description: Steel with 3/4-inch diameter color coded head.

B. Color code as follows:
   1. Yellow - HVAC equipment.
   2. Red - Fire dampers/smoke dampers.
   4. Ceiling tile labels, machine generated, adhesive backed tape labels with black letters, clear tape.

2.6 PLASTIC DUCT MARKERS

A. General: Manufacturer's standard laminated plastic, color-coded duct markers. Supply separate color codes for supply, exhaust, outside, return air and hazardous exhaust lab, chemical, fume hood, isolation room systems.

B. Include the Following Nomenclature:
   1. Direction of air flow.
   2. Duct service (supply, return, general exhaust, outdoor air), kitchen exhaust, dishwasher exhaust, fume hood exhaust, isolation room exhaust, etc.).
PART 3 - EXECUTION

3.1 GENERAL - INSTALLATION

A. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates riveted to equipment body.

B. Identify ductwork with plastic ductmarkers.

C. Identify piping, concealed or exposed, with plastic pipe markers.

D. Coordinate names, abbreviations and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

E. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).

F. Degrease and clean surfaces to receive adhesive for identification materials.

G. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

H. Coordinate with the facility maintenance personnel to ensure consistency with the existing tagging system.

I. Install all products in accordance with manufacturer's instructions.

J. Manual Balancing Dampers: Provide 12-inch long orange marker ribbon to end of balancing damper handle.

3.2 PLASTIC NAMEPLATES

A. Install plastic nameplates with corrosive-resistant mechanical fasteners.

B. Identify control panels and major control components outside panels with plastic nameplates riveted to equipment body.

C. Identify thermostats with nameplates.

3.3 TAGS

A. Use metal tags on piping 3/4-inch diameter and smaller.
B. Tag balancing valves and major dampers with balanced GPM or CFM indicated after balancing is completed and accepted.

C. Install tags with corrosion resistant chain.

D. Small devices, such as in-line pumps, may be identified with tags.

E. Identify valves in main and branch piping with metal tags. Indicate valve function and the normally open or closed positions on the valve tag.

F. Identify air terminal units and radiator valves with numbered plastic tags.

G. Tag automatic controls, instruments, and relays. Key to control schematic.

H. Install valve schedule at each mechanical room.

3.4 PLASTIC PIPE MARKERS

A. Install plastic pipe markers complete around pipe in accordance with manufacturer's instructions.

B. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20-feet (reduced to 10-feet in congested areas and mechanical equipment rooms) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction. Locate near branches, valves, control devices, equipment connections, access doors, floor/wall penetrations.

3.5 CEILING TAGS

A. Provide ceiling tile labels to identify valves, dampers, and equipment above accessible ceilings.

B. Provide ceiling tags to locate valves, dampers, and equipment above accessible ceilings. Locate in corner of ceiling tee grid closest to equipment.

3.6 PLASTIC DUCT MARKERS

A. Identify air supply, return, exhaust, isolation room exhaust, and outside air intake ductwork with duct markers, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork identification color). Identify with air handling unit identification number and area served. Locate identification at air handling unit, in mechanical rooms, at each side of penetration of structure or enclosure, at each obstruction, and within view of access doors/panels. In each space where ductwork is exposed, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment) and at 50 foot spacing along exposed runs. Where noted on Drawings, identify ductwork in exposed/public locations.
B. Access Doors: Provide duct markers on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions.

C. Isolation Rooms and Anteroom: Identify exhaust ducts by labeling with the words "Caution Airborne Infection Isolation Rooms Exhaust." Provide labeling in a manner which is not readily removable and appears on the exhaust duct at intervals of not more than 20-feet and at least once near each room and each story traversed by the exhaust system.

END OF SECTION
SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. General Requirements and Procedures
   2. Pre-Construction Balance (Existing Systems)
   3. Ductwork Pressure Testing
   4. Fundamental Air Systems Balancing Procedures
   5. Temperature Control Verification
   6. Variable Air Volume Systems Additional Procedures
   7. Multizone Systems Additional Procedures
   8. Fundamental Procedures for Hydronic Systems
   9. Sound Testing
   10. Vibration Testing
   11. Pre-Balance Reporting
   12. Final Reports:
      a. Report Requirements
      b. General Report Data
      c. System Diagrams
      d. Air Handling Units
      e. Hydronic Coils
      f. Refrigerant Coils
      g. Fans
      h. Duct Traverses
      i. Diffusers/Registers/Grilles
      j. Instrument Calibration
   13. Additional Tests

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
1. Quality-Assurance Submittals: Submit two copies of evidence that the Testing, Adjusting, and Balancing (TAB) Agent and this Project's TAB team members meet the qualifications specified in the "Quality Assurance" Article below.

2. Pre-Construction Phase Report:
   a. Provide a pre-construction phase TAB Plan at least two weeks prior to the commencement of TAB work. This report is to include:
      1) A complete set of report forms intended for use on the project, with data filled in except for the field readings. Forms to be Project-specific.
      2) Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.
      3) Identification of the type, manufacturer, and model of the actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certifications are to be included.
      4) A narrative of any project specific and/or non-standard TAB procedures to be used, and the equipment or systems they apply to.

3. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit two copies of the Contract Documents review report as specified in Part 3 of this Section.


5. Specify reports required because of editing procedures in Part 3 of this Section.

6. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by the TAB Agent.

7. Sample Report Forms: Submit two sets of sample TAB report forms.

8. Test Instrument Calibration: Submit proof of calibration within the last 6 months.


10. Provide additional submittals to commissioning authority as dictated in commissioning specifications.

1.5 QUALITY ASSURANCE

A. Quality Assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Acceptable Manufacturers:
      a. California:
         1) Raglen System Balance
         2) Pacific Test & Balance, Inc.
         3) Air Test & Balance, Inc.
         4) RSA Analysis, Inc.
         5) Air Balance Co. Inc.
         6) Total Air Balance Co. Inc.
         7) National Air Balance Company (NABCO)
         8) Mesa 3

   2. Acceptable Balance Firm:
      a. General:
1) Procure services of independent TAB agency to balance, adjust and test water circulating and air moving equipment and air distribution or exhaust systems. Minimum experience: 5 years.

b. Industry Standards: Testing and Balancing will conform to NEBB, American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), and American National Standards Institute (ANSI) as follows:


2) ASHRAE: Comply with recommendations pertaining to measurements, instruments, and TAB.

3) ANSI:
   a) S1.4 Specifications for sound level meters.
   b) S1.11 Specifications for Octave-Band and Fractional-Octave-Band analog and digital filters.
   c) ANSI S1.13 Methods for the Measurement of Sound Pressure Levels.

c. Test Observation: If requested, conduct tests in the presence of the Architect or the Architect's representative.

3. Noise Criteria:
   a. Noise levels in all 8 octave bands due to equipment and duct systems are not to exceed the following NC levels:

<table>
<thead>
<tr>
<th>TYPE OF ROOM</th>
<th>NC LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bathrooms and Toilet Rooms</td>
<td>35-40</td>
</tr>
<tr>
<td>Conference Room</td>
<td>30-35</td>
</tr>
<tr>
<td>Corridors (Public)</td>
<td>35-40</td>
</tr>
<tr>
<td>Lobbies, Waiting Areas</td>
<td>35-40</td>
</tr>
<tr>
<td>Offices, Large Open (3 or more occupants)</td>
<td>35-40</td>
</tr>
<tr>
<td>Offices, Small Private (2 or fewer occupants)</td>
<td>30-35</td>
</tr>
<tr>
<td>Kitchens</td>
<td>40-45</td>
</tr>
<tr>
<td>Classrooms (Small, Medium, Large)</td>
<td>30-35</td>
</tr>
<tr>
<td>Cafeteria/Dining</td>
<td>35-40</td>
</tr>
<tr>
<td>All Others</td>
<td>35-40</td>
</tr>
</tbody>
</table>

b. For equipment which has no sound power ratings scheduled on the Drawings, select equipment that the foregoing noise criteria, local ordinance noise levels, and OSHA requirements are not exceeded. Selection procedure in accordance with ASHRAE Fundamentals Handbook, Chapter 7, Sound and Vibration.

c. An allowance, not to exceed 5db, may be added to the measured value to compensate for the variation of the room attenuating effect between room test condition prior to occupancy and design condition after occupancy which may include the addition of sound absorbing material, such as furniture. This allowance may not be taken after occupancy. The room attenuating effect is defined as the difference between sound power level emitted to room and sound pressure level in room.
d. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.

4. Allowable Vibration Tolerances for Rotating, Non-Reciprocating Equipment: Not to exceed a self-excited vibration maximum velocity of 5 mm per second (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. Measurements for internally isolated fans and motors may be made at the mounting feet.

5. Provide proof of testing agency having successfully completed at least five projects of similar size and scope.

6. Code Compliance: Perform tests in the presence of the Authority Having Jurisdiction (AHJ) where required by the Authority Having Jurisdiction (AHJ).

7. Owner Witness: Perform tests in the presence of the Owners representative.

8. Engineer Witness: The engineer or engineer's representative reserves the right to observe tests or selected tests to assure compliance with the specifications.

9. Simultaneous Testing: Test observations by the AHJ, the Owner's representative and the engineer's representative need not occur simultaneously.

10. Do not perform TAB work until heating, ventilating, and air conditioning equipment has been completely installed and is operating continuously as required.

11. Conduct air testing and balancing with clean filters in place. Clean strainers prior to performing hydronic testing and balancing.

12. Agent Qualifications: Engage a TAB agent certified by AABC or NEBB.

13. TAB Conference: Meet with the Owner's and the Architect's representatives on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days advance notice of scheduled meeting time and location.

   a. Agenda Items: Include at least the following:
      1) Submittal distribution requirements.
      2) Contract Documents examination report.
      3) TAB plan.
      4) Work schedule and Project site access requirements.
      5) Coordination and cooperation of trades and subcontractors.
      6) Coordination of documentation and communication flow.

14. Certification of TAB Reports: This certification includes the following:

   a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

   b. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.


16. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards and NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

17. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.
1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. TAB Agency provides warranty for a period of 90 days following submission of completed report, during which time, Owner may request a recheck of up to 10 percent of total number of terminals, or resetting of any outlet, coil, or device listed in the final TAB report.
   2. Guarantee: Meet the requirements of the following programs:
      a. Provide a guarantee on AABC or NEBB forms stating that the agency will assist in completing the requirements of the Contract Documents if the TAB Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
         1) The certified Agent has tested, adjusted, and balanced systems according to the Contract Documents.
         2) Systems are balanced to optimum performance capabilities within design and installation limits.

1.7 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a persons skin than is normally dissipated.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
J. TAB: Testing, Adjusting, and Balancing.

K. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

L. Test: A procedure to determine quantitative performance of a system or equipment.

M. Testing, Adjusting, and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.


P. CTI: Cooling Tower Institute.


R. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.8 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS AND PROCEDURES

A. Project Conditions:
   1. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire TAB period. Cooperate with the Owner during TAB operations to minimize conflicts with the Owner's operations.
   2. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during TAB operations to minimize conflicts with the Owner's operations.
   3. Non-Owner Occupancy: Complete balancing of building systems prior to Substantial Completion and owner occupancy.

B. General Requirements:
1. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and controls, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
2. Perform TAB work with doors, closed windows, and ceilings installed etc., to obtain simulated or project operating conditions. Do not proceed until systems scheduled for TAB are clean and free from debris, dirt and discarded building materials.
3. Where Owner occupies building during the testing period, cooperate with Owner to minimize conflicts with Owner’s operations.

C. Examination:
1. Examine Contract Documents to become familiar with project requirements and existing building record documents (if available) to discover conditions in systems’ designs that may preclude proper TAB of systems and equipment.
   a. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
   b. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
2. Examine approved submittal data of HVAC systems and equipment.
3. Examine project record documents described in Division 01, General Requirements.
4. Examine Architect’s and Engineer’s design data, including Basis of Design, HVAC system descriptions, statements of design assumptions for environmental conditions and systems’ output, and statements of philosophies and assumptions about HVAC system and equipment controls.
5. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, “Fans and Systems,” Sections 7 through 10; or in SMACNA’s “HVAC Systems--Duct Design,” Sections 5 and 6. Compare this data with the design data and installed conditions.
6. Coordinate requirements in system and equipment with this Section.
7. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
8. Examine system and equipment test reports.
9. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
10. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
11. Examine equipment for installation and for properly operating safety interlocks and controls.
13. Beginning of work means acceptance of existing conditions.

D. Preparation:
1. Prepare a TAB plan that includes strategies and step-by-step procedures.
2. Complete system readiness checks and prepare system readiness reports. Verify the following:
   a. Permanent electrical power wiring is complete.
   b. Hydronic systems are filled, clean, and free of air.
   c. Automatic temperature-control systems are operational.
   d. Equipment and duct access doors are securely closed.
   e. Balance, smoke, and fire dampers are open.
   f. Isolating and balancing valves are open and control valves are operational.
   g. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   h. Windows, doors and other portions of the building envelope can be closed so design conditions for system operations can be met.
3. Hold a pre-balancing meeting at least one week prior to starting TAB work.
   a. Attendance is required by installers whose work will be tested, adjusted, or balanced.
4. Provide instruments required for TAB operations. Make instruments available to Architect to facilitate spot checks during testing.

E. General TAB Procedures:
1. Perform TAB procedures on each system according to the procedures contained in AABC national standards or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
2. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
3. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

F. Adjustment Tolerances:
1. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.
2. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
3. Hydronic Systems: Adjust to within plus or minus 10 percent of design at coils and plus or minus 5 percent at system pumps and equipment.
4. Adjust supply, return, and exhaust air quantities to maintain pressurization in spaces indicated on Drawings. Note and document room-to-room pressurization and maintain
these relationships. Adjust pressure controlled spaces to within plus or minus 0.01 in WC.

G. Recording and Adjusting:
   1. Field Logs: Maintain written logs including:
      a. Running log of events and issues.
      b. Discrepancies, deficient or uncompleted work by others.
      c. Contract interpretation requests.
      d. Lists of completed tests.
   2. Ensure recorded data represents actual measured or observed conditions.
   3. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
   4. Mark on drawings locations where traverse and other critical measurements were taken and cross reference location in final report.
   5. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
   6. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
   7. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner's Representative, or Commissioning Agent.

3.2 PRE-CONSTRUCTION BALANCE (EXISTING SYSTEMS)

A. Pre-Construction Balance - Air Systems
   1. Prior to start of construction or demolition; read and record airflow to establish “as-found” conditions. Provide pitot traverse of supply, return and exhaust ductwork at locations indicated on drawings and, as minimum, at central air handlers, main branch ductwork and at each floor.
   2. Read and record static pressure conditions across existing filters, coils and fans.
   3. Read and record amp draw and motor data from each existing air handler and fan that will be modified during project.

B. Pre-Construction Balance - Hydronic Systems
   1. Prior to start of construction or demolition; read and record flow of hydronic systems to establish "as-found" conditions.
   2. Read and record head loss and flow at existing coils, heat exchangers, air control devices, and pumps.
   3. Read and record amp draw and motor data from each existing pump.

C. Report data and observations to Architect.

3.3 DUCTWORK PRESSURE TESTING

A. Provide air pressure testing of concealed ductwork systems (testing is not required for ductwork exposed to air conditioned space). Test ductwork prior to connection to fan equipment. Repair leaks and retest until stipulated results are achieved.
B. Test ductwork prior to connection to fan equipment. Repair leaks and retest until stipulated results are achieved. Pressure testing to meet the following leakage classifications below as a minimum (ASHRAE Chapter 35, Table 6):
   1. Leakage class to be as defined below as a minimum.
      a. Minimum Duct Leakage Classification

<table>
<thead>
<tr>
<th>Duct Type</th>
<th>Leakage Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal (Flexible excluded)</td>
<td>3</td>
</tr>
<tr>
<td>Round and flat oval</td>
<td>3</td>
</tr>
<tr>
<td>Rectangular</td>
<td>12</td>
</tr>
<tr>
<td>Less than or equal to 2-inches of water (both positive and negative pressures)</td>
<td>12</td>
</tr>
<tr>
<td>Greater than 2 and less than or equal to 10-inches of water (both positive and negative pressures)</td>
<td>6</td>
</tr>
</tbody>
</table>

2. Testing machine: Meet requirements of SMACNA standards. Pacific Air Products "Port-O-Lab", Rolok, or United Sheet Metal
3. Test supply systems prior to connecting terminal units.
4. Perform tests in presence of Owner's Representative. Give 48 hours advance notice before commencement of each test.
5. Test ductwork systems in sections as large as possible and record test results accordingly.
6. Coordinate testing with ceiling installation.
   a. Provide sheet-metal plates and install between each duct test section (applies to main-to-main fittings, branch-to-branch fittings and main-to-branch fittings). At each plate location, fabricate joint with Ductmate. Insert 14 gauge sheet metal between Ductmate using a neoprene gasket on both sides of metal plate.
   b. Leave plates in place until isolated section has been tested and approved by Owner's Representative.
   c. Once sections have passed test, remove plates and reattach Ductmate joints. After fan unit is running, test joint for leakage by using a mixture of soap and water. If any noise or bubbling occurs, reseal joint. Owner's representative to witness this procedure.
7. Test duct at 1.5 times the design air pressure. Seal any audible leaks.

3.4 FUNDAMENTAL AIR SYSTEMS BALANCING PROCEDURES

A. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

B. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.

C. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
D. Prepare test reports for both fans and inlets and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross check the summation of required outlet volumes with required fan volumes.

E. Prepare schematic diagrams of systems' "as-built" duct layouts.

F. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

G. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

H. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

I. Verify that motor starters are equipped with thermal protection, sized for the connected load.

J. Check dampers for proper position to achieve desired airflow path.

K. Check for airflow blockages.

L. Check that condensate drains are installed, trapped and primed and routed to drain.

M. Check for readily observable leaks in air-handling unit components and ductwork.

N. Use sheaves and pulleys to adjust the speed of belt drive fans to achieve design flow with motors running at 60 Hertz unless noted otherwise.

3.5 VARIABLE AIR VOLUME SYSTEMS ADDITIONAL PROCEDURES

A. Compensating for Diversity:
   1. When the total airflow of terminal units is more than the fan design airflow volume, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the design airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
   2. Pressure-Independent, Variable-Air Volume Systems:
      a. After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
         1) Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
         2) Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure to deliver design airflow at the terminal unit.
         3) Measure total system airflow. Adjust to within 10 percent of design airflow.
         4) Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use the terminal unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units.
         5) Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow.
a) If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

6) Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets.

7) Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure adequate static pressure is maintained at the most critical unit. Balance system to achieve the lowest required differential pressure for the system to minimize fan brake horsepower.

8) Balance terminal units in variable volume systems for maximum cooling, maximum heating, and minimum ventilation (demand based ventilation systems) airflow rates.

9) Record the final fan performance data.

3. Additional Requirements: Provide all additional procedures to compensate for diversity as prescribed in ASHRAE and/or NEBB standards.


3.6 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Examine strainers for clean screens and proper perforations.

B. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.

C. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

D. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

E. Prepare schematic diagrams of systems' "as-built" piping layouts.

F. Prepare hydronic systems for TAB according to the following, in addition to the general preparation procedures specified above:
   1. Open manual valves for maximum flow.
   2. Check expansion tank liquid level, or air charge if bladder type.
   3. Check makeup-water-station pressure gauge for adequate pressure for highest vent.
   4. Check flow-control valves for specified sequence of operation and set at design flow.
   5. Set differential-pressure control valves at the specified differential pressure.
   6. Set system controls so automatic valves are wide open to heat exchangers and coils.
   7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
   8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

G. Calibrate water flow measuring stations.
3.7 SOUND TESTING

A. Perform and record required sound measurements in accordance with ANSI S1.13.
   1. Take readings in rooms, for rooms with a minimum of five typical (i.e. offices, classrooms, etc.), sampling of approximately 15 percent of each type of typical room is allowed per building. Request from Architect which rooms are preferred to be sampled.
   2. Provide all equipment and cooling tower sound measurements.

B. Take measurements with a calibrated sound level meter and octave band analyzer of the accuracy required by AABC or NEBB. Follow ANSI specifications.


D. Determine compliance with specifications as follows:
   1. When sound pressure levels are specified, including the NC Criteria:
      a. Reduce the background noise as much as possible by shutting off unrelated audible equipment.
      b. Measure octave band sound pressure levels with specified equipment "off."
      c. Measure octave band sound pressure levels with specified equipment "on."
      d. Use the DIFFERENCE in corresponding readings to determine the sound pressure due to equipment.

<table>
<thead>
<tr>
<th>Difference</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 to 9</th>
<th>10 or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
<td>10</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

E. Factor:
   1. Sound pressure level due to equipment equals sound pressure level with equipment "on" minus FACTOR.
      a. Plot octave bands of sound pressure level due to equipment for typical rooms on a graph which also shows noise criteria (NC) curves.
   2. When sound power levels are specified:
      a. Perform steps 1.a. thru 1.d., as above.
      b. For Indoor Equipment: Determine room attenuating effect, i.e., difference between sound power level and sound pressure level. Determined sound power level will be the sum of sound pressure level due to equipment plus the room attenuating effect.
      c. For Outdoor Equipment: Use directivity factor and distance from noise source to determine distance factor, i.e., difference between sound power level and sound pressure level. Measured sound power level will be the sum of sound pressure level due to equipment plus the distance factor. Use 30-feet for sound level location.
   3. Where sound pressure levels are specified in terms of dB(A), measure sound levels using the "A" scale of meter. Single value readings will be used instead of octave band analysis.
F. Where measured sound levels exceed specified level, installing contractor or equipment manufacturer to take remedial action approved by the Architect and the necessary sound tests to be repeated.

G. Test readings for sound testing could go higher than 15 percent if determination is made by the Architect based on the recorded sound data.

3.8 VIBRATION TESTING

A. Furnish instruments and perform vibration measurements. Provide measurements for all rotating HVAC equipment of 1/2 horsepower and larger, including centrifugal/screw compressors, cooling towers, pumps, fans and motors.

B. Record initial measurements for each unit of equipment on test forms and submit a report to the Architect. Where vibration readings exceed the allowable tolerance, correct the problem. TAB agency to verify that the corrections are done and submit a final report to the Architect.

3.9 PRE-BALANCE REPORTING

A. Pre-Construction Phase Report:
   1. Provide a pre-construction phase TAB Plan at least 2 weeks prior to the commencement of TAB work. This report is to include:
      a. A complete set of report forms intended for use on the project, with all data filled in except for the field readings. Forms to be project specific.
      b. Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.
      c. Identification of the type, manufacturer, and model of actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certifications are to be included.
      d. A narrative of any project specific and/or non-standard TAB procedures to be used, and the equipment or systems they apply to.

B. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

C. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced.

3.10 FINAL REPORTS

A. Report Requirements:
   1. General:
a. Computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.

b. Include a certification sheet in front of binder signed and sealed by the certified TAB engineer.
   1) Include a list of the instruments used for procedures, along with proof of calibration.

c. Final Report Contents: In addition to the certified field report data, include the following:
   1) Pump curves.
   2) Fan Curves
   3) Manufacturers Test Data
   4) Field test reports prepared by system and equipment installers.
   5) Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

B. General Report Data:
   1. In addition to the form titles and entries, include the following data in the final report, as applicable:
      a. Title Page
      b. Name and Address of TAB Agent
      c. Project Name
      d. Project Location
      e. Architect's Name and Address
      f. Engineer's Name and Address
      g. Contractor's Name and Address
      h. Report Date
      i. Signature of TAB Agent who Certifies the Report
      j. Summary of Contents, Including the Following:
         1) Design versus Final Performance
         2) Notable Characteristics of Systems
         3) Description of System Operation Sequence if it varies from the Contract Documents
      k. Nomenclature Sheets for Each Item of Equipment
      l. Data for Terminal Units, including Manufacturer, Type Size, and Fittings
      m. Notes to explain why certain final data in the body of reports vary from design values.
      n. Test Conditions for Fans and Pump Performance Forms, Including the Following:
         1) Settings for Outside-, Return-, and Exhaust-air Dampers
         2) Conditions of Filters
         3) Cooling Coil, Wet- and Dry-bulb Conditions
         4) Face and Bypass Damper Settings at Coils
         5) Fan Drive Settings, including Settings and Percentage of Maximum Pitch Diameter
         6) Inlet Vane Settings for Variable-Air-Volume Systems
         7) Settings for Supply-air, Static-pressure Controller
         8) Other System Operating Conditions that affect Performance

C. System Diagrams:
1. Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
   a. Quantities of Outside, Supply, Return, and Exhaust Airflows
   b. Water and Steam Flow Rates
   c. Duct, Outlet, and Inlet Sizes
   d. Pipe and Valve Sizes and Locations
   e. Terminal Units
   f. Balancing Stations

D. Air Handling Units:
   1. For air-handling units, split systems, fan coils, pumps, and evaporator units with coils, include the following:
      a. Unit Data: Include the following:
         1) Unit Identification
         2) Location
         3) Make and Type
         4) Model Number and Unit Size
         5) Manufacturer's Serial Number
         6) Unit Arrangement and Class
         7) Discharge Arrangement
         8) Sheave Make, Size in inches, and Bore
         9) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
         10) Number of Belts, Make, and Size
         11) Number of Filters, Type, and Size
      b. Motor Data: Include the following:
         1) Make and Frame Type and Size
         2) Horsepower and rpm
         3) Volts, Phase, and Hertz
         4) Full-load Amperage and Service Factor
         5) Sheave Make, Size in Inches, and Bore
         6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
      c. Test Data: Include design and actual values for the following:
         1) Total Airflow Rate in cfm (L/s)
         2) Total System Static Pressure in Inches wg (Pa)
         3) Fan rpm
         4) Discharge Static Pressure in Inches wg (Pa)
         5) Filter Static-pressure Differential in Inches wg (Pa)
         6) Preheat Coil Static-pressure Differential in Inches wg (Pa)
         7) Cooling Coil Static-pressure Differential in Inches wg (Pa)
         8) Heating Coil Static-pressure Differential in Inches wg (Pa)
         9) Outside Airflow in cfm (L/s)
        10) Return Airflow in cfm (L/s)
        11) Outside-air Damper Position
        12) Return-air Damper Position
        13) Vortex Damper Position

E. Hydronic Coils:
   1. For hydronic coils in all equipment with coils, include the following:
a. Coil Data: Include the following:
1) System Identification
2) Location and Zone
3) Room or Riser Served
4) Coil Type
5) Number of Rows
6) Fin Spacing in Fins per Inch o.c.
7) Make and Model Number
8) Face Area in SF
9) Tube Size in NPS (DN)
10) Tube and fin Materials
11) Circuiting Arrangement

b. Test Data: Include design and actual values for the following:
1) Airflow Rate in cfm
2) Average Face Velocity in fpm
3) Air Pressure Drop in Inches wg
4) Outside-air, Wet- and Dry-bulb Temperatures in Degrees F
5) Return-air, Wet- and Dry-bulb Temperatures in Degrees F
6) Entering-air, Wet- and Dry-bulb Temperatures in Degrees F
7) Leaving-air, Wet- and Dry-bulb Temperatures in Degrees F
8) Water Flow Rate in gpm
9) Water Pressure Differential in Feet of Head or PSIG
10) Entering-water Temperature in Degrees F
11) Leaving-water Temperature in Degrees F

F. Refrigerant Coils:
1. For refrigerant coils in all equipment with coils, include the following:
   a. Coil Data: Include the following:
      1) System Identification
      2) Location and Zone
      3) Room or Riser Served
      4) Coil Type
      5) Number of Rows
      6) Fin Spacing in Fins per Inch o.c.
      7) Make and Model Number
      8) Face Area in SF
      9) Tube Size in NPS (DN)
      10) Tube and fin Materials
      11) Circuiting Arrangement

   b. Test Data: Include design and actual values for the following:
      1) Airflow Rate in cfm
      2) Average Face Velocity in fpm
      3) Air Pressure Drop in Inches wg
      4) Outside-air, Wet- and Dry-bulb Temperatures in Degrees F
      5) Return-air, Wet- and Dry-bulb Temperatures in Degrees F
      6) Entering-air, Wet- and Dry-bulb Temperatures in Degrees F
      7) Leaving-air, Wet- and Dry-bulb Temperatures in Degrees F
      8) Refrigerant Expansion Valve and Refrigerant Types
9) Refrigerant Suction Pressure in PSIG
10) Refrigerant Suction Temperature in Degrees F

G. Fans:
   1. Fan Test Reports: For supply, return, and exhaust fans, include the following:
      a. Fan Data: Include the following:
         1) System Identification
         2) Location
         3) Make and Type
         4) Model Number and Size
         5) Manufacturer's Serial Number
         6) Arrangement and Class
         7) Sheave Make, Size in Inches, and Bore
         8) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches.
      b. Motor Data: Include the following:
         1) Make and Frame Type and Size
         2) Horsepower and rpm
         3) Volts, Phase, and Hertz
         4) Full-load Amperage and Service Factor
         5) Sheave Make, Size in Inches, and Bore
         6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
         7) Number of Belts, Make, and Size
      c. Test Data: Include design and actual values for the following:
         1) Total Airflow Rate in cfm
         2) Total System Static Pressure in Inches wg
         3) Fan rpm
         4) Discharge Static Pressure in Inches wg
         5) Suction Static Pressure in Inches wg

H. Duct Traverses:
   1. Include a diagram with a grid representing the duct cross-section and record the following:
      a. Report Data: Include the following:
         1) System and Air-handling Unit Number
         2) Location and Zone
         3) Traverse Air Temperature in Degrees F
         4) Duct Static Pressure in Inches wg
         5) Duct Size in Inches
         6) Duct Area in SF
         7) Design Airflow Rate in cfm
         8) Design Velocity in fpm
         9) Actual Airflow Rate in cfm
        10) Actual Average Velocity in fpm
        11) Barometric Pressure in PSIG

I. Diffusers/Registers/Grilles:
   1. For diffusers, registers and grilles, include the following:
      a. Unit Data: Include the following:
1) System and Air-handling Unit Identification
2) Location and Zone
3) Test Apparatus Used
4) Area Served
5) Air-terminal-device Make
6) Air-terminal-device Number from System Diagram
7) Air-terminal-device Type and Model Number
8) Air-terminal-device Size
9) Air-terminal-device Effective Area in SF
b. Test Data: Include design and actual values for the following:
   1) Airflow Rate in cfm
   2) Air Velocity in fpm
   3) Preliminary Airflow Rate as Needed in cfm
   4) Preliminary Velocity as Needed in fpm
   5) Final Airflow Rate in cfm
   6) Final Velocity in fpm
   7) Space Temperature in Degrees F

J. Instrument Calibration:
   I. For instrument calibration, include the following:
      a. Report Data: Include the following:
         1) Instrument Type and Make
         2) Serial Number
         3) Application
         4) Dates of Use
      b. Dates of Calibration.

3.11 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION
SECTION 23 07 00
HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Type A, Flexible Glass Wool Blanket
   2. Type B, Duct Liner
   3. Type 1, Glass Wool Pipe Insulation
   4. Type 2, Flexible Elastomeric Pipe Insulation
   5. Jacketing
   6. Accessories
   7. Duct Insulation Accessories
   8. Duct Insulation Compounds

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Installer qualifications.
   2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any) for each type of product indicated.
   3. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.
   4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
   5. Submit manufacturer’s installation instructions.
1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Formaldehyde Free: Should be third-party certified with UL Environment Validation.
   2. Recycled Content: A minimum of 40 percent post-consumer recycled glass content certified and UL validated.
   3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
   4. Installer to have minimum 5 years' experience in the business of installing insulation.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 FIRE HAZARD CLASSIFICATION

A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.

B. Test pipe insulation in accordance with the requirements of current edition of UL "Pipe and Equipment Coverings R5583 400 8.15".

C. Test duct insulation in accordance with current edition of ASTM E84, UL 723, NFPA 255, NFPA 90A and NFPA 90B.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Type A, Flexible Glass Wool Blanket:
   1. Certainteed
   2. Johns Manville
   3. Knauf
   4. Owens-Corning
   5. Or equal.

B. Type B, Duct Liner:
   1. Certainteed
   2. Johns Manville
   3. Knauf
   4. Owens-Corning
   5. Or equal.

C. Type 1, Glass Wool Pipe Insulation:
1. Certainteed
2. Johns Manville
3. Knauf
4. Owens-Corning
5. Or equal.

D. Type 2, Flexible Elastomeric Pipe Insulation:
   1. Glue:
      a. Armacell LLC Armaflex Low VOC Adhesive
      b. Halstead
      c. Or equal.
   2. Paint:
      a. Armacell LLC Armaflex
      b. Halstead
      c. Or equal.

E. Jacketing:
   1. ITW Insulation Systems
   2. Or equal.

F. Accessories:
   1. ITW Insulation Systems
   2. Or equal.

G. Duct Insulation Accessories:
   1. Certainteed
   2. Johns Manville
   3. Owens-Corning
   4. Or equal.

H. Duct Insulation Compounds:
   1. Certainteed
   2. Johns Manville
   3. Owens-Corning
   4. Or equal.

2.2 TYPE A, FLEXIBLE GLASS WOOL BLANKET

A. ASTM C553, Type 1, Class B-2; flexible blanket.

B. 'K' Value: 0.27 BTU*in/(hr*sf*F) at 75 degrees F installed, maximum service temperature: 250 degrees F.

C. Density: 0.75 pounds per cubic foot.

D. Vapor Barrier Jacket: FSK aluminum foil reinforced with glass wool yarn and laminated to fire resistant Kraft, secured with UL listed pressure sensitive tape or outward clinched expanded staples and vapor barrier mastic as needed.

E. DBDE-free. UL/E validated to be formaldehyde-free.
2.3 TYPE B, DUCT LINER

A. ASTM C1071; flexible blanket.

B. 'K' Value: ASTM C518, 0.25 BTU*in/(hr*sf*F) at 75 degrees F, maximum service temperature: 250 degrees F.

C. Noise Reduction Coefficient: 0.65 or higher based on ASTM C 423 "Type A mounting."

D. Maximum Velocity on Mat or Coated Air Side: 5,000 FPM.

E. Adhesive: UL listed waterproof type.

F. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.


H. ASTM G21 and ASTM G22 Microbial Growth Resistance.

I. UL GREENGUARD Certified does not support the growth of mold, fungi, or bacteria per ASTM C 1338 and meets UL Environment GREENGUARD Microbial Resistance Listing per UL 2824-“GREENGUARD Certification Program Method for Measuring Microbial Resistance”. DBDE-free. UL/E validated to be formaldehyde-free.

2.4 TYPE 1, GLASS WOOL PIPE INSULATION

A. Glass Wool: ASTM C547 Type I and IV; rigid molded, noncombustible.
   1. Thermal Conductivity Value: As indicated in the insulation tables below.
   2. Maximum Service Temperature: 850 degrees F to 1000 degrees F.
   3. Vapor Retarder Jacket: White Kraft paper reinforced with glass wool and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips or vapor barrier mastic.

2.5 TYPE 2, FLEXIBLE ELASTOMERIC PIPE INSULATION

A. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
   1. Thermal Conductivity Value: As indicated in the insulation tables below.
   2. Maximum Service Temperature of 220 degrees F.
   4. Maximum Smoke Developed: 50 (1-inch thick and below).
   5. Connection: Waterproof vapor retarder adhesive as needed.
   6. UV Protection: UV outdoor protective coating per manufacturer's requirements.

B. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam. Armacell LLC Armaflex Low VOC adhesive, Halstead, or equal.

C. Paint: Nonhardening high elasticity type, specifically manufactured as protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather. Armacell LLC Armaflex, Halstead, or equal.
2.6 JACKETING

A. Canvas Jacket: UL listed fabric, 6 ounce/sq. yd., plain weave cotton treated with dilute fire retardant lagging adhesive.

B. PVC preformed molded insulation covers. Zeston or equal.

C. Aluminum Jacket: 0.016-inch-thick sheet, (smooth/embossed) finish, with longitudinal slip joints and 2-inch laps, die-shaped fitting covers with factory attached protective liner.

D. Stainless Steel Jacket: Type 304 stainless steel, 0.010-inch, smooth finish.

2.7 ACCESSORIES

A. Equipment Insulation Jacketing: Presized glass cloth, not less than 7.8 ounces/sq.yd., except as otherwise indicated. Coat with gypsum based cement.

B. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

C. General: Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories, i.e., adhesives, mastics, cements and tape to have the same flame and smoke component ratings as the insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide nonwater soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

2.8 DUCT INSULATION ACCESSORIES

A. Staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

2.9 DUCT INSULATION COMPOUNDS

A. Cements, adhesives, coatings, sealers, protective finishes and similar accessories as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Verification of Conditions:
   1. Do not apply insulation until pressure testing and inspection of ducts and piping has been completed.
   2. Examine areas and conditions under which duct and pipe insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Preparation: Clean and dry surfaces to be insulated.
C. Installation:
   1. Insulation: Continuous through walls, floors and partitions except where noted otherwise.
   2. Piping and Equipment:
      a. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.
      b. Cover insulation on pipes above ground, outside of building, with aluminum jacketing. Position seam on bottom of pipe.

D. Provide accessories as required. See Part 2 Article "Accessories" above.

E. Protection and Replacement: Installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

F. Glass Wool Insulation:
   1. Lap seal insulation with waterproof adhesive. Do not use staples or other methods of attachment which would penetrate the vapor barrier. Apply fitting covers with seated tacks and vapor barrier tape.
   2. Apply insulation to pipe and seal with self-sealing lap. Use self-sealing butt strips to seal butt joints. Insulate fittings, valves and unions with single or multiple layers of insulation and cover to match pipe or use performed PVC molded insulation covers.

G. Labeling and Marking: Provide labels, arrows and color on piping and ductwork. Attach labels and flow direction arrows to the jacketing per Section 23 05 53, Identification for HVAC Piping, Ductwork and Equipment.

H. Ductwork:
   1. Install insulation in conformance with manufacturer's recommendations to completely cover duct.
   2. Butt insulation joints firmly together and install jackets and tapes smoothly and securely.
   3. Apply duct insulation continuously through sleeves and prepared openings, except as otherwise specified. Apply vapor barrier materials to form complete unbroken vapor seal over insulation.
   4. Coat staples and seals with vapor barrier coating.
   5. Cover breaks in jacket materials with patches of same material as vapor barrier. Extend patches not less than 2-inches beyond break or penetration on all directions and secure with adhesive and staples. Seal staples and joints with vapor barrier coating.
   6. Fill jacket penetrations. i.e., hangers, thermometers and damper operating rods, and other voids in insulation with vapor barrier coating. Seal penetration with vapor barrier coating. Insulate Hangers and Supports for cold duct in un-conditioned spaces to extent to prevent condensation on surfaces.
   7. Seal and flash insulation terminations and pin punctures with reinforced vapor barrier coating.
8. Continue insulation at fire dampers and fire/smoke dampers up to and including those portions of damper frame visible at outside of the rated fire barrier. Insulating terminations at fire dampers in accordance with this Section.

9. Do not conceal duct access doors with insulation. Install insulation terminations at access door in accordance with this Section.

I. Insulated Pipe Exposed to Weather: Where piping is exposed to weather, cover insulation with aluminum jacket. Seal watertight jacket per manufacturer's recommendations. Install metal jacket with 2-inch overlap at longitudinal and butt joints with exposed lap pointing down. Secure jacket with stainless-steel draw bands 12-inches on center and at butt joints.

J. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 2-inches and larger for steam and chilled water piping.

K. Ductwork Surfaces to be Insulated:

<table>
<thead>
<tr>
<th>Item to be Insulated</th>
<th>System Insulation Type</th>
<th>Duct Size</th>
<th>Insulation Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply ductwork where duct is not specified to be lined.</td>
<td>A</td>
<td>All</td>
<td>1-1/2-inch</td>
</tr>
<tr>
<td>Return ductwork where duct is not specified to be lined or where ductboard is not utilized.</td>
<td>--</td>
<td>All</td>
<td>None</td>
</tr>
<tr>
<td>Supply ductwork (exposed to weather, in crawl space and in unheated attics)</td>
<td>A</td>
<td>All</td>
<td>3-inch</td>
</tr>
<tr>
<td>Return ductwork (exposed to weather, in crawl space and in unheated attics)</td>
<td>A</td>
<td>All</td>
<td>3-inch</td>
</tr>
<tr>
<td>Outside Air Ducts</td>
<td>A</td>
<td>All</td>
<td>3-inch</td>
</tr>
<tr>
<td>HVAC plenums and unit housings not preinsulated</td>
<td>B</td>
<td>All</td>
<td>1-1/2-inch</td>
</tr>
</tbody>
</table>

1. Note: Insulation thickness shown is a minimum. If state codes require additional thickness, then provide insulation thickness per code requirements.

L. Piping Surfaces to be Insulated:
<table>
<thead>
<tr>
<th>Item to be Insulated</th>
<th>System Insulation Type</th>
<th>Conductivity Range (Btu-inch per hour per SF per degrees F)</th>
<th>Pipe Size (inches)</th>
<th>Insulation Thickness (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating, Steam, and Condensate (201F to 250F)</td>
<td>1,4</td>
<td>0.27-0.30 at a mean rating temperature of 150 degrees F</td>
<td>&lt;1</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 to &lt;1.5</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.5 to &lt;4</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 to &lt;8</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;= 8</td>
<td>3.0</td>
</tr>
<tr>
<td>Heating, Steam, and Steam Condensate (141F to 200F)</td>
<td>1,4</td>
<td>0.25-0.29 at a mean rating temperature of 125 degrees F</td>
<td>&lt;1</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 to &lt;1.5</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.5 to &lt;4</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 to &lt;8</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;= 8</td>
<td>2.0</td>
</tr>
<tr>
<td>Heating, Steam, and Steam Condensate (105F to 140F)</td>
<td>1,4</td>
<td>0.22-0.28 at a mean rating temperature of 100 degrees F</td>
<td>&lt;1</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 to &lt;1.5</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.5 to &lt;4</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 to &lt;8</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;= 8</td>
<td>1.5</td>
</tr>
<tr>
<td>Chilled Water (40F to 60F)</td>
<td>1,4</td>
<td>0.21-0.27 at a mean rating temperature of 75 degrees F</td>
<td>&lt;1</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 to &lt;1.5</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.5 to &lt;4</td>
<td>1.0</td>
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<td></td>
<td></td>
<td></td>
<td>4 to &lt;8</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;= 8</td>
<td>1.0</td>
</tr>
<tr>
<td>Chilled Water (&lt;40F)</td>
<td>1.4</td>
<td>0.20-0.26 at a mean rating temperature of 50 degrees F</td>
<td>&lt;1</td>
<td>0.5</td>
</tr>
<tr>
<td>----------------------</td>
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<td>--------------------------------------------------------</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>1 to &lt;1.5</td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.5 to &lt;4</td>
<td></td>
<td>1.0</td>
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<tr>
<td></td>
<td></td>
<td>4 to &lt;8</td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;= 8</td>
<td></td>
<td>1.0</td>
</tr>
</tbody>
</table>

1. Note: Insulation thickness shown is a minimum. If state code requires additional thickness, then provide insulation thickness per code requirements.

3.2 **TYPE A, FLEXIBLE GLASS WOOL BLANKET**

A. Install insulation in conformance with manufacturer's recommendations and requirements.

B. Duct Wrap: Cover air ducts per insulation table except ducts internally lined where internal duct lining is adequate to achieve adequate insulating values to meet local Energy Codes (indicate on shop drawings, locations where duct wrap is planned to be omitted and indicate internal duct lining insulating values to confirm they will meet the Energy Code.) Wrap tightly with circumferential joints butted and longitudinal joints overlapped minimum of 2-inches. On ducts over 24-inches wide, additionally secure insulation with suitable mechanical fasteners at 18-inches on center. Circumferential and longitudinal joints stapled with flare staples 6-inches on center and covered with 3-inch wide, foil reinforced tape.

3.3 **TYPE B, DUCT LINER**

A. Install insulation in conformance with manufacturer's recommendations and requirements.

B. Duct Liners: Mat finish surface on air stream side. Secure insulation to cleaned sheet metal duct with continuous (minimum 90) percent coat of adhesive. Secure liner with mechanical fasteners 15-inches on center or per manufacturer requirements. Accurately cut liner and thoroughly coat ends with adhesive. Butt joints tightly. Top and bottom Sections of insulation overlap sides. Factory/field coat exposed edges. Metal nosing for exposed leading or transverse edges and when velocity exceeds 3500 FPM or manufacturer rating on exposed edges. Keep duct liner clean and free from dust. At completion of project, vacuum duct liner if it is dirty or dusty. Do not use small pieces. If insulation is installed without horizontal, longitudinal, and end joints butted together, installation will be rejected and work removed and replaced with work that conforms to this Specification.

3.4 **TYPE 1, GLASS WOOL PIPE INSULATION**

A. Install insulation in conformance with manufacturer's recommendations and requirements.

B. See General Installation Requirements above.

C. Lap seal insulation with waterproof adhesive. Do not use staples or other methods of attachment which would penetrate vapor barrier. Apply fitting covers with seated tacks and vapor barrier tape.
D. Apply insulation to pipe and seal with self-sealing lap. Use self-sealing butt strips to seal butt joints. Insulate fittings, valves and unions with single or multiple layers of insulation and cover to match pipe or use preformed PVC molded insulation covers.

E. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 2-inches and larger (hot and cold piping).

3.5 TYPE 2, FLEXIBLE ELASTOMERIC PIPE INSULATION

A. Flexible Elastomeric Insulation:
   1. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and below grade with two coats of finish as recommended by manufacturer.

B. Flexible Elastomeric Tubing:
   1. Flexible Elastomeric Tubing: Slip insulation over piping or, if piping is already installed, slit insulation and snap over piping. Joints and butt ends must be adhered with 520 adhesive.

C. Install insulation in conformance with manufacturer's recommendations and requirements.

D. See General Installation Requirements above.

E. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and undergrade with two coats of finish as recommended by manufacturer.

F. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 2-inches and larger (hot and cold piping).

G. Install in accordance with manufacturer's instructions for below grade installation.

3.6 JACKETING

A. See General Installation Requirements above.

B. Install in accordance with manufacturer's instructions.

3.7 ACCESSORIES

A. Install insulation in conformance with manufacturer's instructions, recommendations and requirements.

B. See General Installation Requirements above.

C. Provide and install accessories for all insulation types listed in this Section.
3.8  DUCT INSULATION ACCESSORIES
   A. Install insulation in conformance with manufacturer's recommendations and requirements.

3.9  DUCT INSULATION COMPOUNDS
   A. Install insulation in conformance with manufacturer's recommendations and requirements.

END OF SECTION
SECTION 23 08 00

COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Definitions, warranties, test equipment requirements, and mechanical commissioning requirements.

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Certificates of readiness.
   2. Certificates of completion of installation, prestart, and startup activities.
   3. Operation and Maintenance Manuals.
   4. Test reports.
   5. Control Drawings Submittal
      a. Provide a key to abbreviations.
      b. Provide graphic schematic depictions of the systems and each component.
      c. Include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
      d. Provide a full points list with at least the following included for each point:
         1) Controlled system
         2) Point abbreviation
         3) Point description
         4) Display unit
         5) Control point or set point (Yes / No)
         6) Monitoring point (Yes / No)
         7) Intermediate point (Yes / No)
         8) Calculated point (Yes / No)
6. Architect forwards one set of submittals for systems to be commissioned to Commissioning Agent at same time as design team.
7. Commissioning Agent forwards comments to design team for consideration in their submittal response.
8. Design team sends consolidated response to submittals and copies to Commissioning Agent.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to Commissioning Authority upon request.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Commissioning, inspecting, and testing will not modify terms or time periods of mechanical equipment, systems, and controls warranties including related equipment and systems, and adjacent work.
   2. Control system warranty period starts from date of Commissioning Agent acceptance.

1.7 COORDINATION

1.8 PURPOSE

A. Purpose of commissioning process is to provide Owner assurance that systems have been installed in prescribed manner and will operate within performance guidelines. Commissioning is intended to enhance quality of system startup and aid in orderly transfer of systems to beneficial use by Owner.

B. Commissioning procedures and results will be observed by Commissioning Authority or Owner's staff. Contractor is expected to verify functional readiness of systems to be tested prior to performing the tests in presence of Owner's witness. A high rate of test failure will indicate that Contractor has not adequately verified readiness of systems.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Provide standard testing equipment required to perform startup, initial checkout and functional performance testing for the equipment being tested. For example, the mechanical contractor of Division 23, HVAC will ultimately be responsible for standard testing equipment for the HVAC&R system and controls system in Division 23, HVAC, except for the equipment
specific to and used by TAB in their commissioning responsibilities. Provide a sufficient quantity of two-way radios by each subcontractor.

B. Include special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing in the base bid price to the Owner and leave on site, except for stand-alone data logging equipment that may be used by the Commissioning Authority.

C. Manufacturer of equipment to provide proprietary test equipment and software required for programming and/or start-up, whether specified or not. Manufacturer provides the test equipment, demonstrates its use, and assists in the commissioning process as needed. Proprietary test equipment (and software) become the property of the Owner upon completion of the commissioning process.

D. Data logging equipment and software required to test equipment will be provided by the Commissioning Authority, and will not become the property of the Owner.

E. Use only testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers have a certified calibration within the past year to an accuracy of 0.5 degree F and a resolution of plus or minus 0.1 degree F. Pressure sensors have an accuracy of plus or minus 2.0 percent of the value range being measured (not full range of meter) and have been calibrated within the last year.

PART 3 - EXECUTION

3.1 GENERAL DOCUMENTATION REQUIREMENTS

A. With assistance from the installing contractors, the Commissioning Authority will prepare prefunctional checklists for commissioned components, equipment, and systems.

B. Red-Lined Drawings:
   1. Verify equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings.
   2. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing.
   3. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings.
   4. The contracted party, as defined in the Contract Documents will create the as-built drawings.

C. Operation and Maintenance (O&M) Data:
   1. Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for commissioned equipment and systems.
   2. The Commissioning Authority will review the O&M literature once for conformance to project requirements.
   3. The Commissioning Authority will receive a copy of the final approved O&M literature once corrections have been made by the Contractor.
D. Demonstration and Training:
1. Contractor will provide demonstration and training as required by the specifications.
2. A complete training plan and schedule must be submitted by the contractor to the Commissioning Authority four weeks prior to any training.
3. A training agenda for each training session must be submitted to the Commissioning Authority one week prior the training session.
4. Notify the Commissioning Authority at least 72 hours in advance of scheduled tests so that testing may be observed by the Commissioning Authority and Owner's representative. Provide a copy of the test record to the Commissioning Authority, Owner, and Architect.
5. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specific equipment.
6. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, trouble shooting, servicing, and maintaining equipment.
7. Review data in O&M Manuals.

E. Systems Manual Requirements:
1. The Systems Manual is intended to be a usable information resource containing the information related to the systems, assemblies, and Commissioning Process in one place with indexes and cross references.
2. Include final approved versions of the following information for the Systems Manual:
   a. Facility Description.
   c. A list of contractors, subcontractors, suppliers, architects, and engineers involved in the project along with their contact information.
   d. Overview of each commissioned system including operational schedules and sequence of operations.
   e. General maintenance recommendations and procedures.
   f. Recommendations for recalibration frequency of sensors and actuators.
   g. Recommended best practices for keeping the system running efficiently.
   h. Blank Functional Performance Tests so the Owner can recommission the facility at a later date.
3. Organize and arrange information by building system, such as fire alarm, chilled water, heating hot water, etc.
4. Provide Information in an electronic version to the extent possible. Legible, scanned images are acceptable for non-electronic documentation to facilitate this deliverable.

3.2 CONTRACTOR'S RESPONSIBILITIES

A. Mechanical, Controls and TAB Contractors. The commissioning responsibilities applicable to each of the mechanical, controls and TAB contractors of Division 23, HVAC are as follows (references apply to commissioned equipment only):
1. Perform commissioning tests at the direction of the Commissioning Authority.
2. Attend construction phase controls coordination meetings.
3. Attend testing, adjusting, and balancing review and coordination meetings.
4. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the Commissioning Authority.
5. Provide information requested by the Commissioning Authority for final commissioning documentation.
6. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or subcontract written.
7. Prepare preliminary schedule for mechanical system orientations and inspections, operation and maintenance manual submissions, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, testing and balancing and task completion for owner. Distribute preliminary schedule to commissioning team members.
8. Update schedule as required throughout the construction period.
9. During the startup and initial checkout process, execute the related portions of the prefunctional checklists for commissioned equipment.
10. Contractor to participate and complete checklists using the Commissioning Authority's web based commissioning software Facility Grid. A desktop, laptop, tablet, or iPad will be required.
11. Assist the Commissioning Authority in verification and functional performance tests.
12. Gather operation and maintenance literature on equipment, and assemble in binders as required by the specifications. Submit to Commissioning Authority 45 days after submittal acceptance.

B. Coordinate with the Commissioning Authority to provide 48 hour advance notice so that the witnessing of equipment and system start-up and testing can begin.

C. Notify the Commissioning Authority a minimum of two weeks in advance of the time for start of the testing and balancing work. Attend the initial testing and balancing meeting for review of the official testing and balancing procedures.

D. Participate in, and schedule vendors and contractors to participate in the training sessions.

E. Provide written notification to the Construction Manager/General Contractor (CM/GC) and Commissioning Authority that the following work has been completed in accordance with the Contract Documents, and that the equipment, systems, and sub-system are operating as required.
   1. HVAC&R equipment including fans, air handling units, ductwork, dampers, terminals, and other equipment furnished under this Division.
   2. Fire stopping in the fire rated construction, including fire and smoke damper installation, caulking, gasketing and sealing of smoke barriers.
   3. Fire detection and smoke detection devices furnished under other divisions of the specification.

F. Equipment supplier to document the performance of his equipment.

G. Test, Adjust and Balance Contractor:
   1. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
   2. Participate in verification of the testing and balancing report, which will consist of repeating measurements contained in the testing and balancing reports. Assist in diagnostic purposes when directed.

H. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
I. Equipment Suppliers:
   1. Provide requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner, to keep warranties in force.
   2. Assist in equipment testing per agreements with contractors.
   3. Provide information requested by Commissioning Authority regarding equipment sequence of operation and testing procedures.

3.3 TESTING PREPARATION

A. Certify in writing to the Commissioning Authority that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify in writing to the Commissioning Authority that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify in writing that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the Commissioning Authority.

3.4 TESTING, ADJUSTING AND BALANCING VERIFICATION

A. Prior to performance of Testing, Adjusting and Balancing work, provide copies of reports, sample forms, checklists, and certificates to the Commissioning Authority.

B. Notify the Commissioning Authority at least 10 days in advance of testing and balancing Work, and provide access for the Commissioning Authority to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the Commissioning Authority.
   1. The Commissioning Authority will notify testing and balancing subcontractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
   2. Testing and balancing subcontractor to use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes, other than sound, a deviation of more than 10 percent.
Failure of more than 10 percent of selected items to result in rejection of final testing,
adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB to
result in rejection of final testing. Variations in background noise must be considered.
4. Remedy the deficiency and notify the Commissioning Authority so verification of failed
portions can be performed.

3.5 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction
of the Commissioning Authority.

B. Scope of HVAC&R testing to include entire HVAC&R installation, from central equipment
for heat generation and refrigeration through distribution systems to each conditioned space.
Testing to include measuring capacities and effectiveness of operational and control functions.

C. Test operating modes, interlocks, control responses, and responses to abnormal or emergency
conditions, and verify proper response of building automation system controllers and sensors.

D. The Commissioning Authority along with the HVAC&R contractor, testing and balancing
Subcontractor, and HVAC&R Instrumentation and Control Subcontractor to prepare detailed
testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to
test under design conditions. Before simulating conditions, calibrate testing instruments.
Provide equipment to simulate loads. Set simulated conditions as directed by the
Commissioning Authority and document simulated conditions and methods of simulation.
After tests, return settings to normal operating conditions.

G. The Commissioning Authority may direct that set points be altered when simulating conditions
is not practical.

H. The Commissioning Authority may direct that sensor values be altered with a signal generator
when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R
system, document the deficiency and report it to the Owner. After deficiencies are resolved,
reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance
tests and documentation and schedule seasonal tests.

3.6 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in
individual Division 23, HVAC Sections. Provide submittals, test data, inspector record, and
certifications to the Commissioning Authority.
B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23, HVAC Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Assist the Commissioning Authority with preparation of testing plans.

C. Pipe System Cleaning, Flushing, Hydrostatic Tests, and Chemical Treatment: Test requirements are specified in Division 23, HVAC Piping Sections. HVAC&R Contractor to prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the Commissioning Authority. Plan to include the following:
   1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Provide drawings keyed to pipe zones or sectors formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
   2. Description of equipment for flushing operations.
   4. Tracking checklist for managing and ensuring that pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of components, systems and sub-systems. Evaluate the following equipment and systems:
   1. HVAC Equipment and Systems (all)
   2. Building Automation System
   3. Pumps
   4. VFDs

3.7 DEFICIENCIES/NONCONFORMANCE, COST OF RETESTING, FAILURE DUE TO MANUFACTURER DEFECT

A. Reference Division 01, General Requirements for requirements pertaining to deficiencies/nonconformance, cost of retesting, or failure due to manufacturer defect.

3.8 OPERATION AND MAINTENANCE MANUALS

A. The Operation and Maintenance Manuals to conform to Contract Documents requirements as stated in Division 23, HVAC.

B. Provide an updated as-built version of the control drawings and sequences of operation in the final controls O&M manual submittal.

3.9 TRAINING OF OWNER PERSONNEL

A. Mechanical Contractor's Training Responsibilities:
   1. Provide the Commissioning Authority with a training plan two weeks before the planned training.
2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, HVAC equipment (i.e., pumps, heat exchangers, chillers, heat rejection equipment, air conditioning units, air handling units, fans, terminal units, controls and water treatment systems, etc.).

3. Training starts with classroom sessions followed by hands-on training on each piece of equipment to illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.

4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

5. The appropriate trade or manufacturer's representative provides the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

6. Controls contractor to attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

7. The training sessions follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

8. Training includes:
   a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
   b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. Training to include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
   c. Discussion of relevant health and safety issues and concerns.
   d. Discussion of warranties and guarantees.
   e. Common troubleshooting problems and solutions.
   f. Explanatory information included in the O&M manuals and the location of plans and manuals in the facility.
   g. Discussion of any peculiarities of equipment installation or operation.

9. Schedule training after functional testing is complete, unless approved otherwise by the Owner.

B. Controls Contractor's Training Responsibilities:
   1. Provide the Commissioning Authority and A/E with a training plan four weeks before the planned training.
   2. Provide designated Owner personnel training on the control system in this facility. The intent is to clearly and completely instruct the Owner on the capabilities of the control system.
   3. Training manuals. The standard operating manual for the system and any special training manuals will be provided for each trainee, with three extra copies left for the O&M manuals. In addition, copies of the system technical manual will be demonstrated during training and three copies submitted with the O&M manuals. Manuals include detailed
description of the subject matter for each session. Manuals to cover control sequences and have a definitions section that fully describes relevant words used in the manuals and in software displays. Manuals will be approved by the Commissioning Authority and A/E. Deliver copies of audiovisuals to the Owner.

4. The trainings will be tailored to the needs and skill-level of the trainees.

5. The trainers will be knowledgeable on the system and its use in buildings. For the on-site sessions, the most qualified trainer(s) will be used. Owner to approve the instructor prior to scheduling the training.

6. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

7. Attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

8. Three Training Sessions, as Follows:
   a. Training I - Control System. The first training consists of eight hours of actual training. This training may be held on-site or in the supplier's facility. If held off-site, the training may occur prior to final completion of the system installation. Upon completion, each student, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
   b. Training II - Building Systems. The second session held on-site for a period of eight hours of actual hands-on training after the completion of system commissioning. The session includes instruction on:
      1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system, including HVAC systems, lighting controls and any interface with security and communication systems.
      2) Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing set points and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
      3) Trending and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will actually set-up trends in the presence of the trainer.
      4) Completely discuss every screen, allowing time for questions.
      5) Use of keypad or plug-in laptop computer at the zone level.
      6) Use of remote access to the system via phone lines or networks.
      7) Setting up and changing an air terminal unit controller.
      8) Graphics generation.
      9) Point database entry and modifications.
     10) Understanding DDC field panel operating programming (when applicable).
c. Training III - The third training will be conducted on-site six months after occupancy and consist of eight hours of training. The session will be structured to address specific topics that trainees need to discuss and to answer questions concerning operation of the system.

END OF SECTION
SECTION 23 09 00

INSTRUMENTATION AND CONTROL PERFORMANCE SPECIFICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Communications
   2. Operator Interface
   3. Controller Software
   4. Web Based Access
   5. BAS Graphics
   6. Building Controllers
   7. Application Specific Controllers
   8. Application Specific Controller - Terminal Unit Controllers
   9. Input/Output Interface
   10. Power Supplies and Line Filtering
   11. Control Panels
   12. Auxiliary Control Devices
   13. Wiring and Raceways
   14. Smoke Detection for Projects with a Building Fire Alarm System

B. This is a performance specification and Contractor is responsible for design tasks and engineering.

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   2. Current edition of UL 916 Underwriters Laboratories Standard for Energy Management Equipment, Canada and the US.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
1. Prepare and submit a detailed schedule of work. Schedule to identify milestones such as equipment submittals, control panel diagrams, color graphic panel displays, Interlock.

2. Wiring diagrams, control program sequence, software flow chart diagrams, conduit layout diagrams, device location diagrams, equipment and component deliveries, installation sequencing, controller startup, point to point startup, control programming, sequence testing, commissioning/acceptance testing and training.

3. Submit design drawings, sequences of operation, program listings, software flow charts and details for each typical piece of equipment and system being controlled. No work to be initiated or fabrication of any equipment started prior to the Owner's Representatives return of REVIEWED submittals.
   a. Sequence of Operation: The sequence of operation included in the design documents is intended only to communicate the Engineers’ general control intent and is not to be used as a direct reference for programming of the EMS system. Verbatim duplication of the Engineer’s Sequence of Operation on the submittals is discouraged and may result in non-approval of the submittal. Sequence of operation on submittals to accurately detail the system's intended programming, and include details of enhancements, adjustments, or deviations from the Engineer's sequence of operation. Submitted sequence of operation to be written with a logical and organized format and flow. Provide detailed, clear and unambiguous sequence of operation language. Point descriptors and point nomenclature referenced in the submitted sequence of operation to match those (to be) actually programmed. As-built submittal Sequence of Operation to include modifications to the programming made as a result of any addendum, bulletins, RFI's, change orders, and commissioning.

4. Format: Make each submittal in one complete and contiguous package. Partial or unmarked submittals will be rejected without review.

5. Submit Manufacturers Data as follows:
   a. Complete materials list of items proposed to be furnished and installed. A complete Bill of Materials, listing materials, components, devices, wire and equipment are required for this work. The Bill of Materials to be separate for each controller on its own page(s) and to contain the following information for each item listed:
      1) Manufacturer's Name and Model number with furnished options highlighted.
      2) Quantity of each by controller location.
      3) Description of product (generic).
      4) Specified item.
      5) Operating range or span.
      6) Operating point or setpoint.
   b. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements, including but not limited to: Catalog cuts, technical data and descriptive literature on hardware, software, and system components to be furnished.
   c. The data to be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data. Submit printed manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials and including printed installation instructions and start-up instructions.
   d. Unless specifically called for otherwise, provide bound copies of catalog cuts for standard products, not requiring specifically prepared Shop Drawings, for the following:
1) Wire and Cable, Class II
2) Face Plates for Devices
3) Disconnect Switches for Power Control

e. Where more than one item, size, rating or other variations appear on a catalog cut sheet, clearly identify items to be provided. These items to be properly indexed and referenced to identification numbers, designations and/or details on the Drawings.

6. Shop Drawings: Submit shop drawings for each controlled system, depicting the following information:
   a. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves and other control/monitoring devices.
   b. Label each control device with initial setting or adjustable range of control. Label points in schematic diagrams with termination at corresponding controller.
   c. Electrical Wiring: Clearly differentiate between portions of wiring that are factory installed and portions of be field-installed.
   d. Details of control panel faces, including controls, instruments, and labeling.
   e. Interfaces to control panel faces, including under other Specification Sections identifying numbers of wires, termination location, voltages and pertinent details. Responsibility for each end of the interfaces to be noted on these drawings whether or not they are a part of this Section.
   f. System architecture diagram showing the global connectivity of new controllers and any existing systems that will be connected to.

7. Equipment locations, wiring and piping schematics, details, panel configurations, sizes, damper motor mounting details, and a points list keyed to specific hardware submittals. Control wiring depicted as fully annotated ladder diagrams with terminations identified, completely configured as to the exact panel, wiring, relay, switch, and component configuration.

8. Tag Number Lists: Develop instruments tag number system and submit list for approval. Coordinate methods and number block with the Owner Representative.

9. Format the Shop and Field Drawings to Include:
   a. A Title Sheet containing a drawing list, abbreviations list, symbols list, site and vicinity maps for project location and schedules.
   b. Floor Plans showing proposed device locations and device nomenclatures.
   c. A Riser Diagram illustrating conduit relationships between devices shown on the Floor Plans. Show device nomenclatures.
   d. A Single-Line Diagram for each system showing signal relationships of devices within the system. Show device nomenclatures.
   e. A Wiring Diagram for each assembly, enclosure or free standing device, showing:
      1) The Devices Within
      2) Wiring Connections
      3) Wire Identification
      4) Voltage Levels
      5) Fuse Ratings
   f. Operations and Maintenance Manuals:
      1) Following approval of Shop Drawings of control equipment and prior to acceptance of control work, prepare Operating and Maintenance manuals describing operating, servicing, and maintenance requirements of control systems and equipment installed under this Section, in accordance the General and Special Conditions of these Specifications.
2) Information contained in the manual for the above equipment to include the following:
   a) Manufacturer's catalog cuts and printed descriptive bulletins.
   b) Manufacturer's installation, operating, and maintenance instruction booklets. Complete instructions regarding the operation and maintenance of equipment involved.
   c) Instrument calibration certificates.
   d) Parts list and costs.
   e) Complete nomenclature of replaceable parts, list of recommended spare parts for 12 months operation, their part numbers, current cost and name and address of the nearest vendor of replacement parts.
   f) Name, address and telephone number for closest source of spare parts.
   g) Wiring and schematic diagrams.
   h) Include final record copies of shop drawings.
   i) Copy of guarantees and warranties issued for the various items of equipment, showing dates of expiration.
   j) Reduced plans, diagrams, and control schematics.
   k) Copies of test results.
   l) Control System Operating Manual including: point of summary and point data base; complete printout of program listings; magnetic tape CD or DVD backup of Field Control Cabinet programs; cabinet layout; hard copy of graphic screens; hard copy of specified reports.

   g. A final Bill of Quantities including a separate schedule for portable equipment, if delivered as part of this work.
   h. Performance, Test and Adjustment Data: Comprehensive documentation of performance verification according to parameters specified in these specifications.
   i. Record Drawings: Comply with Division 01, General Requirements and Section 23 00 00, HVAC Basic Requirements. Provide complete as-built submittals including "as-programmed" sequence of operation as well as final occupancy schedules. Controls submittal to be graphics submittal (GUI) clearly showing adjustable set points.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Installer Qualifications: Company specializing in performing work of the type specified in this Section with minimum five years' experience in the local area. Installers required to have successfully completed manufacturer's control system factory training.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
1.7 SYSTEM DESCRIPTION

A. Control system referenced throughout specifications and drawings as Building Automation System (BAS), Building Management System (BMS), or Energy Management System (EMS) interchangeably consists of high-speed, peer-to-peer network of DDC controllers, control system server, and operator workstation.

B. System software based on server/thin-client architecture, designed around open standards of web technology. Control system server accessed using a web browser over control system network, Owner’s local area network, and remotely over Internet (through Owner’s LAN). Intent of thin-client architecture is to provide operators complete access to control system via web browser. No special software other than web browser required to access graphics, point displays, and trends.

C. Local Area Network (LAN) either 10 or 100 Mbps Ethernet network.

D. System will consist of open architecture that is capable of:
   1. High speed Ethernet communication using TCP/IP protocol.
   2. Native BACnet communications according to ANSI / ASHRAE Standard 135, latest edition. Provide necessary BACnet-compliant hardware and software to meet the system’s functional specifications. Controller devices must be BTL tested and listed by an official BACnet Testing Laboratory and have the BTL mark issued.

E. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation valves and dampers.

F. Prepare individual hardware layouts, interconnection drawings, building riser/architecture diagram and sequence of control from the project design data. Any architecture diagrams on design drawings have been included as schematics only and are not meant to portray quantity of devices or power/data requirements.

G. Design, provide, and install equipment cabinets, panels, data communication network infrastructure (including cables, conduits, outlets, connections, etc.) needed, and associated hardware.

H. Provide complete manufacturer's specifications for items that are supplied. Include vendor name and model number of every item supplied.

I. Provide a comprehensive operator and technician training program as described in these Specifications.

J. Provide as-built documentation, operator's terminal software, diagrams, and other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.

K. Provide 120V power, low voltage power, transformers, etc. for control panels, transformer panels, and BAS devices. Install per Division 26, Electrical Specifications. Power for devices within this Specification Section is solely the responsibility of the BAS Contractor.

L. Conduit and raceway systems. Provide per Division 26, Electrical Specifications.
M. Devices, components, controllers, and software to be manufacturer's most current version at the
time of installation.

1.8 SYSTEM PERFORMANCE

A. Performance Standards - System conforms to following minimum standards over network
connections:
1. Graphic Display: Graphic with 20 dynamic points display with current data within 10
seconds.
2. Graphic Refresh: Graphic with 20 dynamic points update with current data within 8
seconds.
3. Object Command: Devices react to command of binary object within 2 seconds. Devices
begin reacting to command of analog object within 2 seconds.
4. Object Scan: Data used or displayed at controller or workstation have been current within
previous 6 seconds.
5. Alarm Response Time: Object that goes into alarm is annunciated at workstation within
45 seconds.
6. Program Execution Frequency: Custom and standard applications are capable of running
as often as once every 5 seconds. Select execution times consistent with mechanical
process under control.
7. Performance: Programmable controllers are able to completely execute DDC PID control
loops at frequency adjustable down to once per second. Select execution times consistent
with mechanical process under control.
8. Multiple Alarm Annunciation: Each workstation on network receive alarms within 5
seconds of other workstations.

B. Reporting Accuracy: System reports values with minimum end-to-end accuracy listed in
Reporting Accuracy Table below.
1. Reporting Accuracy Table:

<table>
<thead>
<tr>
<th>Measure Variable</th>
<th>Reported Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Temperature</td>
<td>Plus or Minus 1 degree F</td>
</tr>
<tr>
<td>Ducted Air</td>
<td>Plus or Minus 1 degrees F</td>
</tr>
<tr>
<td>Outside Air</td>
<td>Plus or Minus 2 degrees F</td>
</tr>
<tr>
<td>Dew Point</td>
<td>Plus or Minus 3 degrees F</td>
</tr>
<tr>
<td>Water Temperature</td>
<td>Plus or Minus 1 degree F</td>
</tr>
<tr>
<td>Delta-T</td>
<td>Plus or Minus 0.25 degree F</td>
</tr>
<tr>
<td>Water Flow</td>
<td>Plus or Minus 2 percent of full scale</td>
</tr>
</tbody>
</table>

2. Note 1: Accuracy applies to 10 percent-100 percent of scale
3. Note 2: For both absolute and differential pressure
4. Note 3: Not including utility-supplied meters

C. Control Stability and Accuracy. Control loops maintain measured variable at setpoint within
tolerances listed in Control Stability and Accuracy Table below.
1. Control Stability and Accuracy Table:

<table>
<thead>
<tr>
<th>Controlled Variable</th>
<th>Control Accuracy</th>
<th>Range of Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Pressure</td>
<td>Plus or minus 0.2 inch wg</td>
<td>0-6 inch wg</td>
</tr>
<tr>
<td></td>
<td>Plus or minus 0.01 inch wg</td>
<td>-0.1 to 0.1 inch wg</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Airflow</td>
<td>Plus or minus 10 percent of full scale</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space Temperature</td>
<td>Plus or minus 2.00 degrees F</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duct Temperature</td>
<td>Plus or minus 3.0 degrees F</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid Pressure</td>
<td>Plus or minus 1.0 inch wg</td>
<td>0-50 inch wg differential</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PART 2 - PRODUCTS

2.1 NORTHERN CALIFORNIA MANUFACTURERS/INSTALLERS

A. Andover (Schneider Electric)/Steven Engineering, EMCOR Mesa Energy, Alameda Electrical Distributors Inc, Graybar Electric Company Inc, Powermatic Associates

B. Duct/Spot-Type Smoke Detectors (Project with Fire Alarm System):
   1. See Division 28 for Products.

2.2 COMMUNICATIONS

A. Each controller to have communication port for connection to operator interface.
   1. Internetwork operator interface and value passing to be transparent to internetwork architecture.
   2. Operator interface connected to controller to allow operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, reports, system software, and custom programs to be viewable and editable from each internetwork controller.

B. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers to be readable by each controller on internetwork.

2.3 CONTROLLER SOFTWARE

A. Furnish following applications software for building and energy management. Software applications reside and operate in system controllers. Software to be manufacturer's most current version at the time of installation. Software and associated functions (scheduling, optimum start/stop, etc.) noted in this specification are to be configured and enabled for this project. Incorporate into sequence of operation submittals for review prior to installation.

B. System Security:
   1. User access secured using individual security passwords and user names.
   2. Restrict user passwords to objects, applications, and system functions as assigned by system manager. Provide monitoring only access to Engineer of Record and Commissioning Authority for period of one year for trouble shooting purposes.
   3. Record user Log On/Log Off attempts.
   4. Provide passwords, user names, and access assignments adjustable at the operator's terminal. Each user to have a set security level, which defines access to displays and individual objects the user may control. System to include 10 separate and distinct security levels for assignment to users.
5. System to include an Auto Logout Feature that will automatically logout user when there has been no keyboard or mouse activity for a set period of time. Time period to be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal to display message on screen that user is logged out after Auto Logout occurs.

C. Scheduling: Provide capability to schedule each object or group of objects in system. Coordinate schedule with Owner and program accordingly. Each schedule consists of:
   1. Operator's workstation to show information in easy-to-read daily format. Priority for scheduling: Events, holidays and daily with events being the highest.
   2. Holiday and special event schedules to display data in calendar format. Operator able to schedule holidays and special events directly from these calendars.
   3. Operator able to change information for a given weekly or exception schedule if logged on with the appropriate security access.

D. Optimum Start/Stop: Provide software and program system to start equipment on sliding schedule based upon indoor and outdoor conditions. Determine minimum time of HVAC system operation needed to satisfy space environmental requirements and also determine earliest possible time to stop mechanical systems (i.e. shut down cooling/heating and only provide ventilation one hour prior to scheduled unoccupied period.) Optimum start/stop program operates in conjunction with scheduled start/stop and night setback programs.

E. Alarms:
   1. Operator's workstation to provide visual means of alarm indication. The alarm dialog box to always become the top dialog box regardless of the application(s), currently running.
   2. System to provide log of alarm messages. Alarm log to be archived to the hard disk of the system operator's terminal. Each entry to include a description of the event-initiating object generating the alarm. Entry to include time and date of alarm occurrence.
   3. Alarm messages in user-definable text and entered either at the operator's terminal or via remote communication.
   4. Each binary object set to alarm based on operator-specified state.
   5. Each analog object have both high and low alarm limits.
   6. Alarms must be able to be automatically and manually disabled.
   7. Alarms are routed to appropriate workstations based on time and other conditions. An alarm is able to start programs, print, be logged in event log, generate custom messages, and display graphics.
   8. System have ability to dial out in event of alarm.
   9. Alarm Levels:
      a. Provide 5 levels of alarm as follows, and program alarm levels for every required and specified alarm:
         1) Level 1: Critical/life safety.
         2) Level 2: Significant equipment failure.
         3) Level 3: Non-critical equipment failure/operation.
         4) Level 4: Energy conservation monitor.
         5) Level 5: Maintenance indication, notification.
      b. Prior to training of Owner's representative, submit the complete Points List and suggested Alarm Levels to the Owner.
      c. During training of Owner's representative(s):
         1) Discuss Alarm Levels and the alarms currently included in the BAS.
2) Provide additional alarms without addition of new hardware points, as required by Owner’s Representative.
3) Agree with the Owner’s Representative on action(s) to be taken for each alarm level and implement same for each alarm. Said action to include visual and/or audible alarm(s) at the Operator workstation including whether Operator acknowledgement is required or not, email messages, and text messages.

F. Demand Limiting:
1. System to include demand limiting program that includes two types of load shedding. One type of load shedding to shed/restore equipment in binary fashion based on energy usage when compared to shed and restore settings. The other type of shedding to adjust operator selected control setpoints in an analog fashion based on energy usage when compared to shed and restore settings. Shedding may be implemented independently on each and every zone or piece of equipment connected to system.
2. Status of each and every load shed program capable of being displayed on every operator terminal connected to system. Status of each load assigned to an individual shed program displayed along with the description of each load.
3. Demand-limiting program monitor building power consumption from signals generated by pulse generator (provided by BAS contractor) mounted at building power meter or from watt transducer or current transformer attached to building feeder lines.
4. Demand-limiting program predicts probable power demand so that when demand exceeds demand limit, action will be taken to reduce loads in predetermined manner. When demand limit will not be exceeded, action will be taken to restore loads in predetermined manner.

G. Maintenance Management: System monitors equipment status and generate maintenance messages based upon user-designated run-time, starts, and/or calendar date limits. Coordinate settings with Owner.

H. Sequencing: Provide application software based upon sequences of operation specified to properly sequence designated systems. Provide points to achieve specified sequences.

I. Staggered Start: This application prevents controlled equipment from simultaneously restarting after a power outage. Order in which equipment (or groups of equipment) is started, along with time delay between starts to be user-selectable.

J. Energy Calculations: Provide software to allow instantaneous power (e.g. kW) or flow rates (e.g. L/s (gpm)) to be accumulated and converted to energy usage data.

K. Anti-Short Cycling: Binary output objects protected from short cycling by allowing minimum on-time and off-time to be selected.

L. On/Off Control with Differential: Provide algorithm that allows binary output to be cycled based on controlled variable and setpoint. Algorithm direct-acting or reverse-acting and incorporate adjustable differential.

M. Run-Time Totalization: Provide software to totalize run-times for binary input objects.
2.4 WEB BASED ACCESS

A. General Description: BAS supplier to provide web-based access to the system as part of standard installation. Provide access to user of displays of real-time data that are part of the BAS via a standard Web browser. Web browser to tie into the network via Ethernet network connection. Provide web-page host that resides on the BAS network. Web-page software not to require a per user licensing fee or annual fees. The web-page host must be able to support at least 50 simultaneous users with the ability to expand the system to accommodate an unlimited number of users. Software to be manufacturer’s most current version at time of installation.

B. Browser Technology: Browser to be standard version of Microsoft Internet Explorer (latest edition). No special vendor-supplied software needed on computers running browser. Displays viewable and the Web-page host to directly access real-time data from the BAS network. Data displayed in real time and update automatically without user interaction. User able to change data on displays if logged in with the appropriate user name and password.

C. Display of Data: Web page graphics shown on browser to be replicas of the BAS displays. User to need no additional training to understand information presented on Web pages when compared to what is shown on BAS displays. Web page displays to include animation just as BAS displays. Fans to turn, pilot lights to blink, and coils to change colors, and so on. Real-time data shown on browser Web pages. This data must be directly gathered via the BACnet network and automatically updated on browser Web page displays without any user action. Data on the browser to automatically refresh as changes are detected without re-drawing the complete display. User to be able to change data from browser Web page to if the user is logged on with the appropriate password. Clicking on a button or typing in a new value to change digital data. Using pull-down menus or typing in a new value to change analog data. Data displays navigated using pushbuttons on the displays that are simply clicked on with the mouse to select a new display. Alternatively, the standard back and forward buttons of the browser can be used for display navigation.

D. Web Page Generation: Web pages generated automatically from the BAS displays that reside on the BAS server. User to access Web-page host via the network and initiate a web page generation utility that automatically takes the BAS displays and turns them into Web pages. The Web pages generated are automatically installed on the Web page host for access via any computer’s standard browser. Any system that requires use of an HTML editor for generation of Web pages will not be considered.

E. Password Security and Activity Log: Access via Web browser to utilize the same hierarchical security scheme as BAS system. User asked to log in once the browser makes connection to Web-page host. Once the user logs in, any changes that are made to be tracked by the BAS system. User able to change only those items that the user has authority to change. A user activity report to show any activity of the users that have logged in to the system regardless of whether those changes were made using a browser or via the BAS workstation.

F. Communication: Web-page host to communicate using the specified protocol standard to devices on the BAS network.
2.5 BAS GRAPHICS

A. Develop customized graphics showing the project building(s) and their floor plans, mechanical, and electrical equipment, flow and control diagrams, and other relevant features on Workstation graphic screens. Associated input, output, and virtual objects (e.g., temperature and pressure setpoints) listed in the Sequence of Operation, and shown on the Input/Output Objects List included in the graphic screens and bound to the database. Real-time value of objects updated on the display of each graphic automatically. For projects where existing campus and/or building controls systems exist, replicate graphics used in the existing BAS graphics screens.

B. Graphics to have links to the Print function and to display a Standard Legend in the corner of the graphic. Graphics, except pop-ups, to have the date and time displayed in the upper corner of the graphic. Each graphic titled.

C. Weather: Graphics, except pop-ups, to have the outdoor temperature and humidity in the upper corner of the graphic.

D. Alarms: System and component summary alarms located near the top of each relevant graphic screen. Provide links to the associated system/component as part of these tags to assist trouble shooting. Other alarms placed near the associated system/device as depicted in the graphic. Provide text and color of information tags that describe each object and alarm value consistent with a graphics color legend.

E. The Following Graphics Provided as a Minimum:
   1. A building graphic, typically a photograph of the building, with links to each floor plan and other links as defined below.
   2. A central plant graphic with equipment (chillers, boilers, pumps, heat exchangers, storage tanks, etc.), temperature sensors, pressure sensors, flow sensors and refrigeration leak detectors. The central plant graphic to have links to each building on the campus.
   3. Central equipment such as air handler, package rooftop equipment, supply fans, exhaust fans, and smoke control systems.
   4. Floor plans of each floor, with temperature sensors, pressure sensors, temperature control zones, heating/cooling zones, ventilation zones, and supply air zones identified. Rooms grouped on a graphic only to the extent that detailed and complete sensing information can be comfortably viewed by an operator and the bound points updated in less than 10 seconds. Each zone to have a temperature symbol that changes color over the range from low (blue) through normal (green) to high (red) and indicate an alarm (flashing red). The zone temperature and or pressure symbol(s) to be a link to a zone control pop-up graphic. Individual floor plan graphics to provide links to related mechanical systems. The mechanical room plan graphics to show the relative location of, and provide links to, either the equipment pop-up or flow and control graphic for mechanical equipment monitored or controlled by the BAS.
   5. Pop-up graphics provided for each zone control system showing a flow diagram and related monitoring and control points and system parameters. Pop-up graphics provided for each piece of equipment that is not shown on a flow and control graphic.
   6. Flow and control diagrams for each system including but not limited to fan coils, chilled water systems, heating hot water systems, zone terminal units, combination fire and smoke damper status, and ventilation systems. The flow and control graphics to have parameters grouped in the lower portion of the graphics. Standard equipment graphics
used. Pumps, fans, dampers and other elements to dynamically indicate their state (i.e. pumps and fans to rotate when on and damper positions to dynamically adjust and be shown in their current position, etc.). System flow and control graphics displayed in a general left to right flow or loop arrangement. Return and exhaust air flow shown on top and return water shown on the bottom of the graphic.

7. Individual equipment/component screens showing sensing and control information available for each device provided.

F. Penetration: The graphic interface to consistently apply a convention whereby a left-click to always penetrate to more detailed information. The text windows to represent the deepest level of penetration. A right-click to always produce a menu of options that are specific to the item selected.

G. Navigation: Graphics organized to provide a "branching structure" that allows an operator to move from a "macro view" to a "micro view" and return. These links to other associated graphics, or allow a return to a previous macro view, provided and arranged horizontally along the bottom of each graphic screen. From left to right, the graphic links as follows: site/building map, building/trailer floor plans, and major mechanical systems at each building. Pop-up right click menus provided as needed on the lower button bar to allow for uncluttered navigation.

H. Clutter Minimization: Each graphic to have separate check boxes in the lower right corner that show/hide setpoints, alarms/safeties, and devices/equipment.

I. Templates: To the maximum extent possible, use standard graphics as templates to provide a consistent look throughout the interface.

J. Color Scheme: The graphics to use dynamic color changes to communicate equipment type, or object status consistent with the graphics color legend.

K. Symbols and Animations: Fans, pumps, dampers, coils, and generation equipment to be dynamic symbols indicating rotation, state, or position, movement, flow, etc.

L. Macros: When macros are used to add functionality to the graphics, detailed documentation provided.

M. Configure Mode: Access to “Configure Mode” for editing of the graphics password protected to prevent unauthorized changes to the graphics. This password supplied to the appropriate personnel.

N. Graphics Version: Graphics provided in the most current format available at time of control system programming.

O. Points and graphics checked for the proper binding and graphic programming, settings to ensure that the correct system, location, point values and dynamics are shown in the proper location and rotate in the proper directions.

P. After graphics have been accepted, provide, on a CD ROM in an agreed upon file structure. If the graphics have active-x controls or other files that must be placed outside the graphics folder structure a set-up program provided on the disk to place the files in the correct locations.
2.6  BUILDING CONTROLLERS

A. General: Provide adequate number of building controllers to achieve performance specified. Panels to meet the following requirements.
   1. Building Automation System (BAS) to be composed of one or more independent, stand-alone, microprocessor-based building controllers to manage global strategies described in Controller Software article.
   2. Provide sufficient memory to support operating system, database, and programming requirements.
   3. Share data between networked building controllers.
   4. Distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
   5. Controllers that perform scheduling have real-time clock.
   6. Continually check status of its processor and memory circuits and if abnormal operation is detected, controller:
      a. Assume predetermined failure mode.
      b. Generate alarm notification.
   7. Building Controller communicates with other devices on internetwork including BACnet communications according to specified protocol.

B. Communication:
   1. Each building controller resides on network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and performs routing to network of custom application and application specific controllers.
   2. Controller provides a service communication port for connection to a portable operator's terminal.

C. Environment:
   1. Controllers used outdoors and/or in wet ambient conditions mounted within NEMA waterproof enclosures and rated for operation at 0 degrees F to 150 degrees F.
   2. Controllers used in conditioned space are mounted in NEMA dust-proof enclosures and rated for operation at 32 degrees F to 120 degrees F.

D. Keypad: Local keypad and display to be provided for each controller. Security password to be available to prevent unauthorized use of keypad and display.

E. Serviceability: Provide diagnostic LEDs for power, communication, and processor. Wiring connections are made to modular terminal strips or to termination card connected by ribbon cable.

F. Memory: Building controller maintains BIOS and programming information in event of power loss for at least 72 hours.

G. Immunity to power and noise. Controller able to operate at 90 percent to 110 percent of nominal voltage rating and performs an orderly shutdown below 80 percent nominal voltage. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3-feet.
H. Controller to have a battery to provide power for orderly shutdown of controller and storage of data in nonvolatile flash memory. Battery backup to maintain real-time clock functions for a minimum of 10 days.

2.7 APPLICATION SPECIFIC CONTROLLERS

A. Application specific controllers (ASCs) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers to be fully programmable using graphical programming blocks.

1. ASC controllers communicate with other devices on internetwork.
2. Each ASC capable of stand-alone operation without being connected to network.
3. Each ASC will contain sufficient I/O capacity to control target system.
4. Application controllers to include universal inputs with minimum 10-bit resolution that accept thermistors, 0-10VDC, 0-5 VDC, 4-20 mA and dry contact signals. Any input on a controller may be either analog or digital with at least 1 input that accepts pulses. Controller to also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller to include binary and analog outputs on board. Provide analog outputs switch selectable as either 0-10VDC or 0-20mA. Software to include scaling features for analog outputs. Application controller to include 24VDC voltage supply for use as power supply to external sensors.
5. Program sequences stored on board application controller in EEPROM. No batteries needed to retain logic program. Program sequences executed by controller 10 times per second and capable of multiple PI and PID loops for control of multiple devices. Calculations completed using floating-point math and system to support display of information in floating-point nomenclature at operator's terminal. Programming of application controller completely modifiable in the field without installed BAS LANs or remotely via modem interface. Operator to program logic sequences by graphically moving function blocks on screen and tying blocks together on screen.
6. Application controller to include support for room sensor. Display on room sensor programmable at application controller and include an operating mode and a field service mode. Provide button functions and display data programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

B. Communication:
1. Controller resides on network using MS/TP Data Link/Physical layer protocol.
2. Each controller connected to building controller.
3. Each controller capable of connection to laptop computer or portable operator's tool.

C. Environment:
1. Controllers used outdoors and/or in wet ambient conditions mounted within NEMA waterproof enclosures and rated for operation at 0 degrees F to 150 degrees F.
2. Controllers used in conditioned space mounted in NEMA dust-proof enclosures and rated for operation at 32 degrees F to 120 degrees F.

D. Serviceability: Provide diagnostic LEDs for power, communication, and processor.

E. Memory: ASC use nonvolatile memory and maintains BIOS and programming information in event of power loss.
2.8 APPLICATION SPECIFIC CONTROLLER - TERMINAL UNIT CONTROLLERS

A. Provide one application controller for each terminal unit that adequately covers objects listed in object list for unit. Controllers to interface to building controller via LAN using specified protocol. Controllers to include on board flow sensor, inputs, outputs and programmable, self-contained logic program as needed for control of units.

B. Application controllers to include universal inputs with 10-bit resolution that can accept thermistors, 0-5 VDC, and dry contact signals. Inputs on controller may be either analog or digital. Controller to also include support and modifiable programming for interface to intelligent room sensor with digital display (digital display to indicate setpoint only). Controller to also include binary outputs on board. For applications using variable speed parallel fans, provide a single analog output selectable for 0-10 V or 0-20 mA control signals. Application controller to include microprocessor driven flow sensor for use in pressure independent control logic. Terminal units controlled using pressure independent control algorithms and flow readings to be in CFM.

C. Program sequences stored on board application controller in EEPROM. No batteries needed to retain logic program. Program sequences executed by controller 10 times per second and capable of multiple PI loops for control of multiple devices. Provide programming of application controller completely modifiable in the field over installed specified protocol LANs or remotely via modem interface. Operator to program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller programmed using the same programming tool as Building Controller and as described in Operator Workstation article.

D. Application controller to include support for intelligent room sensor. Display on room sensor programmable at application controller and include an operating mode and a field service mode. Button functions and display data programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence for specific display requirements for intelligent room sensor.

E. Provide duct temperature sensor at discharge of each terminal unit that is connected to controller for reporting back to operator workstation. Provide analog inputs for the duct temperatures.

2.9 INPUT/OUTPUT INTERFACE

A. Input/output points protected such that shorting of point to itself, to another point, or to ground will cause no damage to controller. Input and output points protected from voltage up to 24 V.

B. Binary inputs (BI or DI) allow monitoring of On/Off signals from remote devices. Binary inputs sense “dry contact” closure without external power (other than that provided by controller) being applied.

C. Pulse accumulation input objects accept up to 10 pulses per second for pulse accumulation.

D. Analog inputs (AI) allow monitoring of low-voltage (0 to 10 VDC), current (4 to 20 mA), or resistance signals (thermistor, RTD).
E. Binary outputs (BO or DO) provide for On/Off operation or pulsed low-voltage signal for pulse width modulation control. Binary outputs on building and custom application controllers have three-position (On/Off/Auto) override switches and status lights. Outputs selectable for either normally open or normally closed operation.

F. Analog outputs (AO) provide a modulating signal for control of end devices. Outputs provide either a 0 to 10 VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs on building controllers have status lights and two-position (AUTO/MANUAL) switch and adjustable potentiometer for manual override. Analog outputs not exhibit drift of greater than 0.4 percent of range per year.

G. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms run zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

2.10 POWER SUPPLIES AND LINE FILTERING

A. Control transformers UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits. Limit connected loads to 80 percent of rated capacity.

B. DC power supply output match output current and voltage requirements. Unit operates between 32 degrees F and 120 degrees F.

C. Line voltage units UL listed and CSA approved.

D. Power line filtering. Provide transient voltage and surge suppression for workstations and controllers.

2.11 CONTROL PANELS

A. Control Panels:
   1. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures to be NEMA 12 when installed in other than a clean environment. Outdoor enclosures must be NEMA 3R. Provide (hinged door) key-lock latch and removable subpanels. Single key common to field panels and subpanels. In existing campus or building settings, key lock to match existing keys.
   2. Interconnections between internal and face-mounted devices prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections UL listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection individually identified per control drawings.
   3. Provide ON-OFF power switch with overcurrent protection for control power sources to each local panel.
   4. Provide laminated plastic nameplates for enclosures in any mechanical room or electrical room labeled with TCP number. Laminated plastic to be 1/8-inch thick sized appropriately to make label easy to read.
2.12 AUXILIARY CONTROL DEVICES

A. Temperature Instruments:
1. Room Temperature Sensor: Thermistor or platinum RTD type with accuracy of plus or minus 0.5 degrees F at 70 degrees F; operating range 30-120 degrees F; linear signal; single point sensing element in wall-mounted ventilated enclosure with insulating back plate if mounted on exterior wall; push button for occupancy override; digital setpoint adjustment plus or minus 2 degrees F in both directions; LCD temperature display indicating setpoint only. Setpoint adjustment to revert to building programmed standard temperature upon next building occupancy schedule change (user adjustable). Room temperature sensor may have integral space carbon dioxide sensor with minimum performance characteristics identified within this specification. Include integral occupancy sensor for public rooms but not in offices.

2. Averaging Duct Temperature Sensors: Thermistor or platinum RTD element with accuracy of plus or minus 0.5 degrees F at 32 degrees F, consisting of array of single point sensing elements, securely mounted in duct or plenum; operating range 20-120 degrees F; linear signal; 1-foot element per 2 SF of duct cross-sectional area. Use when duct is 9 SF or larger or where air is subject to temperature stratification.

3. Probe Duct Temperature Sensors: Thermistor or platinum RTD element with accuracy of plus or minus 0.5 degrees F at 32 degrees F, consisting of single point sensing elements, securely mounted in duct or plenum; operating range 20-120 degrees F; linear signal; 24-inch rigid probe. Use where duct is less than 9 SF cross-sectional area.

4. Outside Air Temperature Sensor: Thermistor or platinum RTD element with accuracy of plus or minus 0.5 degrees F at 32 degrees F; Range -58 to 120 degrees F, single element, linear, with weather and sun shield for exterior mounting.

5. Low Temperature Limit Thermostat: Minimum 20 foot capillary sensing element, triggering on low temperature as sensed by any 12-inch segment; snap acting, normally open contacts, manual reset, line voltage.

6. Liquid Immersion Temperature Sensor: Thermistor or platinum RTD element, with accuracy of plus or minus 0.5 degrees F at 32 degrees F, stainless steel well and assembly, range 30 to 250 degrees F.

B. Pressure Transmitters and Transducers:
1. Transducer have linear output signal; field adjustable zero and span. Sensing elements withstand continuous operating conditions of positive or negative pressure 50 percent greater than calibrated span without damage.

2. Differential Pressure Switch: Setpoint adjustable with operating range of 0.5 to 12-inch WG for fans, and 5 to 30-feet WC for pumps. Switches UL listed; SPDT snap-acting; pilot duty rated (125 VA minimum); NEMA 1 enclosure; scale range and differential suitable for intended application.

3. Filter Differential Pressure Switch: Setpoint adjustable with operating range of 0.1 to 5-inch WG; auto reset. Contactor to close when pressure differential setting is met or exceeded. Provide mounting bracket, metallic tubing and appropriate fittings for connection to duct or air-handling unit.

4. Duct Static Differential Pressure Transducer: Operating range 0 to 5-inch WC for duct mounted transmitter; ceramic capacitive sensing element with probe securely mounted in duct; digital input terminal and push button to zero output. Accuracy plus or minus 1 percent of full scale; maximum response time 2 seconds.
5. Building Static Pressure Transducer: Operating range of -0.1 to 0.1-inch WC, linear signal. Sensing tubes located inside and outside building use shielding and/or surge tanks to minimize effects of wind. Accuracy plus or minus 1 percent of full scale.

6. Piping Pressure Transmitter: Operating range 0 to 50 PSIG, linear signal; stainless steel diaphragm; digital input terminal and push button to zero output. Accuracy plus or minus 1 percent of full scale.

C. Motorized Control Dampers:
1. Performance: Maximum leakage of 3 CFM/SF at 1-inch WG differential pressure, AMCA Class 1A, maximum pressure rating of 13-inch WG differential pressure, maximum velocity of 6,000 fpm, -72 degrees F to 275 degrees F temperature rating.
2. Multi-blade type, except where either dimension is less than 10-inch single blade may be used. Maximum blade length to be 48-inch.
3. Provide parallel blades for modulating mixing service and opposed blades for throttling service.
4. Blades to be interlocking; minimum 16 gauge galvanized steel; compression type edge seals and side seating stops. In copper, aluminum and stainless steel duct work, damper material matches duct work material.
5. Damper blades are reinforced, have continuous full length axle shafts, axle to axle linkage, and/or operating “jackshafts” as required to provide coordinated tracking of blades.
7. Dampers over 25 SF in area to be in two or more sections, with interconnected blades.
8. Provide remote damper position status with binary input.
9. Tested in accordance with AMCA Standard No. 500.

D. Motorized Control Valves:
1. Body pressure rating and connection type construction conforms to pipe, fitting and valve schedules.
2. Fluid valve close-off ratings and spring ranges operate at maximum flows and maximum available pump heads scheduled without leakage.
3. Screwed ends except 2-1/2-inch and larger valves with flanged ends.
4. Motorized Control Valves (Pressure Independent Control Valves):
   a. Description: Valve consists of pressure compensating cartridge, actuated ball or Y pattern globe valve, and multiple pressure/temperature test ports in a single valve housing.
   b. Construction: Rated for no less than 125 PSI and 250 degrees F. 2-inch and Smaller: brass with threaded connections. 2-1/2-inch and larger: cast iron with flanged connections.
   c. Performance: Flow rate controlled linearly to within 5 percent of target flow rate, for any actuator position (0 to 100 percent), over an operating differential pressure range of 6 to 50 PSI across the valve. Provide valve with integral test ports to verify pressure differential.
   d. Manufacturers: Belimo, Danfoss, Flow Control Industries, Griswold, Tour and Andersson or equal.
5. Fluid three-way valves globe valves with linear plug with composition disc for tight shutoff.
6. Pressure drop equal to twice pressure drop through heat exchanger (load), 50 percent of pressure difference between supply and return mains, or 5 PSI, whichever is greater, except two-position valves to be line size.

E. Electric Damper/Valve Actuators:
1. Provide mechanical or electronic stall protection for each actuator.
2. Where indicated provide internal mechanical, spring-return mechanism or provide uninterruptible power supply (UPS). Non-spring-return actuators have external manual gear release to position damper/valve when actuator is not powered.
3. Proportional actuators accepts 0 to 10 VDC or 0 to 20 mA control signal and provide 2 to 10 VDC or 4 to 20 mA operating range.
4. Actuator sized for torque required plus 25 percent; UL or CSA listed; electronic current overload protection.
5. VAV Actuators: Actuators proportional 24 VAC actuators using a 4 to 20 mA range of control signals; stops automatically at end of travel; include permanently lubricated gear train.

F. Air Flow Meters:
1. Fan Inlet Type: Self-supporting aluminum traverse probes housing thermal dispersion sensors. Probe spacing and sensor quantity as recommended by manufacturer. Provide factory calibrated electronic flow transmitter with CFM readout display and capability of providing 4 to 20 milliamp output for interface with direct digital controls. Ebtron GTx116-PC.
2. Duct Mounted Air Flow Station: Self-supporting aluminum alloy tube with stainless steel mounting brackets. Probe and sensor density quantity as recommended by manufacturer. Sensor use thermal dispersion technology with two “bead in glass,” hermetically sealed thermistor probes at each measuring point. Provide electronic flow transmitter with CFM readout display and capable of 4-20 mA output signal. Ebtron GTA116-PC.

G. Room Pressure Monitor: Active room pressure monitor and alarm which provides local audio alarm and analog and alarm signals to DDC system. Wall mounted panel with LED differential pressure readout; audible and visual alarm; mute button; range of -0.05 to +0.05-inch WC; accurate to 1 percent of full scale; repeatability plus or minus 1.0 percent of full scale per year, alarm delay ability between 0-30 seconds. Provide door switch to deactivate alarm when space door(s) are open. Input status from BAS to deactivate alarm in unoccupied or shutdown modes. Phoenix Controls APM100.

H. Wall Mounted Space Carbon Dioxide Sensor:
1. Sensor to employ non-dispersive infrared technology. (N.D.I.R.)
3. Sensor Accuracy: Less than or equal to 75 ppm over 0-1500 ppm range.
4. Sensor Response Time: Less than 1 minute.
5. Sensor to employ reference channel design for long-term stability.
6. Sensor to have field selectable 0-10VDC, or 4-20mA outputs.
7. Sensor power requirement less than 3W.
8. Sensor Input Voltage: 20 to 30VAC/DC.
9. Sensor Operating Temperature Range: 0 degrees C to 50 degrees C.
10. Sensor to have models for wall mounting or duct mounting.
11. Sensor to provide at least a 1-year factory warranty from date of purchase.
12. Sensor to match cover in color and look to temperature sensor.
13. Sensor to have display.
14. Manufacturers:
   a. Telaire
   b. Vaisala
   c. Veris

I. Occupancy Sensor: Dual technology infrared and ultrasonic sensing device, ceiling or wall mounted, built-in self-adjusting settings, timer settings of 30 seconds to 30 minutes, with manual and automatic modes. Provide multiple devices in parallel when area served is greater than a single device sensing capability. Provide integral power pack, 120 VAC input, 24 VDC output, with manual override switch. Leviton OSC-MOW series.

J. Relays:
   1. Control relays UL listed plug-in type with dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage to be suitable for application.
   2. Time delay relays UL listed solid-state plug-in type with adjustable time delay. Delay adjustable plus or minus 200 percent (minimum) from setpoint or as indicated. Contact rating, configuration, and coil voltage to be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

K. Override Timers: Override timers spring-wound line voltage, UL Listed, with contact rating and configuration as required by application. Provide 0-to-6-hour calibrated dial unless otherwise specified. Timer suitable for flush mounting on control panel face and located on local control panels or where shown.

L. Current Transmitters:
   1. AC current transmitters are self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4 to 20 mA two-wire output. Unit range compatible with actual applied span of current value, with internal zero and span adjustment and plus or minus 1 percent full-scale accuracy at 500 ohm maximum burden.
   2. Transmitter meets or exceeds ANSI/ISA S50.1 requirements and UL/CSA recognized.
   3. Unit split-core type for clamp-on installation on existing wiring.

M. Current Transformers: AC current transformers UL/CSA recognized and completely encased (except for terminals) in approved plastic material; plus or minus 1 percent accuracy at 5 A full-scale.

N. Voltage Transmitters: AC voltage; self-powered single-loop (two-wire) type; 4 to 20 mA output with zero and span adjustment; UL/CSA recognized at 600 VAC rating and meet or exceed ANSI/ISA S50.1. Ranges include 100 to 130 VAC, 200 to 250 VAC, 250 to 330 VAC, and 400 to 600 VAC full-scale, adjustable, with plus or minus 1 percent full-scale accuracy with 500 ohm maximum burden.

O. Voltage Transformers: AC voltage transformers UL/CSA recognized, 600 VAC rated; built-in fuse protection; suitable for ambient temperatures of 40 degrees F to 130 degrees F; plus or minus 0.5 percent accuracy at 24 VAC and a 5 VA load.

P. Power Monitors: Selectable rate pulse output for kWh reading; 4-20 mA output for kW reading; N.O. alarm contact; ability to operate with 5.0 amp current inputs or 0-0.33 volt inputs;
plus 1.0 percent full-scale true RMS power accuracy; plus 0.5 Hz, voltage input range 120-600 V, and auto range select; NEMA 1 enclosure. Current transformers having a 0.5 percent FS accuracy, 600 VAC isolation voltage with 0-0.33 V output. If 0-5 A current transformers are provided, a three-phase disconnect/shorting switch assembly is required.

Q. Emergency Stop Switch: Red, mushroom type, pull out to operate.

R. End Switches: Turret head Type SPDT. Schneider Electric/Square D Class 9007, Type C54B2, or equal.

2.13 WIRING AND RACEWAYS

A. General: Provide copper wiring, plenum cable, and raceways as specified in applicable Sections of Division 26, Electrical.

B. Insulated wire to be copper conductors, UL labeled for 90 degrees C minimum service.

C. Field panels and controllers to be supplied by building emergency power system where systems being monitored or controlled are on emergency power.

D. Run control wiring as follows:
   1. Mechanical Rooms: In conduit.
   2. Exposed in Building Spaces: In conduit.

E. Field and Subfield Panels: Voltage in panels not-to-exceed 120 volts.

F. Motor Control Centers: Responsibility for correct voltage of holding coils and starter wiring in pre-wired motor control centers interfacing with automatic controls is included hereunder.

G. Wiring for BAS systems communications busses two conductor minimum 18 gauge foil-shielded, stranded twisted pair cable rated at 300 VDC or more than 80 degrees C.

2.14 SMOKE DETECTION (FOR PROJECTS WITH A FIRE ALARM SYSTEM)

A. See Division 28 for Products.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Terminal Devices: Remove terminal sensors, actuators and controls as indicated on drawings and as required to accommodate scope of mechanical work shown on drawings and described in specifications. Remove pneumatic piping and cap with hardware as appropriate. Remove wiring and conduit associated with devices. Do not leave any unused abandoned piping or wiring in space.

B. Graphics and Programming: Remove symbols from control system graphics associated with deleted terminal elements. Modify programming code to delete alarms, control loops, etc., associated with deleted terminal devices.
3.2 EXAMINATION

A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.

B. Notify the Owners' representative in writing of conditions detrimental to the proper and timely completion of the work.

C. Do not begin work until unsatisfactory conditions are resolved.

3.3 CONTROL SYSTEM CHECKOUT AND TESTING

A. Testing completed before Owner's representative is notified of system demonstration.

B. Calibrate and prepare for service of instruments, controls, and accessory equipment furnished under this specification.

C. Verify that control wiring is properly connected and free of shorts and ground faults.

D. Enable control systems and verify calibration and operation of input and output devices.

E. Verify that system operation adheres to sequences of operation.

F. Commissioning and Verification: In addition to commissioning requirements specified elsewhere, provide the following commissioning on the HVAC instrumentation and controls system:
   1. Control systems completely commissioned to ensure aspects of the system are operating as intended and at optimum tuning.
   2. Wiring connections verified and traced from field device to panel to ensure proper connections.
   3. Measured values verified by a hand held calibrated device to validate that value indicated by the control system is in fact the actual measured value.
   4. Loops properly tuned to obtain the desired control value. Each loop to be "upset" and put back in control to demonstrate its ability to stabilize quickly.
   5. Provide a final point-by-point report submitted that indicates the date of each verification, the results, and initialed on each page by the person performing the reading.

3.4 ACCEPTANCE TESTING AND TRAINING

A. Site Testing:
   1. Contractor provides personnel, equipment, instrumentation, and supplies necessary to perform testing. Owner or Owner's representative will witness and sign off on acceptance testing.
   2. Contractor demonstrates compliance of completed control system with Contract Documents. Using approved test plan, physical and functional requirements of project demonstrated.

B. Training:
   1. General: Contractor conducts training courses for up to three other designated personnel in operation and maintenance of system. Training manuals provided for each trainee, with two additional copies provided for archival at project site. Manuals include detailed
description of subject matter for each lesson. Copies of audiovisuals delivered to Owner.
Training day is defined as 8 hours of classroom instruction, including two 15-minute
breaks and excluding lunch time, Monday through Friday, during normal first shift in
effect at training facility. Notification of any planned training given to Owner’s
representative at least 15 days prior to training.

2. Operator’s Training I: First course taught at supplier’s facility for period of one training
day. Upon completion, each student should be able to perform elementary operations
with guidance and describe general hardware architecture and functionality of system.

3. Operator’s Training II: Second course taught at project site for a period of one training
day after completion of contractor’s field testing. Course includes instruction on specific
hardware configuration of installed system and specific instructions for operating
installed system. Upon completion, each student should be able to start system, operate
the system, recover system after failure, and describe specific hardware architecture and
operation of system.

4. Operator’s Training III: Third course taught at project site for period of one training day
no later than six months after completion of the acceptance test. Course will be structured
to address specific topics that students need to discuss and to answer questions
concerning operation of system. Upon completion, students should be fully proficient in
system operation and have no unanswered questions regarding operation of installed
system.

3.5 WIRING

A. Provide electrical wiring required to control systems specified in this Section. Control and
interlock wiring complies with national, state and local electrical codes and Division 26,
Electrical of this specification.

B. Power wiring required for building control panel(s) to be dedicated circuit(s).

C. Verify location of operator work station with Owner prior to installation.

D. NEC Class 1 (line voltage) wiring UL Listed in approved raceway according to NEC and
Division 26, Electrical requirements.

E. Low-voltage wiring meets NEC Class 2 requirements. (Low-voltage power circuits subfused
when required to meet Class 2 current limit.)

F. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including
ceiling return air plenums, approved cables not in raceway may be used provided that cables
are UL listed for intended application.

G. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels
containing high-voltage wiring and equipment may not be used for low-voltage wiring except
for purpose of interfacing (e.g., relays and transformers).

H. Where Class 2 wiring is run exposed, wiring run parallel along surface or perpendicular to it
and tied at 10 foot intervals.

I. Where plenum cables are used without raceway, support from structural members. Do not
support cables with ductwork, electrical raceways, piping, or ceiling suspension systems.
J. Make wire-to-device connections at terminal block or terminal strip. Make wire-to-wire connections at terminal block.

K. Maximum allowable voltage for control wiring 24 V. If only higher voltages are available, provide step-down transformers.

L. Wiring installed as continuous lengths, with no splices permitted between termination points.

M. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at penetrations.

N. Include one pull string in each raceway 1-inch or larger.

O. Control and status relays are to be located in designated enclosures. Enclosures include packaged equipment control panels unless they also contain Class 1 starters.

P. Install raceway to maintain a minimum clearance of 6-inches from high-temperature equipment (e.g., steam pipes or flues).

Q. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

R. Install insulated bushings on raceway ends and openings to enclosures. Seal top end of vertical raceways.

S. Flexible metal raceways and liquid-tight, flexible metal raceways not-to-exceed 3-feet in length and be supported at each end. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways to be used.

T. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections joined with couplings. Terminations made with fittings at boxes.

U. Input and output terminations to be labeled at the controller to identify if they are AI, DI, AD, DO, and function (i.e. pump start, OM Sensor).

3.6 COMMUNICATION WIRING

A. Follow manufacturer's installation recommendations for communication cabling.

B. Verify integrity of network following cable installation.

C. Communication wiring unsnipped length when that length is commercially available; labeled to indicate origination and destination data.

D. Grounding of coaxial cable in accordance with NEC regulations article on “Communications Circuits, Cable, and Protector Grounding.”

3.7 INSTALLATION OF AUXILIARY CONTROL DEVICES

A. General:
1. Install sensors and thermostats in accordance with manufacturer's recommendations.
2. Room sensors and thermostats installed at 48-inches AFF to midline of sensor on concealed junction boxes properly supported by wall framing at the locations shown on the Drawings.
3. Low-limit sensors used in mixing plenums installed in a serpentine manner horizontally across duct.
4. Pipe-mounted temperature sensors installed in wells with heat-conducting fluid in thermal wells.
5. Install outdoor air temperature sensors on north facing wall or screen, complete with sun shield at designated location.

B. Actuators:
   1. General:
      a. Mount and link control damper actuators according to manufacturer's instructions.
      b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

   2. Actuator Mounting for Damper and Valve Arrangements to Comply with the Following:
      a. Damper Actuators: Do not install in the airstream.
      b. Use a weatherproof enclosure (clear and see through) if actuators are located outside.
      c. Damper or valve actuator ambient temperature not-to-exceed 122 degrees F through any combination of medium temperature or surrounding air. Provide appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation as necessary. Mount per manufacturer's recommendations.
      d. Actuator cords or conduit to incorporate a drip leg if condensation is possible. Do not allow water to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point to be avoided to prevent water from condensing in conduit and running into actuator.
      e. Damper mounting arrangements to comply with the following:
         1) Furnish and install damper channel supports and sheet metal collars.
         2) Jack shafting of damper sections not allowed.
         3) Multi-section dampers arranged so that each damper section operates individually. Provide one electronic actuator direct shaft mounted per section.
      f. Size damper sections based on actuator manufacturers specific recommendations for face velocity, differential pressure and damper type. In general: Damper section not-to-exceed 24 ft.-sq. with face velocity 1500 FPM.
      g. Multiple section dampers of two or more arranged to allow actuators to be direct shaft mounted on the outside of the duct.
      h. Multiple section dampers of three or more sections wide arranged with a 3-sided vertical channel (8-inch wide by 6-inch deep) within the duct or fan housing and between adjacent damper sections. Vertical channel anchored at the top and bottom to the fan housing or building structure for support. Connect sides of each damper frame to the channels. Holes in the channel to allow damper drive blade shafts to pass through channel for direct shaft mounting of actuators. Face open side of channel downstream of the airflow, except for exhaust air dampers.
      i. Multiple section dampers to be mounted flush within a wall or housing opening to receive either vertical channel supports as described above or sheet metal standouts.
collars. Sheet metal collars (12-inch minimum) to bring each damper section out of the wall to allow direct shaft mounting of the actuator on the side of the collar.

C. Control Valve:
1. Valves installed in accordance with manufacturer's recommendations.
2. Slip-stem control valves installed so that stem position is not more than 60 degrees from vertical up position. Ball type control valves installed with stem in horizontal position.
3. Control valves accessible and serviceable.
4. Install isolation valves so that control valve may be serviced without draining supply/return side piping system. Install unions at connections to screw-type control valves.
5. Valve Sizing for Water Coil:
   b. Modulating control valve body size may be reduced, at most, two pipe sizes from the line size or not less than 1/2 the pipe size. BAS contractor to size water coil control valves for the application as follows:
      1) Booster-heat valves sized not-to-exceed 4-9 PSI differential pressure. Size valve for 50 percent valve authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
      2) Primary valves sized not-to-exceed 5-15 PSI differential pressure. Size valve for 50 percent valve authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
      3) Butterfly valves sized for modulating service at 60 to 70 degree rotation. Design velocity 12-feet per second or less when used with standard EPDM seats.
   c. Valve Mounting Arrangements to Comply with the Following:
      1) Provide unions on ports of two-way and three-way valves.
      2) Install three-way equal percentage Characterized Control valves in a mixing configuration with the “A” port piped to the coil.
      3) Install 2-1/2-inch and above, three-way globe valves, as manufactured for mixing or diverting service to the coil.

D. Control Damper:
1. Dampers installed in accordance with manufacturer's instructions. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
2. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

E. Air Flow Station: Install where indicated in ductwork and/or equipment with manufacturer's recommended straight ductwork upstream and downstream of air flow station or as shown on drawings, whichever is greater. Where equipment manufacturer's standard airflow measuring station cannot read airflows at required design velocities, provide appropriate air flow measuring station to provide accurate reading throughout system design operations range.

3.8 SMOKE DETECTION (FOR PROJECTS WITH A FIRE ALARM SYSTEM)

A. Smoke detector furnished and powered/wired under Division 28, Electronic Safety and Security. Coordinate with fire alarm equipment supplier. Installation of duct smoke detector housing and sampling tube under Division 23, HVAC.
B. Install smoke detectors in supply air systems greater than 2000 CFM.

3.9 SEQUENCES OF OPERATION AND POINTS LISTS

A. Where local energy code dictates certain sequences (such as night setback, night flush, pressure and temperature reset, terminal unit sequences, etc.), the sequences are not necessarily repeated in the documents. It is not the intent of this specification or documentation to reiterate the energy code. Provide energy code mandated sequences and document in sequence of operations submittals at no additional cost to the Owner. Provide required points to achieve the appropriate sequences.

B. See control diagrams and sequences on drawings in addition to sequences below.

C. Variable Frequency Drives: For a VFD dependent on an external input for its output setting (e.g., the VFD gets "Frequency" as an input), loss of that external input to result in the VFD holding its last value. If the VFD is running its own PID loop and the external input to the VFD is a setpoint (e.g. duct static pressure setpoint), the VFD to hold the last setpoint. If the VFD loses its process variable (e.g. duct static pressure), the VFD to go to its minimum speed setting.

D. Except as specified otherwise, throttling ranges, proportional bands, and cycle differentials to be centered on the associated setpoint. Modulating feedback control loops to include the capability of having proportional, integral, and derivative action. Unless the loop is specified "proportional only" or "P+I", Contractor to apply appropriate elements of integral and derivative gain to each control loop to result in stable operation, minimum settling time and maintain the primary variable within the specified maximum allowable variance.

E. Provide a real time clock and schedule controller with sufficient scheduling capability to schedule required controllers and sequences. Schedule functionality may reside in a controller. If a controller is used, document scheduling functionality including names and types on controller points list submittal. Set up initial schedules in coordination with Owner.

F. Scheduling Terminology: When air handlers are scheduled throughout the day, the following defines the terminology used:
   1. Occupied Period: Period of time when the building is in use and occupied. Confirm schedule with Owner. Exclude all national holidays. Generally systems will be fully operational throughout this period and ventilation air to be continuously introduced. Space temperature setpoints will generally be in the “normal” range of 68 degrees to 78 degrees F.
   2. Unoccupied period: Period of time when the building or zone is not in use and unoccupied. Ventilation air not to be introduced.
   3. Preoccupancy Period: Time prior to the Occupied period when the systems are returning the space temperatures from setback to "normal" or occupied setpoints (warm-up and cool-down). Ventilation air shall not be introduced unless outside air conditions permit free-cooling or to support a pre-occupancy purge sequence. Time period to be determined by an optimum start strategy unless otherwise specified.
   4. Setback Period: Setback will typically start with the end of the occupied period and end with the start of the preoccupancy period, however it shall be provided with its own schedule. Generally systems will be off except to maintain a “setback” temperature, economization may be enabled to maintain “setback” cooling setpoint when applicable.
G. Where any sequence or occupancy schedule calls for more than one motorized unit to start simultaneously, the BAS start commands to be staggered by 5 second (adj.) intervals to minimize inrush current.

H. Wherever a value is indicated as adjustable (adj.), it shall be modifiable, with the proper password level. For these points, it is unacceptable to have to modify programming statements to change the setpoint.

I. When a power failure is detected in any phase, the BAS start commands to be retracted immediately from electrically powered units served by the failed power source. If the associated controller is powered by normal or emergency power, it may monitor its own power source as an indication of power status. If the controller is powered by uninterruptible power supply (UPS), or if it is not capable of monitoring its own power for use in sequences, provide at least one voltage monitor (three phase when applicable) per building. When the BAS detects that normal or emergency power has been restored, all equipment for which the BAS start command had been retracted to be automatically restarted in an orderly manner on staggered 5 second intervals to minimize inrush current.

J. Where reset action is specified in a sequence of operation, but a reset schedule is not indicated on the drawings, employ one of the following methods:
   1. Determine a fixed reset schedule to result in stable operation and maintain the primary variable within the specified maximum allowable variance.
   2. Use a floating reset algorithm which increments the secondary variable setpoint (setpoint of control loop being reset) on a periodic basis to maintain primary variable setpoint. The recalculation time and reset increment to be chosen to maintain the primary variable within the specified maximum allowable variance.
   3. Primary variable to control the devices directly using a PID feedback control loop without resetting the secondary variable. However, the control devices to still modulate as necessary to maintain upper and lower limits on the secondary variable. Proportional band, integral gain, and derivative term to be selected to maintain the primary variable within the specified maximum allowable tolerance while minimizing overshoot and settling time. Gain prior approval for implementing this method of reset.

K. Where a supply air temperature or duct pressure setpoint is specified to be reset by the space temperature of the zones calling for the most cooling/heating, employ the following method:
   1. Use a floating reset algorithm which increments the secondary variable (e.g., supply air temperature or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g., space temperature) setpoint. The reset increment to be determined by the quantity of "need heat" or "need cool" requests from individual SCU's. A SCU's "need heat" virtual point to activate whenever the zone's space temperature falls below the currently applicable (occupied or unoccupied) heating setpoint throttling range. A SCU's "need cool" virtual point to activate whenever the zone's space temperature rises above the currently applicable (occupied, unoccupied, or economy) cooling setpoint throttling range. The recalculation time and reset increment to be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. Reset range maximum and minimum values to limit the setpoint range.

L. Where a supply air temperature, duct pressure, or differential water pressure setpoint is specified to be reset by valve or damper position of the zone or zones calling for the most cooling/heating, the following method to be employed:
1. A floating reset algorithm to be used which increments the secondary variable (e.g., supply air temperature, pipe or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g., cooling valve, heating valve, damper position) setpoint of 85 percent open. The reset increment to be calculated based on the average position of the quantity of the worst (most open valve/damper) zone(s) as specified. The recalculation time, reset increment and control device position influence to be chosen to maintain the primal variable within the specified maximum allowable variance while overshoot and settling time. The BAS analog output value to be acceptable as indicating the position of the control device.

2. Alternatively to continuously calculating the average of the quantity of worst valve/damper positions, a method similar to the one described above may be employed whereby the “need heat” or “need cool” virtual point to increment by one unit each time a zone's valve/damper position rises to greater than 95 percent. The quantity of “need heat” or “need cool” points to then be the basis for reset.

M. Where “prove operation” of a device (generally controlled by a digital output) is indicated in the sequence, it shall require that the BAS, after an adjustable time delay after the device is commanded to operate (feedback delay), confirm that the device is operational via the status input. If the status point does not confirm operation after the time delay or anytime thereafter for an adjustable time delay (debounce delay) while the device is commanded to run, an alarm to be enunciated audibly. Upon failure, run command to be removed and the device to be locked out until the alarm is manually acknowledged unless specified otherwise.

N. BAS to provide for adjustable maximum rates of change for increasing and decreasing output from the following analog output points:
   1. Speed control of variable speed drives
   2. Control Reset Loop
   3. Valve Travel Limit

O. Wherever a value is indicated to be dependent on another value (i.e., setpoint plus 5 degrees F) BAS to use that equation to determine the value. Simply providing a virtual point that the operator must set is unacceptable. In this case three virtual points to be provided. One to store the parameter (5 degrees F), one to store the setpoint, and one to store the value which is the result of the equation.

P. Trend points as identified in the points list. Trends to be grouped system specific and setup in two-axis (x,y) graphical format that display object values relative to time. Setup trends to record data in 5 minute increments.

Q. **Air Handling Unit (AHU-X), VAV HW/CHW 100 Percent Outside Air:**
   1. General: Unit to operate under following modes: Occupied, Shutdown and Unoccupied. H-O-A switches on graphics screens or text dialog boxes may override on/off equipment.
   2. Equipment:
      a. Air Handling Units: AHU-X
   3. Occupied Mode:
      a. Occupied mode initiated from controller based on time of day or operator input. During occupied mode supply fan runs continuously.
      b. Normally closed outdoor air damper open.
Normal closed fire smoke dampers in distribution ductwork open. Provide sufficient delay in fan start/stop to allow fire and smoke dampers to open/close without causing duct damage.

d. Discharge air temperature sensor signals controller which modulates in sequence normally open heating coil valve and normally closed cooling coil valve to maintain discharge air temperature setpoint of 55 degrees F as reset below.

c. Outdoor air and exhaust air temperature sensors signal controller.

f. Supply Air Temperature Setpoint Reset
1) When unit is enabled in occupied mode initially SAT setpoint set at 70 degrees F
2) If any zone has a cooling demand above 10 percent set the SAT setpoint at 62 (adj) degrees F (adj).
3) If the total number of zones with 100 percent cooling demand is greater than one reset the SAT setpoint down 1 degree F every five minutes (adj) to a minimum of 55 degrees F (adj).
4) If the total number of zones with 100 percent cooling demand is zero, then reset SAT setpoint up 1 degrees F every five minutes (adj) to a maximum of 62 (adj) degrees F.
5) If the total number of zones with a cooling demand greater than 10 percent is zero set the SAT setpoint at 70 degrees F (adj).

Remote duct static pressure sensors, as located on Drawings, signal controller which modulates supply fan variable frequency drive to maintain required static pressure setpoint at each location. Static pressure setpoints at each location continuously reset to maintain at least two terminal units with 100 percent damper position while maintaining space temperature setpoints.

h. Controller receives RPM signal from supply fan variable frequency drives.

4. Shutdown Mode:
   a. Supply fan is not operating.
   b. Dampers and valves in their normal de-energized positions.
   c. Fire and smoke dampers in distribution ductwork closed.

5. Unoccupied Mode:
   a. Night Setback and Setup: Supply fan operates when any space temperature drops to 60 degrees F or below or rises to 85 degrees F or above in designated zones. Maintain fan operation until space temperature rises to 63 degrees F (heating) or 82 degrees F (cooling). When supply fan operates, outdoor air dampers open, heating coil valve open (heating) or cooling coil valve open (cooling). Associated exhaust fans operate in conjunction with supply fan.
   b. Unoccupied Mode Override: Upon receiving an “override” signal from designated space temperature sensors, controller changes building to occupied mode for period of 2 hours (adjustable). Coordinate location of designated sensors (quantity 2) with Owner.
   c. In unoccupied mode, whenever supply fan operate, open fire smoke dampers in distribution ductwork. Provide sufficient delay in fan start/stop to allow fire and smoke dampers to open/close without causing duct damage. When supply fan operates in unoccupied mode, it operates as described for occupied mode.

6. Alarms/Safeties:
   a. Low limit detection thermostat located upstream of cooling coils signal controller which initiates shutdown mode upon sensing temperature below 38 degrees F and generate alarm.
b. Differential pressure switches located across each filter bank generates an alarm when static pressure drop exceeds 0.75-inches for pre-filters and 1.2-inches for final filters.

c. Each variable frequency drive signals controller to generate alarm in event of drive/control failure.

d. Static pressure sensor in air handler discharge signals controller which overrides supply fan speed control algorithm to limit static pressure to maximum of 3-inches and generate alarm. Discharge static pressure sensor signals controller which shuts down mode in event that static pressure exceeds 4.0-inches and generate alarm.

R. **Combination Fire Smoke Dampers (FSD):**
   1. Dampers closed upon receiving signal from fire alarm system, or from central controller.
   2. Dampers closed when their corresponding fan is not operating.
   3. Dampers open when fan systems are operating, unless overridden by fire alarm system.

S. **Variable Frequency Drives (VFD):**
   1. Variable speed drives monitored by controller though LAN communications port on each drive. Reference Section 23 09 13. As a minimum, monitor the following points:
      a. Frequency output - Hz
      b. Speed - RPM
      c. Current - Amps
      d. Power - Percentage
      e. Runtime - Hours
      f. System Fault
      g. Input speed setpoint - RPM

T. **Global Sequence of Operations**
   1. Include the following sequences in the BAS catalog of routines and execute when called upon by specific equipment. Mode of operation of units is initiated from BAS schedule.

U. **Terminal Units with Hot Water Reheat (TU):**
   1. **Occupied Mode**
      a. Maintain space heating and cooling temperature setpoints by implementing the following routine, in sequence:
         1) If space temperature is higher than cooling temperature setpoint, disable terminal unit’s heating system and maintain cooling temperature setpoint by modulating damper from Minimum airflow to Maximum Cooling airflow.
         2) If space temperature is less than heating temperature setpoint, initiate first stage of heating at Minimum Heating airflow and modulate heating coil’s control valve(s), as applicable, to gradually increase unit’s supply air temperature setpoint from 80 to 95 F.
         3) If space temperature is still less than heating temperature setpoint, confirm that the boiler plant is enabled and supply air temperature is above room setpoint and initiate second stage of heating by modulating damper from Minimum Heating airflow to Maximum Heating airflow while maintaining supply air temperature setpoint of 95 F.
         4) If space temperature is still less than occupied heating setpoint temperature, initiate third stage of heating by modulating heating coil’s control valve.

b. **Standby Mode**
1) During occupied hours, for spaces without an occupancy sensor, enter Standby mode at the end of the Unoccupancy Override period if Unoccupancy Override switch has been activated, or when the Unoccupancy Override switch has been not activated by the occupant.

2) Initiate Standby mode if all normally occupied spaces served by the unit are provided with occupancy sensors.

3) Enter “Standby Mode” if the occupancy sensors in all rooms served by the terminal unit do not detect occupancy for 15 minutes (adj).

4) During Standby mode:
   a) Reset cooling temperature setpoint to 3 F (adj) above normal occupied setpoint and heating temperature setpoint to 3 F (adj) below normal occupied heating setpoint.
   b) After 30 minutes in Standby mode (adj), for a period of 15 minutes (adj) reset Minimum Heating CFM of the terminal unit to zero. At the end of 15 minute (adj) period, increase the Minimum outdoor air quantity setpoint of the air handling system by the Minimum Heating CFM of the zone.
   c) If the zone’s occupancy sensors in all rooms served by the terminal unit do not detect occupancy for an additional 45 minutes (adj), or Unoccupancy Override switch has not been activated, for the next 15 minutes (adj) reset Minimum Heating CFM of the terminal unit to zero. Continue this routine until occupancy is detected, Unoccupancy Override switch has been activated, or there is a change in the mode of the system.
   d) When occupancy has been detected for 3 minutes (adj), or Unoccupancy Override switch has been activated, terminate Standby mode and reset all values to their original setpoints.

   c. For zones with CO2 sensors, if space CO2 concentration is greater than 800 ppm (adj) modulate damper between Minimum Heating and Maximum Heating airflow setpoints to maintain maximum CO2 concentration of 900 ppm. Generate an alarm if the zone CO2 concentration is greater than 1,200 ppm (adj). Provide adequate delay (time determined during commissioning) to avoid false alarming and adequate time for system to balance during sudden loading of spaces.

2. Unoccupied Mode:
   a. Close terminal unit damper and disable heating system. Ignore any signals from space occupancy or carbon dioxide sensors.
   b. If space temperature is greater than unoccupied cooling temperature setpoint, and if central air handling unit is operating, modulate damper between no airflow and Maximum Cooling airflow setpoints to maintain space temperature at unoccupied cooling temperature setpoint.
   c. If space temperature is less than unoccupied heating temperature setpoint, modulate damper between no airflow and Maximum Heating airflow setpoints, in sequence with modulating heating coil’s control valve subject to a maximum discharge air temperature of 95 degrees F (adj.), as appropriate, to maintain space temperature at unoccupied heating setpoint.
   d. During Unoccupied Mode, if any single zone falls below 40 F, generate an alarm and initiate Setback Mode until all zones are above 50 F.

3. Morning Warm-up Mode
a. Modulate damper between no airflow and Maximum Heating airflow setpoints, in sequence with modulating heating coil’s control valve subject to a maximum discharge air temperature of 90 degrees F to maintain space temperature setpoint corresponding to the appropriate mode.

4. Night Setback Mode
   a. Modulate damper between no airflow and Maximum Heating airflow setpoints, in sequence with modulating heating coil’s control valve subject to a maximum discharge air temperature of 90 degrees F to maintain space temperature setpoint corresponding to the appropriate mode.

5. Morning Cool-down Mode:
   a. Modulate damper between no airflow and Maximum Cooling airflow setpoints to maintain space temperature at unoccupied cooling temperature setpoint.

6. Night Set-up Mode:
   a. Modulate damper between no airflow and Maximum Cooling airflow setpoints to maintain space temperature at unoccupied cooling temperature setpoint.

7. Night Purge Mode:
   a. Modulate damper between no airflow and Maximum Cooling airflow setpoints to maintain space temperature at unoccupied cooling temperature setpoint.

8. Pre-occupancy Purge Mode:
   a. One hour prior to occupancy operate the terminal unit at a minimum flowrate of 3 air changes per hour for all areas served by the unit and modulate terminal unit damper and HHW heating control valve, in sequence, to maintain corresponding cooling and heating temperature setpoints.

9. Unoccupied Override
   a. When an override signal from a space temperature sensor has been activated, change the mode of the terminal unit to Occupied for 2 hours (adj).
   b. Terminate Unoccupied Override mode when one of the following occurs:
      1) Timed override period of 2 hours (adj) has expired.
      2) Timed override is cancelled.

V. Terminal Units - Cooling Only (TU)
   1. Occupied Mode:
      a. Maintain space heating and cooling temperature setpoints by implementing the following routine, in sequence:
         1) If space temperature is higher than cooling temperature setpoint, maintain cooling temperature setpoint by modulating damper from Minimum airflow to Maximum airflow.

   2. Standby Mode
      a. During occupied hours, for spaces without an occupancy sensor, enter Standby mode at the end of the Unoccupancy Override period if Unoccupancy Override switch has been activated, or when the Unoccupancy Override switch has been not activated by the occupant.
      b. Initiate Standby mode if all normally occupied spaces served by the unit are provided with occupancy sensors.
      c. Enter “Standby Mode” if the occupancy sensors in all rooms served by the terminal unit do not detect occupancy for 15 minutes (adj).
      d. During Standby mode:
1) Reset cooling temperature setpoint to 3 F (adj) above normal occupied setpoint and heating temperature setpoint to 3 F (adj) below normal occupied heating setpoint.

2) After 30 minutes (adj) in Standby mode, for a period of 15 minutes (adj) reset Minimum CFM of the terminal unit to zero. At the end of 15 minute (adj) period, increase the Minimum outdoor air quantity setpoint of the air handling system by the Minimum CFM of the zone.

3) If the zone’s occupancy sensors in all rooms served by the terminal unit do not detect occupancy for an additional 45 minutes (adj), or Unoccupancy Override switch has not been activated, for the next 15 minutes (adj) reset Minimum CFM of the terminal unit to zero. Continue this routine until occupancy is detected, Unoccupancy Override switch has been activated, or there is a change in the mode of the system.

4) When occupancy has been detected for 3 minutes (adj), or Unoccupancy Override switch has been activated, terminate Standby mode and reset all values to their original setpoints.

3. For zones with CO2 sensors, if space CO2 concentration is greater than 800 ppm (adj) modulate damper between Minimum and Maximum airflow setpoints to maintain maximum CO2 concentration of 900 ppm. Generate an alarm if the zone CO2 concentration is greater than 1,200 ppm (adj). Provide adequate time delay, to be determined in cooperation with the test and balance agent, to avoid false alarms and adequate time for system to balance during sudden loading of space.

4. Unoccupied Mode:
   a. Close terminal unit damper. Ignore signals from space occupancy or carbon dioxide sensors.
   b. If space temperature is greater than unoccupied cooling temperature setpoint, and if central air handling unit is running, modulate damper between no airflow and Maximum Cooling airflow to maintain space temperature at unoccupied cooling temperature setpoint.
   c. If space temperature is less than unoccupied heating temperature setpoint, close damper.
   d. During Unoccupied Mode, if any single zone falls below 40 F, generate an alarm and initiate Setback Mode until all zones are above 50 F.

5. Morning Warm-up or Night Setback Mode
   a. Modulate damper between no airflow and Maximum Heating airflow setpoints, in sequence with modulating heating coil’s control valve subject to a maximum discharge air temperature of 95 degrees F (adj.), as appropriate, to maintain space temperature setpoint corresponding to the appropriate mode.

6. Morning Cool-down Mode:
   a. Modulate damper between no airflow and Maximum Cooling airflow setpoints to maintain space temperature at unoccupied cooling temperature setpoint.

7. Night Set-up Mode:
   a. Modulate damper between no airflow and Maximum Cooling airflow setpoints to maintain space temperature at unoccupied cooling temperature setpoint.

8. Night Purge Mode:
   a. Modulate damper between no airflow and Maximum Cooling airflow setpoints to maintain space temperature at unoccupied cooling temperature setpoint.

9. Pre-occupancy Purge Mode:
a. One hour prior to occupancy operate the terminal unit at a constant airflow rate of 3 air changes per hour for all areas served by the unit and modulate terminal unit damper to maintain corresponding cooling temperature setpoint.

10. Unoccupied Override
   a. When an override signal from a space temperature sensor has been activated, change the mode of the terminal unit to Occupied for 2 hours (adj).
   b. Terminate Unoccupied Override mode when one of the following occurs:
      1) Timed override period of 2 hours (adj) has expired.
      2) Timed override is cancelled.

W. Variable Volume Exhaust Fan
   1. Enable fans at all times unless shutdown on safeties.
   2. Fan Control:
      a. Shutdown Service Switch: Provide a software point and hardware switch located inside the control panel for fan to be taken out of service that will initiate the shutdown sequence for the fan.
      b. Exhaust Fan Start/Stop Sequencing: Sequence fans on, based on exhaust fan flow. If a fan has failed or has been designated “out of service” per the sequence below, shut down associated Air handler.
      c. Maintain a minimum exhaust discharge velocity of 3,000 fpm, or as otherwise indicated on drawings, by maintaining a minimum flow. Prevent the exhaust fan from falling below this minimum speed to prevent the discharge velocity from falling below design. Determine minimum fan speed required to maintain minimum flow setpoints in cooperation with the test and balance agent.
   3. Static Pressure Control:
      a. Exhaust Fan Speed Control: Maintain a minimum static pressure in the exhaust ductwork. Install static pressure sensing probes in the main exhaust duct located at approximately 3/4 of the way down the main exhaust duct or as shown on the plans. Reference input for duct static pressure sensors shall sense the actual space served by the air system located in the ceiling below the duct probe. Modulate the exhaust fan VFDs to maintain the static pressure setpoint as sensed by the static pressure probe(s). As exhaust airflow requirements decrease and the static pressure becomes more negative than setpoint, decrease the exhaust fan VFD speed signals simultaneously and in parallel to maintain the static pressure setpoint until the minimum fan flow setpoint is reached.
      b. As exhaust airflow requirements increase and duct static pressure becomes less negative than setpoint, operate fan(s) at minimum fan flow setpoints.
   4. Generate alarms as follows:
      a. Low Stack Velocity: If stack nozzle discharge velocity with corresponding pressure drops below 3000 FPM (adj).
      b. Exhaust fan failure: Commanded on, but the status is off.
      c. Exhaust fan operating in Hand mode: Commanded off, but the status is on.
      d. High Exhaust Air Static Pressure: If the exhaust air duct static pressure is 25 percent (adj.) greater than setpoint.
      e. Low Exhaust Air Static Pressure: If the exhaust air duct static pressure is 25 percent (adj.) less than setpoint.

END OF SECTION
SECTION 23 21 13

HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Heating Water Piping, Above Ground
   2. Chilled Water Piping, Above Grade
   3. Equipment Drains and Overflows
   4. Unions

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Welding Certificates: Copies of certificates for welding procedures and personnel.
   2. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
      a. Test procedures used.
      b. Test results that comply with requirements.
      c. Failed test results and corrective action taken to achieve requirements.
   3. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at project site.
   4. Buried piping manufacturer to submit thrust block (chilled water) and anchor plate (heating hot water) layout and details including anchorage and seismic calculations.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Installer Qualifications: Company specializing in performing work of the type specified in this Section, with documented experience.
   2. Welder Qualifications: Certify in accordance with ASME (BPV IX).
   3. ASME Compliance: Comply with ASME B31.9 "Building Services Piping" for materials, products, and installation. Provide safety valves and pressure vessels with the
appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 01.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements, General Requirements.

PART 2 - PRODUCTS

2.1 HEATING WATER PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53/A 53M, Schedule 40, black, Type E (electric resistance welded), Grade B.
   2. Wrought Cast and Forged Steel Flanges and Flanged Fittings: ASME B16.5 including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      b. End Connections: Butt welding.
      c. Facings: Raised face.
   3. Joints: Threaded or AWS D1.1 welded.

B. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), drawn.
   2. Joints: Solder, lead free ASTM B32, HB alloy (95-5 tin antimony), or tin and silver.
   3. Joints: Brazed, AWS A5.8, Classification BAg-1 (silver). Pipes 2-1/2-inches or larger or piping routed over food preparation centers, food serving facilities, and food storage areas.

2.2 CHILLED WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A 53/A 53M, Schedule 40, black, Type E (electric resistance welded), Grade B.
   2. Wrought Cast and Forged Steel Flanges and Flanged Fittings: ASME B16.5 including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      b. End Connections: Butt welding.
      c. Facings: Raised face.
   3. Joints: Threaded or AWS D1.1 welded.

B. Copper Tube: ASTM B 88 (ASTM B 88M), Type K (A), hard drawn.
   2. Joints: Solder, lead free ASTM B32, HB alloy (95-5 tin antimony), or tin and silver.
   3. Joints: Brazed, AWS A5.8, Classification BAg-1 (silver). Pipes 2-1/2-inches or larger or piping routed over food preparation centers, food serving facilities, or food storage areas.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), drawn.
1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
2. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.
3. Joints: Brazed, AWS A5.8, Classification BAg-1 (silver). Pipes 2-1/2-inch or larger or piping routed over food preparation centers, food serving facilities, and food storage areas.

2.4 UNIONS

A. Unions for Pipe 2-inches and Under:
   2. Copper Pipe: Bronze, soldered joints, ASME B16.22.

B. Dielectric Connections: Provide dielectric waterway or brass nipple fitting with threaded ends. Dielectric unions are not allowed.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install per manufacturer's written instructions and requirements.

B. Preparation:
   2. Remove scale and dirt on inside and outside before assembly.
   3. Prepare piping connections to equipment with flanges or unions.
   4. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

C. Above Ground Piping Installation:
   1. Install per manufacturer's written instructions and requirements.
   2. Install heating water piping to ASME B31.9 requirements. Install chilled water piping to ASME B31.5 requirements.
   3. Route piping in orderly manner, parallel to building structure, and maintain gradient.
   4. Install piping to conserve building space and to avoid interference with use of space.
   5. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
   6. Sleeve pipe passing through partitions, walls and floors allowing adequate space for pipe insulation.
   7. Slope piping at 0.2 percent upward in direction of flow and arrange to drain at low points.
   8. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
   9. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
10. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
11. Anchor piping for proper direction of expansion and contraction.
12. Inserts:
   a. Provide inserts for placement in concrete formwork.
b. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
c. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4-inches.
d. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
e. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

13. Pipe Hangers and Supports:
   a. Install in accordance with Division 23, HVAC, Hangers and Supports.
   b. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
   c. Place hangers within 12-inches of each horizontal elbow.
   d. Use hangers with 1-1/2-inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   e. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   f. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.
   g. Provide copper plated hangers and supports for copper piping.
   h. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

14. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

15. Provide access where valves and fittings are not exposed.

16. Use eccentric reducers to maintain top of pipe level.

17. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

18. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.

D. Field Quality Control:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush system with clean water. Clean strainers.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, provide closure capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
   6. Perform the following tests on hydronic piping:
      a. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
      b. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
      c. Check expansion tanks to determine that they are not air bound and that system is full of water.
      d. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure not-to-exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to
pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."

c. After hydrostatic test pressure has been applied for at least four hours, examine piping, joints and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

d. Prepare written report of testing.

E. Flushing and Cleaning of Piping Systems:

1. Clean piping systems thoroughly. Purge pipe of construction debris and contamination before placing the piping systems in service. Provide temporary connections for cleaning, purging, and circulating fluids through the piping system.

2. Use temporary strainers and temporary pumps that can create fluid velocities up to 10 feet per second to flush and clean the piping systems. Do not use Owner's permanent strainers to trap debris during pipe flushing operations. Fit the temporary construction strainers with a line size blowoff valve.

3. When constructing minor piping modifications or additions, verify with Owner if the Owner's pumps and strainers can be used for flushing and chemical cleaning operations. When the flushing and cleaning operations are complete, ensure the strainer baskets and screens installed in the piping systems permanent strainers are replaced with clean elements. Keep temporary strainers in service until the equipment has been tested, then replace straining element with a new strainer and clean and deliver the old straining elements to Owner. Fit the Owner's strainers with a line size blowoff valve.

4. Circulate a chemical cleaner in chilled and heating water piping systems to remove mill scale, grease, oil, and silt. Cleaner to be selected by chemical treatment vendor on project. Circulate for 48 hours, flush system and replace with clean water. Dispose of chemical solution in accordance with local codes. The chilled and heating water system should then be treated with chemicals and inhibitors to be selected by chemical treatment vendor on project. When the chemical cleaning is complete, remove, clean, and reinstall all permanent screens. Notify Owner so that the reinstallation of clean strainer screens may be witnessed.

END OF SECTION
SECTION 23 21 16
HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Air Vents
   2. Instrument Probe Fittings
   3. Strainers

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 01 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.
   2. Certificates: Inspection certificates for pressure vessels from Authority Having Jurisdiction (AHJ).
   3. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
   4. Project Record Documents: Record actual locations of flow controls.
      a. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
1. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this Section, with minimum three years of documented experience.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Air Vents:
   2. ITT Bell & Gossett.
   3. Taco, Inc.
   4. Hoffman
   5. Amtrol
   6. Metraflex
   7. Or equal.

B. Instrument Probe Fittings:
   1. Pete's Plug
   2. Or equal.

C. Strainers:
   1. Armstrong International
   2. Mueller
   3. Keckley
   4. Hoffman
   5. Wheatly
   6. Or equal.

2.2 AIR VENTS

A. Manual Type: Short vertical sections of pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber.
B. Automatic Float Type: Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2.3 INSTRUMENT PROBE FITTINGS

A. Brass or stainless steel body and cap, high pressure rated, valve material neoprene, Nordal or Viton to suit temperature range, 1/4-inch or 1/2-inch NPT tailpiece.

2.4 STRAINERS

A. Size 2-inches and Under: Screwed brass or iron body for 175 PSI working pressure, Y pattern with 1/16-inch stainless steel perforated screen.

B. Size 2-1/2-inches and Larger: Flanged or grooved and above: iron body for 175 PSI working pressure, Y pattern with 1/16 stainless steel perforated screen.

C. Basket Pattern: Flanged iron body for 175 PSI working pressure, basket pattern with 1/8-inch stainless steel perforated screen, clamped or bolted cover.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install specialties in accordance with manufacturer's instructions.

B. Support pump fittings with floor mounted pipe and flange supports. Provide vibration isolation, same as pump, to avoid short circuiting.

3.2 AIR VENTS

A. Where large air quantities can accumulate, provide enlarged air collection standpipes.

B. Automatic: Furnish and install automatic air vents in mechanical equipment rooms and outdoors only. Install at high points of system piping, at heat transfer coils, and elsewhere as required for system air venting. Vents: 3/4-inch with 1/2-inch IPS drain piping to the nearest floor drain or other approved location. Provide a ball valve and union ahead of all automatic air vents. Do not install above ceilings or locations where discharge may occur and cause damage.

C. Manual Vents: Provide at high points of system piping, at heat transfer coils, and elsewhere as required for system venting where automatic air vents are not to be installed. Provide 10-inch length of 1/4-inch copper tube with 180 degree bend down to discharge into hand-held bucket.

3.3 INSTRUMENT PROBE FITTINGS

A. Test Plugs: Install where indicated and in accordance with the manufacturer's recommendations.
3.4 STRAINERS

A. Provide valved drain and hose connection on strainer blow down connection.

END OF SECTION
SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Ductwork, Joints and Fittings
   2. Insulated Flexible Duct
   3. Drain Pans
   4. Ductwork Joint Sealers and Sealants

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. Section 23 05 29, Hangers and Supports for HVAC Piping, Ductwork and Equipment.
   2. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Welding Certificates
   2. Field Quality Control Reports

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. NFPA Compliance:
      a. NFPA 90A Installation of Air Conditioning and Ventilating Systems.
      b. NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
   2. Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Provide sheet metal materials free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
   3. If required, provide ductwork pressure testing per Section 23 05 93, Testing, Adjusting and Balancing for HVAC.
1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Duct design is generally diagrammatic and is not meant to be scaled. Major changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Ductwork, Joints, and Fittings:
   1. Ductmate
   2. Lindab Inc
   3. Nexus Inc
   4. SEMCO
   5. United McGill Corporation
   6. Ward Industries
   7. Or equal.

B. Insulated Flexible Duct:
   1. ATCO
   2. Flexmaster
   3. J.P. Lamborn Co.
   4. Hart and Cooley
   5. Or equal.

C. Ductwork Joint Sealers and Sealants
   1. Ductmate
   2. Durodyne
   3. Hardcast
   4. United McGill Corporation
   5. Vulkem
   6. Foster
   7. Childer
   8. Or equal

2.2 DUCTWORK, JOINTS AND FITTINGS

A. Materials:
1. Galvanized Steel Ducts: Hot-dipped galvanized sheet, lock-forming quality, ASTM A 653/A 653M FS Type B, with G90/Z275 coating. Ducts to have mill phosphatized finish for surfaces exposed to view.

B. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
   1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
   2. Deflection: Duct systems not-to-exceed deflection limits according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
   3. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

C. Formed-On Flanges: construct according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Figure 1-4, using corner, bolt, cleat, and gasket details.
   1. Duct Size: Maximum 30-inches wide and up to 2-inch wg pressure class.
   2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
   3. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19-inches and larger and 0.0359-inch thick or less, with more than 10 SF of nonbraced panel area unless ducts are lined.

D. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of material specified in this Section according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
   1. Ducts up to 20-inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
   2. Ducts 21- to 72-inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
   3. Ducts Larger than 72-inches in Diameter: Companion angle flanged joints per SMACNA HVAC Duct Construction Standards-Metal and Flexible, Figure 3-2.
   4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

E. 90-Degree Tees and laterals and Conical Tees: Fabricate to comply with SMACNA's HVAC Duct Construction Standards-Metal and Flexible, with metal thicknesses specified for longitudinal-seam straight ducts.

F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows to be 1.5 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
   1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's HVAC Duct Construction Standards-Metal and flexible, unless otherwise indicated.
2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):
   a. Ducts 3- to 36-inches in Diameter: 0.034-inch.
   b. Ducts 37- to 50-inches in Diameter: 0.040-inch.
3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
   a. Ducts 3- to 26-inches in Diameter: 0.034-inch.
   b. Ducts 27- to 50-inches in Diameter: 0.040-inch.
4. 90-Degree, Two-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
5. Round Elbows
   a. 8-inches and Less in Diameter: Fabricate die-formed elbows for 45 and 90-degree elbows and pleated elbows for 30, 45, 60 and 90 degrees only. Fabricate nonstandard bend-angle configurations or non-standard diameter elbows with gored construction.
   b. 9 through 14-inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60 and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
   c. Larger than 14-inches in Diameter: Fabricate gored elbows unless space restrictions require mitered elbows.
6. Die-Formed Elbows for Sizes through 8-inches in Diameter and Pressures 0.040-inch thick with two-piece welded construction.
7. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
8. Pleated Elbows for Sizes through 14-inches in Diameter and Pressures through 10-inch wg (2500 Pa): 0.022-inch.
9. Not acceptable:
   a. Corrugated or flexible metal duct.
   b. Adjustable elbows.

2.3 INSULATED FLEXIBLE DUCT

A. Construction: Standard factory fabricated product. Inner wall: Impervious vinyl or chlorinated polyethylene, permanently bonded to a vinyl or zinc-coated spring steel helix.

B. Insulation: Fiberglass blanket insulation covered by an outer wall of vinyl or fiberglass-reinforced metalized vapor barrier.

C. Listing: UL 181 listed Class 1 flexible air duct material. Overall thermal transmission: No more than 0.25 BTU/in or hr/sq. degrees F at 75 degrees F differential, per ASTM C335.

D. Vapor transmission value no more than 0.10 perm, per ASTM E96

E. Pressure Rating: 4-inch wg positive pressure and 1-inch wg negative pressure.

F. Performance Air Friction Correction Factor: 1.3 maximum at 95 percent extension. Working air velocity: Minimum 2000 FPM.

G. Flame Spread Rating: No more than 25.
H. Smoke Development Rating: No more than 50 as tested per ASTM E84.

I. Insertion Loss: Minimum attenuation of 29 DB for 10-foot straight length at 8-inch diameter at 500 Hz.

2.4 DRAIN PANS

A. Primary Drain Pans: Stainless Steel, Fabricated in accordance with ASTM A167 and A480.


2.5 DUCTWORK JOINT SEALERS AND SEALANTS

A. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

B. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure and leakage class of ducts.

C. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E 84.

D. Water Based Sealant for Brush-On Application: Flexible, adhesive sealant, resistant to UV light, UL-181A, and UL-181-B listed, complying with NFPA requirements for Class 1 ducts. Min. 69 percent solids, nonflammable. Hardcast Versa-Grip 181; Childers CP-146; Foster 32-19 for SMACNA 1/2, 1, 2, 3, 4, 6, and 10-inch WG duct classes, and SMACNA Seal Class A, B, or C.

E. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.

F. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

G. Polyurethane Sealant: General-purpose, exterior use, non-brittle sealant for gunned application. Vulkem 616 or equal.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. General: Use the following pressure class(es) in design of ductwork specified in this section unless otherwise noted on Drawings.

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>PRESSURE IP (inches of water)</th>
<th>LEAKAGE CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium pressure supply (fan to terminal unit)</td>
<td>0.5-inch higher than air handlers discharge pressure (min 4-inch pressure class).</td>
<td>A</td>
</tr>
<tr>
<td>Low pressure supply (downstream of terminal unit)</td>
<td>+ 1-inch</td>
<td>A</td>
</tr>
<tr>
<td>Return main (&gt;24-inch)</td>
<td>0.5-inch more negative than return/exhaust fan pressure or -2-inch pressure class, whichever is more negative.</td>
<td>A</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>---</td>
</tr>
</tbody>
</table>
| Return branch (<24-inch) | 0.5-inch more negative than return/exhaust fan pressure or -2-inch pressure class, whichever is more negative. | B, up to -3-inch wg.  
A, more negative than -3-inch wg. |
| General exhaust | 0.5-inch more negative than return/exhaust fan pressure or -2-inch pressure class, whichever is more negative. | B, up to -3-inch wg.  
A, more negative than -3-inch wg. |
| Lab medium pressure exhaust  
(tactical unit to fan) | -6-inch | A |
| Lab low pressure exhaust  
(upstream of terminal unit) | -1-inch | A |
| Hazardous exhaust | -6-inch | A |

B. Ductwork Installation:
1. General: Install entire duct system in accordance with drawings, Specifications, and latest issues of local Mechanical Code, NFPA 90A, and SMACNA Duct Construction Manual. At Contractor's option, rectangular ductwork may be resized to maintain an equivalent air velocity and friction rate, while maintaining a maximum aspect ratio of 3. Remove markings and tagging from ductwork exterior surface in mechanical rooms and other locations where ductwork is exposed.
2. The duct layout shown on the Contract Drawings is diagrammatic in nature. Coordinate the ductwork routing and layout, and make alterations to the ductwork routing and layout to eliminate physical interferences. Where deviations in the ductwork routing as shown in the Contract Drawings are required, alterations may be made so as not to compromise the air flow, pressure drop, and sound characteristics of the duct fitting or duct run as shown on the Contract Drawings. In the event Architect determines that the installed ductwork is inconsistent with the above mentioned criteria, remove and replace at no additional cost to the Owner.
3. Install ducts with fewest possible joints.
4. Install fabricated fittings for changes in directions, size, shape, and for connections.
5. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12-inches, with a minimum of 3 screws in each coupling.
6. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
7. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
9. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
10. Coordinate layout with suspended ceiling, air duct accessories, lighting layouts, and similar finish work.
11. Electrical and IT Equipment Spaces: route ducts to avoid passing through transformer vaults, electrical equipment spaces, IDF/MPOE rooms, and enclosures.

12. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2-inches.

13. Fire- and Smoke-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire, smoke or combination fire and smoke dampers as governed by Building Code and AHJ, including sleeves, and firestopping sealant.


15. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA’s Duct Cleanliness for New Construction Advanced Level.

16. Paint interiors of metal ducts, that do not have duct liner, for 24-inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible duct material.

17. Install ductwork in the location and manner shown and detailed. Review deviations required by job conditions with Architect prior to any fabrication. Provide fittings for construction per SMACNA.

C. Flanged Take-Offs:
   1. Install at branch takeoffs to outlets using round or flex duct.
   2. Flanged take-offs secured with minimum 8-inch screw spacing (three screws minimum).
   3. Provide ductwork taps and branches off of main ducts at 45 degrees whether shown on Drawings or not (drawings are diagrammatic).

D. Cleaning:
   1. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.
   2. Grille and Exposed Duct Cleaning:
      a. After completion of ductwork installation, operate each fan system (excluding exhaust fans) for a minimum of 30 minutes prior to installation of ceiling grilles and diffusers. After grilles and diffusers are installed, clean out accumulation of particles from grilles and diffusers prior to acceptance.
      b. Clean exterior surface of ducts exposed to public view of chalk, pencil and pen marks, labels, sizing tags, dirt, dust, etc., so that upon completion of installation, ducts are left in clean and unblemished manufactured conditions.
      c. Exposed duct and grilles to remain free of dust entrained streaks due to leakage at joints and grille connections during warranty period. Clean leaks, seal and refinish to match existing if visible streaks develop.

3.2 DUCTWORK, JOINTS AND FITTINGS INSTALLATION

A. Duct Materials - Applied Locations:
1. General: Use the following materials in design of ductwork specified in this Section unless otherwise noted on the Drawings.

<table>
<thead>
<tr>
<th>Location or Application</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply, Return, Transfer, and Exhaust - Low Pressure (downstream of terminal units)</td>
<td>Galvanized Steel</td>
</tr>
<tr>
<td>Supply, Return, and Exhaust - Medium Pressure (upstream of terminal units)</td>
<td>Galvanized Steel</td>
</tr>
<tr>
<td>Fume Hood Exhaust</td>
<td>Single Wall, Type 316 Stainless Steel</td>
</tr>
</tbody>
</table>

B. Ductwork Installation:
1. Fabricate radius elbows with centerline radius not less than 1-1/2 duct diameters.
2. Do not install duct size transition pitch angles which exceed 30 degrees for reductions in duct size in the direction of airflow, and 15 degrees for expansions in duct size in the direction of airflow.
3. Install fixed turning vanes in square throat rectangular elbows and in tees.
4. Fabricate duct turns with the inside (smallest) radius at least equal to the duct width (supply ducts) and 1.5 times radius (return and exhaust ducts). Where necessary, square elbows may be used, with maximum available inside radius and with fixed turning vanes. In healthcare settings such as hospitals and medical office buildings, square elbows and turning vanes allowed on supply ductwork only.

3.3 INSULATED FLEXIBLE DUCT INSTALLATION

A. Provide sheet metal plenum or rigid elbow and connect to diffusers and grilles with ductwork connections. Refer to Drawings for more information. Provide straight section of flexible duct with minimum length of 2-feet and maximum length of 5-feet and connect to sheet metal plenums and rigid elbows connected to diffusers and grilles, unless noted otherwise.
1. Provide round neck grilles/diffusers or square-to-round transitions. Flexible duct connections directly to diffuser and grilles is not allowed.
2. Flexible duct allowed in concealed spaces above lay-in ceilings only.

3.4 DRAIN PANS INSTALLATION

A. Install where shown on Drawings. Drain provided by Division 22, Plumbing. Provide drain (sized per code) connection from each drain pan and pipe to nearest floor drain through trap and 10-inch air gap. Drain pans over 6-feet in length require drain connections from both ends. Pitch drain pans in direction of air flow and to drain. Support secondary drain pan independently from equipment.

3.5 DUCTWORK JOINT SEALERS AND SEALANTS INSTALLATION

A. Joints and Seam Joint Sealing:
1. Seal duct seams and joints according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible for duct pressure class indicated.
2. For 1/2- and 1-inch wg pressure classes, seal transverse joints.
3. For 2- and 3-inch wg pressure classes, seal transverse joints and longitudinal seams.
4. For pressure classes more than 3-inch wg, seal transverse joints, longitudinal seams and duct wall penetrations including screw, fastener, pipe, rod, and wire.
5. Seal ducts before external insulation is applied.
6. Fasteners such as sheet-metal screws, machine screws or rivets to be cadmium plated.
7. Rectangular Ductwork: Where intermediate joint reinforcement is required for duct of negative pressure class, pre-drill stiffening flange and provide fastener maximum 8-inches on center. Where retaining flanges are welded to duct wall, paint welds with zinc coating.
8. Single Wall Round Ductwork: Joint to incorporate beaded slip collar with minimum #8 sheet metal screws 8-inches on center. Seal ductwork as specified in this Section.
9. Seal joints and seams. Apply sealant to make end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
10. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
11. Provide openings in ductwork where required to accommodate thermometers and control devices. 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.
12. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities as well as Code required clearances.

END OF SECTION
SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Sheet Metal Materials
   2. Backdraft Dampers
   3. Dampers
   4. Concealed Damper Hardware
   5. Access Doors
   6. Duct Test Holes
   7. Control Dampers
   8. Turning Vanes
   9. Flexible Connectors

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Manufacturer's catalog data and fabrication/installation drawings for each factory fabricated duct accessory. Include leakage, pressure drop and maximum back pressure data.
   2. Shop Drawings: Indicate air duct accessories.
   3. Manufacturer's installation instructions: Provide instructions for each factory fabricated duct accessory.
   4. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
      a. See Division 01, General Requirements, Product Requirements for additional provisions.
      b. Extra Fusible Links: One of each type and size.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
1. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this Section, with minimum five years of documented experience.
2. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
3. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
4. AMCA 511 - Certified Ratings Program for Air Control Devices.
5. CSFM - California State Fire Marshal Listing for Fire Damper and Smoke Damper.
8. NFPA 92B - Smoke Control Systems in Atria, Covered Malls and Large Areas.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Backdraft Dampers:
   1. Air Balance
   2. Cesco
   3. Greenheck
   4. Nailor
   5. Ruskin
   6. Or equal.

B. Dampers:
   1. Air Balance
   2. Cesco
   3. Greenheck
   4. Nailor
   5. Ruskin
   6. Or equal.

C. Concealed Damper Hardware, Cable System:
   1. Young Regulator Company
   2. Or equal.

D. Access Doors:
   1. Ductmate
   2. Cesco
   3. Ruskin
   4. Nailor
   5. Outdoor Installation: Karp MX insulated exterior access door.
6. Or equal.

E. Duct Test Holes:
   1. Ventlok
   2. Or equal.

F. Control Dampers:
   1. Ruskin
   2. Greenheck
   3. CESCO
   4. Air Balance
   5. Nailor
   6. Or equal.

G. Turning Vanes:
   1. Aerodyne
   2. Ductmate Industries
   3. Duro Dyne Corp
   4. Metalaire Inc.
   5. Ward Industries
   6. Or equal.

H. Flexible Connectors:
   1. Duro Dyne Corp.
   2. Ventfabrics Inc.
   3. Ward Industries
   4. Or equal.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M. Galvanizing: 1-1/4 ounces per square foot total both sides; ducts to have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M.

D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36-inches or less; 3/8-inch minimum diameter for lengths longer than 36-inches.

2.3 BACKDRAFT DAMPERS

A. Basis-of-Design: Ruskin CB D6.
B. Description: Multiple-blade gravity balanced with center pivoted blades with sealed edges, assembled in rattle free manner with 90-degree stop, adjustment device to permit setting for varying differential static pressure.

C. Frame: 0.125-inch thick 6063-T5 extruded aluminum channel with galvanized steel braces at mitered corners. Provide mounting flange.

D. Blades: Single piece, overlap frame, parallel action, horizontal orientation, minimum 0.07-inch 6063-T5 extruded aluminum material, maximum 6-inch width.

E. Bearings: Corrosion-resistant synthetic, formed as single piece with axles.

F. Blade Seals: Extruded vinyl, mechanically attached to blade edge.

G. Blade Axles: Corrosion-resistant, synthetic formed as single piece with bearings, locked to blade.

H. Tie Bars and Brackets: Galvanized steel.

I. Return Spring: Adjustable tension.

J. Damper Capacity:
   2. Open Position: Maximum air velocity of 2,500-feet per minute.

K. Counterbalances: Adjustable zinc plated steel weights mechanically attached to blade. Must be capable of operating over wide range of pressures.

L. Finish: Mill aluminum.

M. Temperature Rating: -40 degrees F to 200 degrees F.

N. Operation of Blade:
   1. Start to Open: 0.01-inch wg
   2. Fully Open: 0.05-inch.

O. Pressure Drop: Maximum 0.15-inch wg at 1,500-feet per minute through 24-inch by 24-inch damper.

P. Factory Sleeve: Minimum 20 gauge thickness, 12-inches in length.

Q. Screen: At outdoor intake or discharge. 1/4-inch aluminum.

2.4 DAMPERS

A. Basis-of-Design: Ruskin MD 35.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
1. **Pressure Classes of 3-Inch wg (750 Pa) or Higher:** End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

C. **Rectangular Volume Dampers:** Multiple- or single-blade, parallel- or opposed-blade design with linkage concealed in frame and suitable for horizontal or vertical applications.
   1. **Steel Frames:** Hat-shaped, galvanized sheet steel channels, minimum 16 gauge thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
      a. **Roll-Formed Steel Blades:** 16 gauge thick, galvanized sheet steel.
      b. **Blade Axles:** Minimum 1/2-inch diameter, plated steel, hex shaped, mechanically attached to blade.
      c. **Bearings:** Molded synthetic sleeve, turning in extruded hole in frame.
      d. **Tie Bars and Brackets:** Galvanized steel.
      e. **Mill galvanized.**
      f. **Capacity:**
         1) **Closed Position:** Maximum pressure of 3-inches wg.
         2) **Open Position:** Maximum air velocity of 1,500-feet per minute across 24-inch by 24-inch damper.

D. **Round Volume Dampers:** Single-blade suitable for horizontal or vertical applications.
   1. **Steel Frames:** Galvanized, roll formed, minimum of 20 gauge thick with beads at each end.
   2. **Blades:** Minimum 20 gauge thick, galvanized sheet steel, round, single-piece.
   3. **Blade Axles:** Minimum 3/8-inch square, plated steel, mechanically attached to blade.
   4. **Bearings:** Molded synthetic sleeve, turning in hole in frame.
   5. **Finish:** Mill galvanized.
   6. **Capacity:**
      a. **Closed Position:** Maximum pressure of 3-inches wg
      b. **Open Position:** Maximum air velocity of 1,500-feet per minute.
   7. **Leakage:** Maximum 40 cfm at 1-inch wg for 20-inches diameter damper.
   8. **Pressure Drop:** Maximum 0.02-inch wg at 1,500-feet per minute through 20-inch diameter dampers.

E. **Jackshaft:** 1-inch diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mufflon and at each end of multiple-damper assemblies.
   1. **Length and Number of Mountings:** Appropriate to connect linkage of each damper in multiple-damper assembly.
   2. **Damper Hardware:** Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include 2-inch elevated platform for insulated duct mounting.

2.5 **CONCEALED DAMPER HARDWARE**

A. **Concealed Damper Hardware:** For dampers above non-removable ceilings (gyp, plaster, decorative, etc.) where access panels have not been shown on Architectural drawings or in locations where dampers are more than 2-feet above the ceiling, provide:
   1. **Concealed Damper Regulator:** Young Regulator Company Model 315 or equal.
   2. **Cable System:** Young Regulator Company or equal.
   3. **Controller:** Young Regulator Company 270-275 or equal.
4. Control wrenches, wire stops, casing nuts, and stainless steel wire.
5. Paint cover plate to match ceiling color or as directed by Architect.

2.6 ACCESS DOORS

A. Duct Pressure Class 2-inch WC and Greater: Sandwich-type design with threaded locking bolt assembly. Closed cell neoprene gasket permanently bonded to inside panel. Zinc-coated steel wing nuts or polypropylene molded knobs with threaded metal inserts - zinc coated bolts sealed to inner panel.

B. Duct Pressure Class 1-1/2-inch WC and Less: Galvanized steel assembly incorporating frame, door, hinges, and latch(es). Frame tabbed for attachment to duct panel. Double wall door panel with 1-inch insulation. Open cell neoprene gasket attached to frame. Cam latches for tight closure.

C. Plenum Doors: Extruded aluminum frames with extruded santoprene seals. Double-wall 20 gauge galvanized steel door panel with fiberglass insulation.

D. Size: Maximum size available to fit rectangular duct panel dimension or round duct diameter. Plenum doors minimum 2-feet wide by 4-feet high.

E. For outdoor installation, only provide waterproof access doors installed vertically.

2.7 DUCT TEST HOLES

A. Temporary Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.

2.8 CONTROL DAMPERS

A. Basis-of-Design:
   1. Ruskin Model CD36, low leakage, for use in low pressure ductwork.
   2. Ruskin Model CDR25, low leakage, for use in low pressure round ductwork.
   3. Ruskin Model CDO25, low leakage, for use in low pressure oval ductwork.
   4. Ruskin Model CD60, ultra low leakage, for use in medium pressure ductwork.

B. Fabrication:
   1. Frame: 16 gauge roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gauge U-channel.
   2. Blades (Low Leakage Dampers):
      a. Style: Single skin with 3 longitudinal grooves.
      b. Action: Opposed blade for modulating applications, parallel blade for two position application.
      c. Orientation: Horizontal or vertical with thrust washers.
      d. Material: Minimum 16 gauge equivalent thickness, galvanized steel.
      e. Width: Nominal 6-inches.
   3. Blades (Ultra Low Leakage Dampers):
b. Action: Opposed blade for modulating applications, parallel blade for two position applications.

c. Orientation: Horizontal or vertical with thrust washers.

d. Material: Minimum 14 gauge equivalent thickness, galvanized steel.

e. Width: Nominal 6-inches.


5. Seals:


7. Axles: Minimum 1/2-inch diameter plated steel, hex-shaped, mechanically attached to blade.

8. Mounting: Vertical or horizontal.


C. Performance Data (Low Leakage Dampers):

1. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
   a. Closed Position: Maximum pressure of 5-inches wg at a 12-inch blade length.
   b. Open Position: Maximum air velocity of 2,000-feet per minute.

2. Leakage: Maximum 3.7 cubic-feet per minute per square foot at 1-inch wg for sizes 36-inches wide and above.

3. Pressure Drop: Maximum 0.07-inch wg at 1,500-feet per minute across 24-inch by 24-inch damper.

D. Performance Data (Ultra Low Leakage Dampers):

1. Leakage: Damper to have a maximum leakage of 3 cfm per square foot at 1-inch wg and be AMCA licensed as Class 1A.

2. Differential Pressure:
   a. Damper to have a maximum differential pressure rating of 13-inch wg for a 12-inch blade.

3. Velocity: Damper to have a maximum velocity rating of 6,000-feet per minute.

4. Temperature: Damper rated for -72 degrees F to 275 degrees F.

5. Pressure Drop: Maximum 0.1-inch wg at 2,000-feet per minute across 24-inch by 24-inch damper.

E. Actuator: Provide actuator. See Specification Section 23 09 00, Instrumentation and Control for HVAC.

F. Factory flange frame

G. Factory Sleeve: Minimum 20 gauge thickness.

H. Duct Transition Connection: Per Drawings.

I. Factory Tests: Factory cycle damper assembly to assure proper operation.
2.9 **TURNING VANES**

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners to automatically align vanes.

B. Manufactured Turning Vanes: For medium pressure ductwork, ductwork upstream of terminal units, and in ductwork with equal inlet width and height dimensions and outlet width and height dimension, provide double thickness airfoil turning vanes. Low pressure ductwork and ductwork downstream of terminal units use either single thickness or double thickness turning vanes. For mitered rectangular elbows with changes in size from inlet to outlet, only use single thickness turning vanes. Use 2-inch radius vanes spaced on centers of 1.5-inches for single thickness. Use 2-inch radius vanes spaced on centers of 2.125-inches for double thickness.

C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.10 **FLEXIBLE CONNECTORS**

A. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

B. Metal-Edged Connectors: Factory fabricated with a fabric strip 4-inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Select metal compatible with ducts.

   1. Minimum Weight: 26 ounces per square yard.
   2. Tensile Strength: 480 pounds of force per in the warp and 360 pounds of force per inch in the filling.
   3. Service Temperature: -40 degrees F to 200 degrees F.

   1. Minimum Weight: 14 ounces per square yard.
   2. Tensile Strength: 450 pounds of force per inch in the warp and 340 pounds of force per inch in the filling.
   3. Service Temperature: -67 degrees F to 500 degrees F.

**PART 3 - EXECUTION**

3.1 **DUCT ACCESSORIES GENERAL INSTALLATION**

A. Inspect areas to receive air duct accessories. Notify Engineer of conditions that would adversely affect the installation of the dampers. Do not proceed until conditions are corrected.

B. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.
C. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

D. Do not compress or stretch damper frames into duct or opening.

E. Handle dampers using sleeve or frame. Do not lift dampers using blades, actuators, or jack shafts.

F. Adjust duct accessories for proper settings.

3.2 SHEET METAL MATERIALS INSTALLATION

A. Install bracing for multiple sections to support assembly weights and hold against system pressure. Install bracing as needed.

3.3 BACKDRAFT DAMPERS INSTALLATION

A. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated. Provide at outside air intakes where motorized dampers are not shown on drawings.

3.4 DAMPERS INSTALLATION

A. Where installing volume dampers in ducts with liner, avoid damage to and erosion of duct liner.

B. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts for air balancing. Install at a minimum of two duct widths from each branch takeoff. Provide balancing dampers for all air inlets and outlets.

C. Install dampers square and free from racking with blade running horizontally.

3.5 CONCEALED DAMPER HARDWARE INSTALLATION

A. Coordinate location in Reflected Ceiling Plan and color of concealed damper hardware with Architect prior to installation.

3.6 ACCESS DOORS INSTALLATION

A. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
   1. On both sides of duct coils.
   2. Downstream from volume dampers, turning vanes and equipment.
   3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
   4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot (15-m) spacing.
   5. Install the following sizes for duct-mounting, rectangular access doors:
      a. One-Hand or Inspection Access: 8-inches by 5-inches.
6. Install the following sizes for duct-mounting, round access doors:
a. One-Hand or Inspection Access: 8-inches in diameter.
c. Head and Hand Access: 12-inches in diameter.
7. Label access doors.

3.7 DUCT TEST HOLES INSTALLATION
A. Provide test holes at fan inlets and outlets where indicated and where required for air testing and balancing.

3.8 CONTROL DAMPERS INSTALLATION
A. Handle dampers using sleeve or frame. Do not lift dampers using blades, actuators or jack shafts.
B. Install control dampers in accordance with manufacturer's written instructions.

3.9 TURNING VANES INSTALLATION
A. Vanes must be installed, eliminating every other vane is not allowed.
B. Single thickness vanes cannot be over 36-inches long without intermediate vane runner.
C. Install per SMACNA and fasten/support to prevent vibration, noise, and to maintain proper alignment at design velocity

3.10 FLEXIBLE CONNECTORS INSTALLATION
A. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators. Provide sheet metal weather cover over flexible connections located outdoors. Attach sheet metal to either equipment side or ductwork side, but not both.
B. Per NFPA, do not use flexible connectors on grease exhaust fans
C. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
D. Adjust the following types in the following locations:
   1. FC-I: Indoors.
   2. FC-HC: High corrosive systems inclusive of all laboratory exhaust systems.

END OF SECTION
SECTION 23 34 00

HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Centrifugal Fans

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material gauges and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Motors: Premium efficiency per Section 23 05 13, Common Motor Requirements for HVAC Equipment. Electrically Commutated Motors (ECM) where scheduled on Drawings.
   2. Sound power levels as scheduled on Drawings. If not scheduled, within 5 percent of Basis of Design at design flow.
   3. Project Altitude: Base air ratings on sea-level conditions for project sites below 2,000 feet in elevation. Base air ratings on actual site elevations for project sites above 2,000 feet in elevation.
   4. Operating Limits: Classify according to AMCA 99.
   5. 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.
6. AMCA Compliance: Products are to comply with performance requirements and are to be licensed to use the AMCA-Certified Ratings Seal.
7. NEMA Compliance: Motors and electrical accessories are to comply with NEMA standards.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
C. Lift and support units with manufacturer's designated lifting or supporting points.

1.8 COORDINATION

A. Coordinate size and location of structural-steel support members.
B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Centrifugal Fans:
   1. Greenheck
   2. Twin City
   3. Loren Cook Company
   4. PennBarry
   5. American Fan
   6. Or equal.

2.2 CENTRIFUGAL FANS

A. Description: Centrifugal or utility type centrifugal fans, as indicated, standard factory finish, AMCA rated, single width, single inlet, double width, double inlet, forward curved, backward inclined, or airfoil blades as scheduled.
B. Wheel and Inlet:
1. Backward Inclined: Steel or aluminum construction with smooth curved inlet flange, heavy back plate, backwardly curved blades welded or riveted to flange and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.
2. Airfoil Wheel: Steel construction with smooth curved inlet flange, heavy back plate die formed hollow airfoil shaped blades continuously welded at tip flange, and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.
3. Radial: Steel construction with inlet flange, heavy reinforced back plate, plate blades with reinforcing gussets and wearing strips, welded or riveted to back plate and flange, cast iron or cast steel, hub riveted to back plate and keyed to shaft with set screws.
4. Statically and dynamically balance wheel within its own bearings with maximum balance quality grade at bearings of G16 (0.20 in/sec peak velocity, filter-in as measured at fan RPM) for 5 hp and below and G6.3 (0.15 in/sec peak velocity, filter-in as measured at fan RPM) for 7.5 hp and above per ANSI S2.19. AMCA 210 rated.

C. Housing:
1. Heavy gauge steel, spot welded for AMCA 99 Class I and II fans, and continuously welded for Class III, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut.
2. Finish: Factory finish to manufacturer's standard (Permatecor) or Factory finish to manufacturer's standard with Hi-Pro polyester finish exceeding 1,000 hours of salt spray under ASTM B117 test method. Prime coating of aluminum parts is not allowed.
3. Removable angles and bolts for attaching flexible connections and discharge dampers on fan outlet.
4. Housing Discharge Arrangement: Adjustable to eight standard positions.

D. Bearings and Drives
1. Bearings: Heavy duty pillow block type, self-greasing ball bearings, with ABMA 9 L-10 life at 50,000 hours.
2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil, and shaft guard. Provide anti-corrosive coating.
3. Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 5 hp and under, selected so required rpm is obtained with sheaves set at mid-position fixed sheave for 7.5 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor.
4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
5. Belt Guard: Fabricate to SMACNA Duct Construction Standards - Metal and Flexible; 0.106-inch thick, 3/4-inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

E. Motor: Integrally mounted, 1800 RPM maximum, with pre-lubricated sealed ball bearings. ODP for motors located indoors and TEFC for motors exposed to moisture.

F. Accessories:
1. Access Doors: Shaped to conform to scroll, with quick opening latch type handles and gaskets.
2. Scroll Drain: 1/2-inch steel pipe coupling welded to low point of fan scroll.
3. AMCA 99 Type B spark proof construction where scheduled.
4. Vibration isolation as scheduled and specified. Reference Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install in accordance with manufacturer's instructions.
B. Install power ventilators level and plumb.
C. Install floor-mounting units on concrete bases.
D. Units using vibration isolation devices are scheduled on Drawings.
E. Support suspended units from structure threaded steel rods and vibration isolation device scheduled on Drawings.
F. In seismic zones, restrain support units.
G. Install units with clearances for service and maintenance.
H. Provide fixed sheaves required for final air balance.
I. Pipe scroll drains to nearest floor drain.
J. Provide backdraft dampers on discharge of exhaust fans and as indicated on Drawings.
K. Duct installation and connection requirements are specified in other Division 23, HVAC Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors per Section 23 33 00, Air Duct Accessories.
L. Install ducts adjacent to power ventilators to allow service and maintenance.
M. Ground equipment.
N. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
O. Equipment Startup Checks:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Verify lubrication from bearings and other moving parts.
6. Disable automatic temperature-control operators.

P. Starting Procedures:
   1. Energize motor and adjust fan to indicated rpm.
   2. Measure and record voltage and amperage.

Q. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

R. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

S. Shut unit down and reconnect automatic temperature-control operators.

T. Replace fan and motor pulleys as required to achieve design airflow.

U. Provide totally enclosed fan cooled motors when motor is located outdoors, whether under a cover or not, or exposed to moisture.

V. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

W. Adjust damper linkages for proper damper operation.

X. Lubricate bearings.

Y. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

Z. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

AA. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC fans. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

3.2 CENTRIFUGAL FANS

A. See 3.1, General Installation Requirements above.

END OF SECTION
SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Single Duct Variable Volume and Constant Volume Units

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Titus
B. Price
C. Krueger
D. Trane
E. Nailor
F. Or equal.
2.2 SINGLE DUCT VARIABLE VOLUME AND CONSTANT VOLUME UNITS

A. Casings: Minimum 22 gauge galvanized steel.

B. 1/2-inch dual density insulation which complies with UL 181 and NFPA 90A. Exposed insulation edges to be coated with NFPA 90A approved sealant to prevent entainment of fibers in the airstream.

C. Non-porous, sealed liner which complies with UL 181 and NFPA 90A. Insulation to be 4-pound density. Cut edges must be sealed from the airstream using mechanically bonded metal barrier strips. Liners made of Mylar, Tedlar, Silane or woven fiberglass cloth are not acceptable.

D. 1-inch thick matte faced insulation, meeting UL 181 and NFPA 90A, enclosed between the unit casing and a non-perforated internal 22 gauge sheet metal cover extending over the fiberglass insulation, as well as covering the liner cut edges.

E. Plenum Air Inlets: Round stub connections or S slip drive connections for duct attachment.

F. Plenum Air Outlets: S slip and drive connections.

G. Casing Leakage: Maximum casing leakage not to exceed 10 cfm at 1-inch static pressure for inlet size larger than 12-inches and not to exceed 7 cfm at 1-inch static pressure for inlet size 12-inches and smaller.
   2. Volume Damper: Construct of galvanized steel with peripheral gasket and self lubricating bearings; maximum damper leakage: 7 cfm maximum at inlet static pressure. Shaft to be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. Damper to incorporate a mechanical stop to prevent overstrocking and a synthetic seal to limit close off leakage to the maximum values shown in the damper leakage table.
   3. Flow Sensor: Integral averaging type flow sensor utilizing multiple sensing points with unit mounted calibration chart.
   4. Mount damper operator to position damper normally open.

H. Attenuator Section: Line attenuator sections with 2-inch thick insulation.

I. Hot Water Heating Coil:
   1. Construction: 1/2-inch copper tube mechanically expanded into aluminum plate fins, leak tested under water to 200 PSIG pressure, factory installed.

J. Acoustics: Sound ratings tested as power level 10-12 watts in accordance with AHRI 880 standard at 1.5-inches WG inlet static pressure. NC ratings calculated per AHRI 885-2008 with room attenuations as listed in Appendix E, and not to exceed values scheduled on drawings.
   1. MAXIMUM AIRBORNE SOUND POWER (db)
      a. OCTAVE BAND AND CENTER FREQUENCY (HZ)
      b. Units must have 5-feet 0-inches of 2-inch thick lined duct downstream of terminal unit.
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K. DDC Controls: Damper operator, sensor, and other devices compatible with temperature controls specified in 23 09 00, Instrumentation and Control Performance Specifications.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Upon completion of installation and prior to initial operation, test and demonstrate that air terminals and duct connection to air terminals are leak tight. Repair or replace air terminals and duct connections as required to eliminate leaks and retest to demonstrate compliance.

B. Verify that installation of each air terminal is according to the Contract Documents.

C. Check that inlet duct connections are as recommended by air terminal manufacturer to achieve proper performance.

D. Check that controls and control enclosure are accessible.

E. Verify that control connections are complete.

F. Check that nameplate and identification tag are visible.

G. Verify that controls respond to inputs as specified.

3.2 SINGLE DUCT VARIABLE AND CONSTANT VOLUME UNITS

A. Install in accordance with manufacturer's instructions. Install level and plumb.

B. Provide ceiling access doors or locate units above easily removable ceiling components.

C. Support units individually from structure. Do not support from adjacent ductwork.

D. Provide 9-inch by 9-inch access door with quarter turn latches upstream and downstream of each heating coil.

E. Provide minimum five duct diameters minimum straight duct run upstream of terminal unit.
F. Minimum of 3-feet straight duct downstream of terminal unit prior to first outlet or first branch duct.

G. Branch inlet duct size to match unit inlet connection. For branch inlet ducts over 15-feet long, increase branch duct size one size and provide transition immediately upstream of minimum straight duct run.

H. Connect to ductwork in accordance with Section 23 31 00, HVAC Ducts and Casings.

I. Provide minimum of 5-ft of 1-inch thick lined ductwork downstream of units. Lining to match terminal unit lining type.
   1. Do not provide lined ductwork in group "H" occupancies.

J. Verify that electric power is available and of the correct characteristics.

K. Balance unit to air flows scheduled.

END OF SECTION
SECTION 23 37 00

AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Grilles, Registers, Diffusers

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
   2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
   3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size and accessories furnished.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Air Distribution Diffuser, Register, and Grille Schedule lists Basis of Design, with any specialty accessories, construction, finish or other criteria noted on schedule. Submitted air distribution must match criteria of Basis of Design:
      a. Construction materials and appearance.
      b. Frame/installation method.
      c. Isothermal throw plus or minus 5 percent at design flows shown on drawings.
      d. Noise Criteria: NC value plus or minus 1 at design flows shown on drawings.
      e. Accessories: Equal to Basis of Design.
1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23, HVAC sections, where more than a single type is specified for the application, provide single selection for each product category.

B. Grilles, Registers, Diffusers:
   1. Titus
   2. Price Co.
   3. Anemostat
   4. Carnes
   5. Environmental Air Products
   6. Kruger
   7. Metalaire
   8. Nailor
   9. Shoemaker
   10. Turtle & Bailey
   11. Seiho
   12. Or equal.

2.2 GRILLES, REGISTERS, DIFFUSERS

A. Diffuser, Register and Grille Schedule lists Basis of Design, with specialty accessories, construction, finish or other criteria noted on schedule. Submitted air distribution must match criteria of Basis of Design, including accessories and finish:
   2. Pressure drop equal to or less than Basis of Design at CFM on Drawings.
   3. Throw: Isothermal jet throw plus or minus 5 percent of Basis of Design at CFM listed on Drawings.
   4. Noise Criteria: Plus or minus 1 NC of Basis of Design at CFM listed on Drawings. If Basis of Design NC is below registered level, submitted must match. NC rating with 10 dB room factor or less.

B. Provide 1-, 2-, 3-, or 4-way deflection as indicated on Drawings.

C. Provide pattern controllers for linear supply air diffusers.

D. Register Dampers: Dampers utilized with grilles. Opposed blade dampers utilizing a side operated worm drive which provides external duct operation. Slot the end of the shaft to receive a screwdriver. Factory assembled side operator. Construct of the same material as the grille. Manufacturer same as grilles/diffuser.
E. Coordinate mounting frames with ceiling construction type. Verify per reflected ceiling plans.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Install in accordance with manufacturer's instructions. Provide seismic supports, clips, and bracing per local code. Coordinate installation of framing. Provide complete coverage of rough openings by integral device flanges or auxiliary frames. Where above ceiling location is unconditioned space, caulk rough openings; repair and re-paint locations where dust entrainment streaks develop due to unsealed openings.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Unless otherwise shown on drawings, for ceiling mounted air outlets with adjustable airflow pattern controllers mounted at a height of 12 feet or less, adjust the air outlets for horizontal air distribution, and adjust to vertical air distribution for ceiling height above 12 feet.

D. Exterior color of grilles per Architect. White finish if not otherwise scheduled or noted by Architect. Paint ductwork visible behind air outlets and inlets matte black.

E. Ceiling Membrane: Protect ceiling membrane per code. Fire caulk around openings. Provide listed radiation damper in rated roof/ceiling or floor/ceiling assemblies as required per code.

F. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

3.2 GRILLES, REGISTERS AND DIFFUSERS INSTALLATION

A. Coordinate with Architectural Reflected Ceiling Plan(s). Reflected ceiling plans determine final locations.

B. Install diffusers to ductwork with air tight connection. 18-inch straight duct section or acoustic plenum at connection. Provide square to round adapters where required for connection to round ducts.

C. Linear Slot Diffusers:
   1. Coordinate connection plenum dimensions with linear slot final dimensions to conform with manufacturer's recommendations, or as indicated. Total and active lengths as noted on drawings. Blank off unused sections. Coordinate frame type with Architect.
   2. Paint surfaces visible behind air outlets and inlets, including blank-off sections, matte black unless otherwise called for on drawings.

END OF SECTION
SECTION 23 40 00

HVAC AIR CLEANING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Medium Efficiency Pleated Filters
   2. High Efficiency Pleated Filters
   3. Filter Gauges

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. Division 01, General Requirements, Temporary Facilities and Controls: Filters for temporary heating and ventilating.
   2. Division 26, Electrical, Equipment Wiring: Electrical characteristics and wiring connections.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. ARI 850 - Commercial and Industrial Air Filter Equipment; Air-Conditioning and Refrigeration Institute.
   6. UL 586 - High Efficiency Particulate Air Filter Units; Underwriters Laboratories Inc.
   7. UL 867 - Electrostatic Air Cleaners; Underwriters Laboratories Inc.
   8. UL 900 - Standard for Air Filter Units; Underwriters Laboratories Inc.

1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
1. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.
2. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.
3. Manufacturer’s Installation Instructions: Indicate assembly and change-out procedures.
4. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.
5. Maintenance Materials: Furnish the following for Owner’s use in maintenance of project.
   a. See Division 01, General Requirements for additional provisions.
   b. Extra Filters: One set of each type and size.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 PERFORMANCE REQUIREMENTS

A. Conform to ARI 850, Standard for Performance Rating of Commercial and Industrial Air Filter Equipment, Section 7.4.
   1. Dust Spot Efficiency: Plus or minus 5 percent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Filters:
   1. American Filtration Inc.
   2. AAF International/American Air Filter
   3. Camfil Farr Company
   4. Eco-Air Products
   5. Filtration Group
   6. Flanders Corporation
   7. Or equal.

B. Filter Gauges:
   1. Dwyer Instruments
   2. H.O. Treric Co.
   3. Weiss Instruments
   4. Or equal.
2.2 MEDIUM EFFICIENCY PLEATED FILTERS

A. Media: Blend of cotton and polyester fiber, pleated, support grid, enclosing frame, UL 900.
   1. Thickness 4-inch.

B. Performance Rating per ASHRAE Standard 52.2:
   1. MERV 8.
   2. Dust Spot Efficiency: 25 to 30 percent.
   3. Face Velocity: 500 FPM.
   4. Initial Resistance: 0.30-inch WG.
   5. Recommended Final Resistance: 0.90-inches WG.

C. Frame: Provide galvanized steel frame, including support hardware with air tight seal around frame, upstream servicing.

2.3 HIGH EFFICIENCY PLEATED FILTERS

A. Media: Microfine glass fiber laminated to reinforcing backing, pleated, support grid, mechanically and chemically bonded to enclosing frame, UL Class 1.
   1. Thickness: 12-inch.

B. Performance Rating per ASHRAE Standard 52.1 and Standard 52.2:
   1. MERV 13.
   2. Dust Spot Efficiency: 80 to 85 percent.
   3. Face Velocity: 500 FPM.
   4. Initial Resistance: 0.50 inch WG.
   5. Recommended Final Resistance: 1.50-inches WG.

C. Frame: Provide galvanized steel frame, including support hardware with air tight seal around frame, upstream servicing.

2.4 FILTER GAUGES

A. Direct Reading Dial: 3-1/2-inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0-0.5-inch WG, 2 percent of full scale accuracy.

B. Inclined Manometer: One piece molded plastic with epoxy coated aluminum scale, inclined-vertical indicating tube and built-in spirit level, range 0-3-inch WG, 3 percent of full scale accuracy.

C. Accessories: Static pressure tips with integral compression fittings, 1/4-inch aluminum tubing, 2-way or 3-way vent valves.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install air cleaning devices in accordance with manufacturer's instructions.
B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Provide and install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position/location. Adjust and level.

D. Operation During Construction: If air handlers are operated during construction, provide treated 2-inch media construction filter in front of prefilters and replace periodically to prevent dirt carryover. Install clean prefilters prior to air balancing.

E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.

F. Provide filter gauges on filter banks, installed with separate static pressure tips upstream and downstream of filters.

END OF SECTION
SECTION 23 73 23

CUSTOM CENTRAL STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Casing
   2. Plenum Fan
   3. Fan Accessories
   4. Motor and Drive
   5. Hydronic Coils
   6. Filters
   7. Electrical

1.2 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and
   Division 01, General Requirements.

B. In addition, meet the following:
   1. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance
      Rating: Air Movement and Control Association International, Inc. (ANSI/AMCA 210, same as
      ANSI/ASHRAE 51).
   2. ARI 260 - Sound Rating of Ducted Air Moving and Conditioning Equipment.
   4. ARI 430 - Standard for Central Station Air Handling Units.
   5. ARI-DCAACP - Directory of Certified Applied Air Conditioning Products.
   6. AFBMA 9-90 - Load Ratings and Fatigue Life for Ball Bearings.
   9. ASTM D1654 - Standard Method for Evaluation of Painted or Coated Specimens
      Subjected to Corrosive Environments.
   14. Units with factory wiring to be UL/ETL/CSA approved and labeled.
   15. Filter media to be UL listed.
1.4 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Product Data:
      a. Published Literature: Indicate dimensions, weights, capacities, ratings, gauges and finishes of materials, and electrical characteristics and connection requirements.
      b. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
      c. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.
      d. Water Coils: Computer selection data for each coil bank indicating entering/leaving air conditions, entering/leaving fluid conditions, heating/cooling capacity, fluid flow, face velocity, air pressure drop, fluid pressure drop and circuiting. Coil selections corrected for elevation and glycol content if applicable.
      e. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
      f. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
   2. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
   3. Manufacturer's Instructions: Include installation instructions.
   4. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, accessories listed in this specification, and wiring diagrams.
   5. Certificates: Certify that coil capacities, pressure drops and selection procedures meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Certification: Certify air-handling units in accordance with ARI 430.
   3. Performance Criteria:
      a. Provide fans and motors capable of stable operation at design conditions cubic feet per minute and 110 percent pressure.
      b. Select fan operating point to right hand side of peak static pressure point and near the peak of static efficiency.
   4. Provide units constructed by a manufacturer who has been manufacturing air handling units for at least five years.
5. Ship units in one piece where possible and in shrink wrapping to protect the unit from dirt, moisture and/or road salt. Shipping splits can be provided for installation. Provide lifting lugs on each slide of the split to facilitate rigging and joining of segments.

C. Factory Testing:
   1. Standard Factory Tests: Factory run test fans to ensure structural integrity and proper RPM. Test electrical circuits to ensure correct operation before shipment of unit. Units to pass quality control and be thoroughly cleaned prior to shipment.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:
   1. Governair
   2. Huntair
   3. ClimateCraft
   4. Energy Labs
   5. Haakon
   6. Or equal.

2.2 GENERAL

A. Configuration - Fabricate with:
   1. Supply Fan
   2. Cooling Coils
   3. Heating Coils
   4. Filters
   5. Dampers

B. Fabrication: Conform to AMCA 210 and ARI 430

C. Description: Provide factory-fabricated indoor air handling unit(s) with capacity and accessories as indicated on the schedule. Units to have overall dimensions as indicated and fit into the space available with adequate clearance for service. Units to come completely assembled. Where shipping constraints prohibit shipment of fully assembled units, disassemble units in factory into sections no smaller than necessary. Protect disassembled sections with weather-tight shrink wrap. Furnish units with sufficient gasket and bolts for reassembly in the field by the contractor. Electrical components and assemblies to comply with NEMA standards. Unit internal insulation must have a flame spread rating not over 25 and smoke developed rating no higher than 50 complying with NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems. Units to comply with NFPA 70, National Electrical Code, as applicable for installation and electrical connections of ancillary electrical components of air handling units.
2.3 CASING

A. Construction: Construction of the air handling unit to consist of a 16 gauge painted galvanized steel frame with formed 16 gauge galvanized steel exterior casing panels. Provide exterior casing panels attached to the gasketed steel frame with corrosion resistant fasteners. Provide casing panels completely removable from the unit exterior without affecting the unit's structural integrity. (Units without framed type of construction to be considered, provided the exterior casing panels are made from 14 gauge galvanized steel, maximum panel center lines are less than 20-inches and deflection is less than L/200 at 150 percent of design static pressure.) Air handling unit casing to be of the "no-through-metal" design. Casing to incorporate insulating thermal breaks to ensure that, when fully assembled there is no path of continuous unbroken metal to metal conduction from inner to outer surfaces. Provide necessary support to limit casing deflection to L/200 of the narrowest panel dimension. Caulk and seal panel seams for an airtight unit. Leakage rates to be less than 1 percent at 150 percent of design static pressure. Exterior Panel Finish: Painted with a polyester resin coating designed for corrosion resistance meeting or exceeding ASTM B-117 Salt Spray Resistance of 1,000 hrs at 95 degrees F.

B. Double Wall - Interior Liner:
1. Each unit to have double wall construction with 20 gauge solid galvanized liner in the entire unit. 20 gauge perforated galvanized liner in the entire unit. Provide removable double wall interior panels from the outside of the unit without affecting the structural integrity of the unit.
2. Provide perforated sections furnished with neoprene, teledar, or mylar liner used to prohibit the erosion of the insulation into the air stream.
3. Provide internal liner suitable for washing with a pressure washer or steam cleaner without risk of wetting the insulation. Provide liner installed over top of the panel flanges and each liner seam sealed with a lap joint. Install wall liner over top of the base water dam such that any water run-off from the liner will drip into the water tight base rather than into the wall panel. Install roof liner over top of the roof support so that water cannot enter the roof insulation.
4. Protect insulation edges with metal lagging. Insulation systems using stick pins or adhesives are not acceptable.

C. Floor: Provide unit perimeter base completely welded and fabricated using heavy gauge structural steel tubing. Provide C-Channel cross supports welded to perimeter base steel tubing and located on maximum 24-inch centers to provide support for internal components. Base rails to include lifting lugs welded to perimeter base at the corner of the unit or each section if disassembled. Paint entire base frame with a phenolic coating for long term corrosion resistance. Provide internal walk-on floor 16 gauge galvanized steel and secured to the cross supports and perimeter base with corrosion resistant fasteners. Provide outer floor of the unit made from 16 gauge galvanized steel sealed and secured to the underside of the unit. Provide 4-inch double wall floor insulated with fiberglass insulation. Provide floor seams that are gasketed for thermal break and sealed for airtight and watertight construction. Single wall floors with glued and pinned insulation and no sub floor are not acceptable. Provide base frame attached to the unit at the factory.
1. Provide auxiliary drains in fan sections downstream of cooling coils and in mixing sections.
2. Terminate drain connections on floor mounted air handling units at the side of the unit.
3. Provide a 1-1/2-inch perimeter collar around each floor opening to ensure the unit is internally watertight. Entire base to act as an auxiliary drain pan and hold up to 1-1/2-inches of water.

D. On exterior units pitch roof panels 1/4-inch per foot for drainage and with standing seams.

E. Insulation: Entire unit to be insulated with a minimum 3-inch (R10) thick fiberglass insulation. Insulation to have an effective thermal conductivity (C) of 0.24 (BTU in/sq ft degrees F) and a noise reduction coefficient (NRC) of 0.70 per inch thick (based on a Type "A" mounting). Coefficients to meet or exceed a 3.0 PCF density material rating. Insulation to meet the erosion requirements of UL 181 facing the air stream and fire hazard classification of 25/50 (per ASTM-84 and UL 723 and CAN/ULC S102-M88). Encapsulate insulation edges within the panel. Perforated sections or single wall units to have Tuf-Skin insulation with black acrylic coating.

F. Access Doors:
1. Provide unit equipped with solid double wall insulated, hinged access doors. Provide foam filled extruded aluminum or galvanized steel door frame of same gauge as unit cabinet construction and interior liner with a built in thermal break barrier and dual full perimeter gasket forming an air tight seal. Provide door hinge assembly die cast zinc with stainless steel pivot mechanism, completely adjustable. Provide ETL, UL and CAL-OSHA approved tool operated safety latch on fan section access doors. Doors must be the same thickness as the unit casing.
2. Access Door Handles: Provide minimum of two "Ventlok" Model #310 or equal, heavy duty high pressure latches operable from either side of the door.
4. Positive pressure doors open inward and negative pressure doors open outward.
5. Provide wired glass window at the following location for inspection at fan/motor section or downstream of coils.
6. Where double wall interior liner is specified to be suitable for pressure washing, construct access doors of same construction.

G. Pipe Chase: Provide external pipe chase for chilled/heating or industrial water serving unit with area to accommodate valves, control valves, strainers and instrumentation. Insulate with minimum 2-inches rigid fiberglass. Provide full size access doors suitable for maintenance and installation/removal of piping.

H. Blank-Offs: Provide blank-off panels where required to ensure no air bypass between sections, through perforated panels or around coils or filters.

I. Motor/Fan Removal: Provide structural steel beam within air handler to facilitate motor and fan wheel removal. Orient steel beam over motor/fan and over access door.

J. Bellmouth Fittings: Provide bellmouth duct fittings at supply duct connections with minimum radius of 0.20 times duct diameter.
K. Air Intakes/Exhaust Outlets: Stationary hood at outdoor air intake and exhaust locations, 1/2-inch by 1/2-inch galvanized steel bird screen, same construction as unit casing, finished to match unit. Hoods turned down to prevent water intrusion, with continuous rain gutter around perimeter with drain connections.

2.4 PLENUM FAN

A. Plenum Fan (PF) SWSI Fans: Provide single width single inlet arrangement 3 plenum fan as indicated on the schedule. Provide fan blades that are hollow airfoil in shape, welded to the center and wheel side plates. Provide heavy duty fan bearings, self-aligning; Dodge concentric "Grip Tight" type with full contact on shaft bearings selected for a minimum L-50 life of 200,000 hours at maximum horsepower and operating speed for the classification. Rigid support for the inlet bearing must be removable for access to the wheel. Inlet cone precision spun. Provide fan shaft turned, ground and polished solid steel rated at maximum RPM below critical speed. Fan wheel and sheaves keyed to the shaft. Provide IRD balanced fan IRD balanced (per ANSI/AMCA 204-96 fan application category BV-3) at design RPM with belts and drives in place to a vibration velocity less than or equal to 0.157-inch per second measured horizontal and vertical at each bearing pad. Vibration amplitudes are in inches/second-peak. All values are filter-in at the fan speed. Fan rated in accordance with AMCA 210 for performance and AMCA 300 for sound.

B. Provide flexible duct connections to separate fan from adjacent sections. Reference Section 23 33 00, Air Duct Accessories.

2.5 FAN ACCESSORIES

A. Provide and install pressure relief fittings furnished on bearings.

B. Provide and install stainless steel shaft.

C. Provide and install internally spring isolated fan, motor and drive on a structural steel base complete with UV rated flexible connection. Formed metal isolation bases will not be acceptable. Provide seismically restrained isolator type with deflection in accordance with code and AHJ. Reference Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment.

D. Airflow Monitoring Device:
   1. Provide airflow monitoring device at the inlet of supply fans. Air monitoring device to consist of an array of differential pressure flow sensors mounted at opposing 90 degree positions around the inlet of the plenum fan. Provide flow sensors manifolded together with pneumatic tubing to form a piezometric ring. Each fan assembly and air monitoring device to have been tested for airflow vs. differential pressure and calibrated in an AMCA Accredited Laboratory throughout the fans range of operation. 4-20 mA low pressure transducer with accuracy of plus or minus 1 percent full span and temperature compensated from 25 degrees F to 150 degrees F, mounted on fan inlet plate or fan bulk head wall to provide feedback and input to BMS. Air monitoring device not to obstruct the fan inlet, be directly mounted across the fan inlet or have any effect on fan air performance or sound power levels.
2. Display to be as follows: Provide a method of displaying digitally, in real time, the fan's current airflow. Provide display capable of showing the airflow of all fans simultaneously. For interaction with a controller, the display to output one 0-10 VDC signal for each fan being monitored. The display to require no maintenance throughout its life. Output signal to be accurate to plus or minus 8.5 percent of natural span, including non-linearity, hysteresis and non-repeatability. Display must be water tight allowing for use in outdoor locations. If the display is not water tight, install in a weatherproof housing.

E. Extended lubrication lines to exterior of unit casing.

2.6 MOTOR AND DRIVE

A. Fan motors are to be mounted and isolated on same integral base as fan.

B. Motors: Open drip proof. Reference Section 23 05 13, Common Motor Requirements for HVAC Equipment.

C. Provide shaft grounding on motors served by variable frequency drives.

D. Direct drive sized for 150 percent of motor horsepower.

2.7 HYDRONIC COILS

A. Coils to be certified by manufacturer in accordance with ARI Standard 410, capacities as indicated on drawings.

B. Extended surface type consisting of copper tubing mechanically expanded to bond with plate fins. Design for serpentine flow with one or more feeds from common supply and return headers. Arrange for counter flow operation with supply connections at the bottom.

C. Performance: Provide capacity indicated at water flows no greater than scheduled.

D. Factory Testing: Leak test coils under water at 300 PSIG minimum.

E. Working Pressure: 150 PSIG.

F. Construction:
   1. Tubing: Seamless copper.
   2. Fins: aluminum die formed plates. Continuous within the coil casing.
   4. Headers: Seamless copper tube brazed to heat transfer tubes. Provide high point air vent fitting and low point drain fitting.
   5. Connections: Same end for supply and return unless noted otherwise.
   6. Intermediate Supports: Provide for coils with finned length greater than 44-inches, with maximum spacing of 42-inches.

G. Cooling Coil Drain Pans: Welded 16 gauge 304 stainless steel, cross broken, double sloped to drain connections, designed to extend entire length of cooling coils including headers and return bends, minimum 2-inches deep. Bottom drain pan insulated with closed cell foam to
prevent condensation below unit. Must meet ASHRAE Standard 62.1, most current edition. For coil banks with heights larger than 48-inches, provide intermediate drain pans at no greater than 48-inch intervals.

2.8 FILTERS

A. Provide filters of the type and MERV rating or efficiency indicated on the schedule. Provide factory fabricated filter sections of the same construction and finish as the unit. Housing to accommodate filters corresponding to ASHRAE 52-76 Standards. Face loaded pre and final filters to have Type 8 frames as manufactured by AAF, FARR or equal. Side service filter sections to include hinged access doors on both sides of the unit. Air unit manufacturer to provide internal blank-offs to prevent air bypass around the filters. Filters manufactured by Farr, Purolator, AAF or equal. Provide filters in compliance with ANSI/UL 900 - Test Performance of Air Filters. Clean pressure drop not to exceed indicated pressure drop on the schedule.

B. Filter Access: Provide filters that are accessible from front or rear if indicated on drawings or to slide out when access is not available.

C. Filter Gauges: Manufacturer to provide Dwyer 2000 magnehelic gauges or equal. Magnehelic gauges to be accurate to plus or minus 2 percent of full range. One gauge to be provided for each filter bank. Provide gauges recessed into the cabinet casing.

2.9 ELECTRICAL

A. Power: Provide single point power connection for all three phase equipment and single point power connection for all single phase equipment for each unit. Wire single phase components such as lights, convenience outlet, controls, heaters, etc. from panel with circuit breaker for each device. Provide GFCI duplex receptacles with weatherproof cover plate on exterior unit.

B. Provide electrical work in accordance with NEC and Division 26, Electrical. Reference Section 26 05 09, Equipment Wiring. Provide UL or ETL listed wiring, control panels, and devices.

C. Fan Motor Wiring and Control: Provide wiring connections to fan motors from unit mounted variable frequency drives or starters. Mount devices in control panel inside unit service corridor or on outside of unit. Provide enclosures vented and conditioned from unit supply air. Use flexible conduits for making connections to vibration isolated equipment.

D. Provide combination starters and disconnects or variable frequency drives for each motor as indicated on Drawings.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install in accordance with manufacturer's instructions and requirements. Maintain manufacturer's recommended clearances.

B. Bolt sections together with gaskets. Seal and/or fill openings between casing and AHU components and utility connections to prevent air leakage.
C. Make connections to ductwork. Duct installation requirements are specified in other Division 23, HVAC Sections. Drawings indicate the general arrangement of ducts.

D. Cleaning: Prior to acceptance, thoroughly clean exposed portions of the units, remove shipping labels and traces of foreign substance.

E. Field Quality Control:
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
2. Perform the following field quality-control tests and inspections and prepare test reports:
   a. After installing units and after electrical circuitry has been energized, test units for compliance with requirements.
   b. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   c. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   d. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Remove malfunctioning units, replace with new units, and retest as specified above.

F. Startup Service:
1. Engage a factory-authorized service representative to perform startup service.
2. Protect or remove energy recovery devices prior to starting the units to ensure damage does not occur to the devices or media. Replace at no cost to Owner if devices/media get damaged or are no longer in "as-new" condition.
3. Complete installation and startup checks according to manufacturer's written instructions and do the following:
   a. Inspect for visible damage to unit casing.
   b. Inspect for visible damage to furnace combustion chamber.
   c. Inspect for visible damage to coils, energy recovery devices and fans.
   d. Inspect internal insulation.
   e. Verify that labels are clearly visible.
   f. Verify that clearances have been provided for servicing.
   g. Verify that controls are connected and operable.
   h. Verify that filters are installed.
   i. Adjust vibration isolators.
   j. Lubricate bearings on fan.
   k. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
   l. Start unit according to manufacturer's written instructions. Complete startup sheets and attach copy with Contractor's startup report.
   m. Inspect and record performance of interlocks and protective devices; verify sequences.
   n. Operate unit for an initial period as recommended or required by manufacturer.
   o. Calibrate thermostats.
   p. Adjust and inspect high-temperature limits.
   q. Start system and measure and record the following:
1) Coil leaving air, dry- and wet-bulb temperatures.
2) Coil entering air, dry- and wet-bulb temperatures.
3) Outside air, dry-bulb temperature.

r. Inspect controls for correct sequencing of heating, mixing dampers, cooling, and normal and emergency shutdown.

s. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
1) Supply air volume.

t. After startup and performance testing, change filters, vacuum heat exchanger and coils, lubricate bearings, adjust belt tension, and inspect operation of power vents.

G. Adjusting:
1. Adjust initial temperature and CO2 set points.
2. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
3. Occupancy Adjustments: 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 site outside normal occupancy hours for this purpose, without additional cost.

H. Demonstration: Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain air-handling units. Reference Division 01, General Requirements.

3.2 FAN ACCESSORIES

A. Install flexible duct connections between fan and discharge ductwork. Ensure that metal bands of connectors are parallel with minimum 1-inch flex between ductwork and fan while running.

3.3 MOTOR AND DRIVE

A. Provide fixed sheaves required for final air balance.

3.4 HYDRONIC COILS

A. Make connections to coils with unions or flanges.

B. Comb damaged and bent fins.

C. Install coils to drain in accordance with manufacturer’s recommendations.

D. Install filters upstream of supply air handler coils prior to fan operation.

E. Pipe drain connection to floor drain.

F. Piping: Comply with applicable requirements in Division 23, HVAC. Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.
3.5 ELECTRICAL

A. Electrical System Connections: Comply with applicable requirements in Division 26, Electrical sections for power wiring, switches, and motor controls.

B. Ground equipment according to Division 26, Electrical.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

END OF SECTION
SECTION 26 00 00
ELECTRICAL BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Work included in 26 00 00, Electrical Basic Requirements applies to Division 26, Electrical work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of electrical systems for proposed project.

B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.

C. Definitions:
   1. Provide: To furnish and install, complete and ready for intended use.
   2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
   3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
   4. Or Equal: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
   5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.2 RELATED SECTIONS

A. Contents of Section applies to Division 26, Electrical Contract Documents.

B. Related Work:
   1. Additional conditions apply to this Division including, but not limited to:
      a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
      b. Drawings
      c. Addenda
      d. Owner/Architect Agreement
      e. Owner/Contractor Agreement
      f. Codes, Standards, Public Ordinances and Permits
1.3 REFERENCES AND STANDARDS

A. References and Standards per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 26, Electrical Sections and those listed in this Section.

B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
   1. State of California:
      a. CBC - California Building Code
      b. CEC - California Electrical Code
      c. CEC T24 - California Energy Code Title 24
      d. CFC - California Fire Code
      e. CMC - California Mechanical Code
      f. CPC - California Plumbing Code
      g. CSFM - California State Fire Marshal
      h. DSA - Division of State Architect Regulations and Requirements

C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
   1. ABA - Architectural Barriers Act
   2. ADA - Americans with Disabilities Act
   3. ANSI - American National Standards Institute
   4. APWA - American Public Works Association
   5. ASCE - American Society of Civil Engineers
   6. ASHRAE - Guideline 0, the Commissioning Process
   7. ASTM - ASTM International
   8. CFR - Code of Federal Regulations
   9. EPA - Environmental Protection Agency
   10. ETL - Electrical Testing Laboratories
   11. FCC - Federal Communications Commission
   12. FM - FM Global
   13. IBC - International Building Code
   14. IEC - International Electrotechnical Commission
   15. IEEE - Institute of Electrical and Electronics Engineers
   16. IES - Illuminating Engineering Society
   17. ISO - International Organization for Standardization
   18. MSS - Manufacturers Standardization Society
   19. NEC - National Electric Code
   20. NECA - National Electrical Contractors Association
   21. NEMA - National Electrical Manufacturers Association
   22. NETA - National Electrical Testing Association
   23. NFPA - National Fire Protection Association
   24. OSHA - Occupational Safety and Health Administration
   25. UL - Underwriters Laboratories Inc.

D. See Division 26, Electrical individual Sections for additional references.
E. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.

F. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

1.4 SUBMITTALS

A. See Division 01, General Requirements for Submittal Procedures as well as individual Division 26, Electrical Sections.

B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.

C. In addition:
   1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
   2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one zip file per specification division containing a separate file for each Specification Section. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. Deviations will be returned without review.
   3. Product Data: Provide manufacturer's descriptive literature for products specified in Division 26, Electrical Sections.
   4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the specifications and drawings.
      a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
      b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 26, Electrical Specification Sections for specific items required in product data submittal outside of these requirements.

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ELECTRICAL BASIC REQUIREMENTS
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c. See Division 26, Electrical individual Sections for additional submittal requirements outside of these requirements.

5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; bear costs of these additional reviews at Engineer’s hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.

6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer’s comments. Identify Engineer’s comments and provide an individual response to each of the Engineer’s comments. Cloud changes in the submittals and further identify changes which are in response to Engineer’s comments.

7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer’s installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.

8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 26, Electrical Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.

9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.

10. Substitutions and Variation from Basis of Design:
   a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
   b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of “Submittals”. For any product marked "or equal", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.

11. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Reference individual Division 26, Electrical specification Sections for additional requirements for shop drawings outside of these requirements.
   a. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.

12. Samples: Provide samples when requested by individual Sections.

13. Resubmission Requirements:
   a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor’s submittals. Indicate changes for the resubmittal in a cover letter with
reference to page(s) changed and reference response to comment. Cloud changes in the submittals.

b. Resubmit for review until review indicates no exception taken or "make corrections as noted".

14. Operation and Maintenance Manuals, Owners Instructions:
   a. Submit, at one time, electronic files (PDF format) on CD/DVD of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
   1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
   2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment.
   3) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
   4) Include product certificates of warranties and guarantees.
   5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
   6) Include commissioning reports.
   7) Include copy of startup and test reports specific to each piece of equipment.
   8) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.

b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 26 00 00, Electrical Basic Requirements, Demonstration.

c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.

15. Record Drawings:
   a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of conduit, and location of concealed electrical items. Include items changed by field orders, supplemental instructions, and constructed conditions.

b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
c. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.

d. See Division 26, Electrical individual Sections for additional items to include in record drawings.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations.

B. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e. distribution equipment, duct banks, light fixtures, etc.) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

C. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.

D. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.

E. Provide products that are UL listed.

1.6 WARRANTY

A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.7 COORDINATION DOCUMENTS

A. Prepare and submit coordinated layout drawings (composite drawings), prior to construction, to coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, plumbing, lights, cable tray and electrical services with architectural and structural requirements, and other trades (including plumbing, fire protection, electrical, ceiling suspension, and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
Unless otherwise required by Division 00, Procurement and Contracting Requirements or Division 01, General Requirements, Division 23, HVAC to combine information furnished by other trades into master coordination documents.

B. Prepare Drawings as follows:
1. Coordination models/drawings may be created using Revit 3D modeled elements or a 3D CAD software. The modeled elements to be graphically represented within the model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the model elements. Model elements must have the ability to be spatially coordinated with other modeled elements using either Revit, Autodesk Navisworks or Autodesk A360.
2. Drawings in CAD Format. CAD format release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.
3. Review and revise, as necessary, section cuts in Contract Drawings after verification of field conditions.
4. Incorporate Addenda items and change orders.
5. Provide additional coordination as requested by other trades.

C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

D. Verify in field exact size, location, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.

E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide like items from one manufacturer.

2.2 MATERIALS

A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL approved or have adequate approval or be acceptable by state, county, and city authorities. Equipment/fixture supplier is responsible for obtaining State, County, and City acceptance on equipment/fixtures that are not UL approved or are not listed for installation.

B. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.

C. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
D. Hazardous Materials:
   1. Comply with local, State of California, and Federal regulations relating to hazardous materials.
   2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
   3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

   A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

   B. Install equipment requiring access (i.e., junction boxes, light fixtures, power supplies, motors, etc.) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in passageways, doorways, scuttles or crawlspaces which would impede or block the intended usage.

   C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.

   D. Earthwork:
      1. Confirm Earthwork requirements in Contract Documents. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
         a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork Sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
         b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
         c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

   E. Firestopping:
      1. Confirm requirements in Division 07, Thermal and Moisture Protection. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
         a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet

F. Plenums:
   1. In plenums, provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

G. Start up equipment, in accordance with manufacturer’s start-up instructions, and in presence of manufacturer’s representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

H. Provide miscellaneous supports/metals required for installation of equipment and conduit.

3.2 SEISMIC CONTROL

A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 26 Electrical Sections.

B. Provide means to prohibit excessive motion of electrical equipment during earthquake.

3.3 REVIEW AND OBSERVATION

A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
   1. Underground conduit installation prior to backfilling.
   2. Prior to covering walls.
   3. Prior to ceiling cover/installation.
   4. When main systems, or portions of, are being tested and ready for inspection by AHJ.

C. Final Punch:
   1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Electrical Pre-closure Checklist, complete the checklist confirming completion of systems’ installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer’s acceptance that the electrical systems are ready for final punch.
   2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 CONTINUITY OF SERVICE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
1. During remodeling or addition to existing structure, while existing structure is occupied, present services to remain intact until new construction, facilities or equipment is installed.
2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new wiring, and wiring to point of connection.
3. Coordinate transfer time to new service with Owner. If required, perform transfer during off-peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
   a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
4. No interruption of services to any part of existing facilities will be permitted without express permission in each instance from Owner. Requests for outages must state specific dates, hours and maximum durations, with outages kept to these specific dates, hours and maximum durations. Obtain written permission from Owner for any interruption of power, lighting or signal circuits and systems.
   a. Organize work to minimize duration of power interruption.
   b. Coordinate utility service outages with utility company.

3.5 CUTTING AND PATCHING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:

1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).

2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.

3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.

4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and/or walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.

5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.
3.6 EQUIPMENT SELECTION AND SERVICEABILITY

A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.7 DELIVERY, STORAGE AND HANDLING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
   1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage and handling to be replaced before installation.
   2. Protect equipment to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
   3. Protect bus duct and similar items until in service.

3.8 DEMONSTRATION

A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, and individual Division 26, Electrical Sections.

B. Upon completion of work and adjustment of equipment, test systems and demonstrate to Owner's Representative, Architect, and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.9 CLEANING

A. Confirm Cleaning requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Upon completion of installation, thoroughly clean electrical equipment, removing dirt, debris, dust, temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.
3.10 INSTALLATION

A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.

C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

D. Provide miscellaneous supports/metal required for installation of equipment.

3.11 PAINTING

A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
   1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces (i.e., hangers, hanger rods, equipment stands, etc.) with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
   2. In Electrical Room, on roof or other exposed areas, equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
   3. See individual equipment Specifications for other painting.
   4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
   5. Conduit: Clean, primer coat and paint interior/exterior conduit exposed in public areas with two coats paint suitable for metallic surfaces. Color selected by Architect.
   6. Covers: Covers such as manholes, vaults and the like will be furnished with finishes which resist corrosion and rust.

3.12 ACCEPTANCE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
   1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
      a. Cleaning
      b. Operation and Maintenance Manuals
      c. Training of Operating Personnel
      d. Record Drawings
      e. Warranty and Guaranty Certificates
3.13 FIELD QUALITY CONTROL

A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Tests:
   1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.
   2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.14 LETTER OF CONFORMANCE

A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that Electrical items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.15 SALVAGED EQUIPMENT AND RECYCLED MATERIAL

A. Salvage the following equipment not being reused and return to Owner:
   1. Luminaires
   2. Breakers

B. Electrical equipment that cannot be salvaged for reuse, sell/give to recycling company. Recycle following excess, removed, or demolished electrical material:
   1. Copper or aluminum conductors, buses, and motor/transformer windings.
   2. Steel and aluminum from raceways, boxes, enclosures, and housings.
   3. Acrylic and glass from luminaire lenses/refractors.

C. Provide separate on-site storage space for recycled and salvaged material. Clearly label space.

D. Confirm additional salvaged equipment and recycled materials in the Contract Documents.

END OF SECTION
SECTION 26 05 09
EQUIPMENT WIRING

PART 1 - GENERAL

1.1 SUMMARY
A. Work Included:
   1. Equipment connections, whether furnished by Owner or other Divisions of the Contract.
   2. Equipment grounding.

1.2 RELATED SECTIONS
A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS
A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS
A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
B. In addition:
   1. Verify mechanical and utilization equipment electrical characteristics with Drawings and equipment submittals prior to ordering equipment. Submit confirmation of this verification as a part of, or addendum to, the electrical product submittals.

1.5 QUALITY ASSURANCE
A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements apply to this Section.

1.6 WARRANTY
A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Materials and Equipment for Equipment Wiring: As specified in individual Sections.

2.2 GENERAL
A. Unless otherwise noted, the following voltage and phase characteristics apply to motors:
   1. 3/4 HP and Under: 120 volt, 1 phase.
2. 1 HP and Over: 480 volt, 3 phase.

B. Safety Switches: Provide as required by CEC and as specified in Section 26 28 16, Enclosed Switches and Circuit Breakers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to submittal of product data for electrical distribution equipment, obtain and examine product data and shop drawings for equipment furnished by the Owner and by other trades on the project. Update the schedule of equipment electrical connections accordingly, noting proper ratings for overcurrent devices, fuses, safety disconnect switches, conduit and wiring, and the like. As a minimum, this requirement applies to equipment furnished by Owner and equipment furnished under the following divisions of work under this contract:

1. Division 8, Openings
2. Division 11, Equipment
3. Division 14, Conveying Equipment
4. Division 21, Fire Suppression
5. Division 22, Plumbing
6. Division 23, HVAC, Heating, Ventilating and Air Conditioning
7. Division 27, Communications
8. Division 28, Electronic Safety and Security

3.2 INSTALLATION

A. Do not install unrelated electrical equipment or wiring on mechanical equipment without prior approval of Engineer.

B. Provide moisture tight equipment wiring and switches in ducts or plenums used for environmental air.

C. Connect motor and appliance/utilization equipment complete from panel to motor/equipment as required by code.

D. Install motor starters and controllers for equipment furnished by others.

E. Appliance/Utilization Equipment:
   1. Provide appropriate cable and cord cap for final connection unless equipment is provided with same. Provide receptacle configured to receive cord cap.
   2. Verify special purpose outlet NEMA configuration and ampere rating with equipment supplier prior to ordering wiring devices and coverplates.

F. Furniture Partitions:
   1. Provide liquid-tight flexible connections from wall or floor outlet as shown on Drawings with pull string. Provide handle-tie breakers for simultaneous disconnecting of power by branch circuit breakers for multi-wire branch circuits. Provide connection to furniture as directed by shop drawings for owner furnished furniture partitions.
2. Splice incoming wiring for phases, neutral and ground to the power feed connection provided for the furniture partition system so that no outlets are non-functioning at completion of work.
3. Coordination with Division 08, Openings and Drawing requirements.

3.3 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Division 01, General Requirements.

3.4 SYSTEMS STARTUP

A. Provide field representative to prepare and start equipment.
   1. Test and correct for proper rotation of polyphase motors.

B. Adjust for proper operation within manufacturer's published tolerances.

C. Demonstrate proper operation of equipment to Owner's designated representative.

END OF SECTION
SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Lugs and Pads
   2. Wires and Cables
   3. Connectors

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Cable insulation test reports in project closeout documentation.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Lugs and Pads:
   1. Anderson
   2. Ilsco
   3. Panduit
   4. Thomas & Betts
5. 3M
6. Or equal.

B. Wires and Cables:
   1. General
      a. General Cable
      b. Okonite
      c. Southwire
      d. Or equal.

C. Connectors:
   1. Anderson Power Products
   2. Burndy
   3. Illsco
   4. 3M
   5. Thomas & Betts
   6. Or equal.

2.2 LUGS AND PADS

A. Ampacity: Cross-sectional area of pad for multiple conductor terminations to match ampere rating of panelboard bus or equipment line terminals.

B. Copper Pads: Drilled and tapped for multiple conductor terminals.

C. Lugs: Compression type for use with stranded branch circuit or control conductors; mechanical lugs for use with solid branch and feeder circuit conductors.

2.3 WIRES AND CABLES

A. Copper, 600 volt rated throughout. Conductors 12 AWG and 10 AWG, solid or stranded. Conductors 8 AWG and larger, stranded. 12 AWG minimum conductor size. Minimum insulation rating of 90 degrees C. Insulation Type: THWN-2, XHHW-2 or THHN-2.

B. Phase color to be consistent at feeder terminations; A-B-C, top to bottom, left to right, front to back.

C. Color Code Conductors as Follows:

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<th>480 VOLT</th>
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</tbody>
</table>
D. MC Cable: Not allowed.
E. AC Cable (Armored Cable): Not allowed.
F. NMB Cable: Not allowed.
G. SO Cord: Annealed copper conductors, 600 volt rated. Minimum size No. 12 AWG with
   ground wire. Maximum of six conductors and ground per cable. 90 degrees C rated thermoset
   jacket.

2.4 CONNECTORS
A. Split bolt connectors not allowed.
B. Conductor Branch Circuits: Wire nuts with integral spring connectors for conductors 12 AWG
   through 8 AWG. Push-in type connectors where conductors are not required to be twisted
   together are not acceptable.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS
A. Install per manufacturer instructions and CEC.
B. Field Quality Control:
   1. Test conductor insulation on feeders of 100 amp and greater for conformity with 1000
      volt megohmmeter. Use Insulated Cable Engineers Association testing procedures.
      Minimum insulation resistance acceptable is 1 megohm for systems 600 volts and below.
      Notify Architect if insulation resistance is less than 1 megohm.
   2. Test Report: Prepare a typed tabular report indicating the testing instrument, the feeder
      tested, amperage rating of the feeder, insulation type, voltage, the approximate length of
      the feeder, conduit type, and the measured resistance of the megohmmeter test. Submit
      test reports with project closeout documents.
   3. Inspect and test in accordance with NETA Standard ATS, except Section 4.
   4. Perform inspections and tests listed in NETA Standard ATS, Section 7.3.2.

3.2 LUGS AND PADS
A. Thoroughly clean surfaces to remove all dirt, oil, great or paint.
B. Use torque wrench to tighten per manufacturer's directions.

3.3 WIRES AND CABLES
A. General:
   1. Do not install or handle thermoplastic insulated wire and cable in temperatures below
      +14 degrees F (-10 C).
   2. Install conductors in raceways having adequate, code size cross-sectional area for wires
      indicated.
3. Install conductors with care to avoid damage to insulation.
4. Do not apply greater tension on conductors than recommended by manufacturer during installation.
5. Use of pulling compounds is permitted. Clean residue from exposed conductors and raceway entrances after conductor installation. Do not use pulling compounds for installation of conductors connected to GFCI circuit breakers or GFCI receptacles.
6. Conductor Size and Quantity:
   a. Install no conductors smaller than 12 AWG unless otherwise shown.
   b. Provide required conductors for a fully operable system.
7. Provide dedicated neutrals (one neutral conductor for each phase conductor) in all 120V circuits.
8. Conductors in Cabinets:
   a. Cable and tree wires in panels and cabinets for power and control. Use plastic ties in panels and cabinets.
   b. Tie and bundle feeder conductors in wireways of panelboards.
   c. Hold conductors away from sharp metal edges.
9. Homeruns:
   a. Do not change intent of branch circuit homeruns without approval. Homeruns for 20A branch circuits may be combined to a maximum of six current carrying conductors including neutral conductors in homeruns. Apply derating factors as required per NEC. Increase conductor size as needed.
10. Identify wire and cable under the provisions of Section 26 05 53, Identification for Electrical Systems. Identify each conductor with its panel and circuit number as indicated.
11. Exposed cable is not allowed.

### 3.4 CONNECTORS

A. Install to assure a solid and safe connection.

**END OF SECTION**
SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Connectors and Accessories
   2. Grounding Conductor

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Test reports of ground resistance for service and separately derived system grounds.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Comply with the requirements of ANSI/NFPA 70.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Connectors and Accessories:
   1. Burndy Hyground Compression System
   2. Erico/Cadweld
   3. Amp Ampact Grounding System
4. Pipe Grounding Clamp:
   a. Burndy GAR Series
   b. O Z Gedney
   c. Thomas & Betts
   d. Or equal.

B. Grounding Conductor
   1. General Cable
   2. Okonite
   3. Southwire
   4. Or equal

2.2 CONNECTORS AND ACCESSORIES

A. Grounding Connectors: Hydraulic compression tool applied connectors or exothermic welding process connectors or powder actuated compression tool applied connectors.

B. Pipe Grounding Clamp: Mechanical ground connector with cable parallel or perpendicular to pipe.

2.3 GROUNDING CONDUCTOR

A. Equipment Grounding Conductor: Green insulated, insulation type to match that of associated feeder or branch circuit wiring, size as indicated on drawings.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Verify site conditions prior to beginning work.

B. Separately Derived Systems: Ground each separately derived system per NEC Article 250.

C. Bond together reinforcing steel and metal accessories in pool and fountain structures.

D. Corrosion inhibitors: Apply a corrosion inhibitor to contact surfaces when making grounding and bonding connections. Use corrosion inhibitor appropriate for protecting a connection between metals used.

E. Inspect and test in accordance with NETA Standard ATS, Except Section 4.

F. Perform inspections and tests listed in NETA Standard AB, Section 7.13.

3.2 CONNECTORS AND ACCESSORIES INSTALLATION

A. Install per manufacturer's instructions.

3.3 GROUNDING CONDUCTOR INSTALLATION

A. Raceways:
1. Ground metallic raceway systems. Bond to ground terminal with code size jumper except where code size or larger equipment grounding conductor is included with circuit, use grounding bushing with lay-in lug.
2. Connect metal raceways, which terminate within an enclosure but without mechanical connection to enclosure, by grounding bushings and ground conductor to grounding bus.
3. Where equipment supply conductors are in flexible metallic conduit, install stranded copper equipment grounding conductor from outlet box to equipment frame.
4. Install equipment grounding conductor, code size minimum unless noted on drawings, in metallic and nonmetallic raceway systems.

B. Feeders and Branch Circuits:
   1. Provide continuous green insulated copper equipment grounding conductors for feeders and branch circuits.
   2. Where installed in a continuous solid metallic raceway system and larger sizes are not detailed, provide insulated equipment grounding conductors for feeders and branch circuits sized in accordance with the latest adopted edition of NEC Article 250, Table 250-122.

C. Bond boxes, cabinets, enclosures and panelboard equipment grounding conductors to enclosure with specified conductors and lugs. Install lugs only on thoroughly cleaned contact surfaces.

D. Motors, Equipment and Appliances: Install code size equipment grounding conductor to (motor) equipment frame or manufacturer's designated ground terminal.

E. Receptacles: Connect ground terminal of receptacle and associated outlet box to equipment grounding conductor. Self grounding nature of receptacle devices does not eliminate equipment grounding conductor bolted to outlet box.

F. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Use #2 AWG bare copper conductor.

G. Bond electrostatic discharge (ESD) flooring integral grounding conductor to electrically grounded connectors or structures at two opposite locations, in the area of the ESD flooring installation.

END OF SECTION
SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Anchors, Threaded Rod and Fasteners
   2. Support Channel, Hangers and Supports
   3. Rooftop Conduit Supports

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals not required for this Section.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems, whose products have been in satisfactory use in similar service for not less than 10 years.
   2. Support systems to be supplied by a single manufacturer.
   3. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, equipment hangers/supports, and seismic restraint by a qualified Structural Professional Engineer.
      a. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
1.7 PERFORMANCE REQUIREMENTS

A. General: Provide conduit and equipment hangers and supports in accordance with the following:
   1. When supports, anchorages, and seismic restraints for equipment and supports, anchorages and seismic restraints for conduit, cable tray and equipment are not shown on the Drawings, the Contractor is responsible for their design.
   2. Connections to structural framing shall not introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.

B. Engineered Support Systems: The following support systems to be designed, detailed, and bear the seal of a professional engineer registered in the State of California.
   1. Support frames such as conduit racks or stanchions for conduit and equipment which provide support from below.
   2. Equipment and piping support frame anchorage to supporting slab or structure.

C. Provide channel support systems, for conduits to support multiple conduits capable of supporting combined weight of support systems and system contents.

D. Provide heavy-duty steel trapezes for piping to support multiple conduit capable of supporting combined weight of supported systems and system contents.

E. Provide seismic restraint hangers and supports for conduit and equipment.

F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Anchors, Threaded Rod and Fasteners:
   1. Anchor It
   2. Epon System
   3. Hilti-Hit System
   4. Power Fast System
   5. Or equal.

B. Support Channel, Hangers and Supports:
   1. B-Line
   2. Kindorf
   3. Superstrut
   4. Unistrut
   5. Or equal.

C. Rooftop Conduit Supports:
   1. Cooper B-Line Dura-Block Rooftop Support Base
   2. Or equal.
2.2 ANCHORS, THREADED ROD AND FASTENERS

A. Anchors, Threaded Rod and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

B. Concrete Inserts: Cast in concrete for support fasteners for loads up to 800 lbs.

C. Anchors and Fasteners:
1. Do not use powder-actuated anchors.
2. Concrete Structural Elements: Use precast inserts.
3. Steel Structural Elements: Use beam clamps.
7. Sheet Metal: Use sheet metal screws.

D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.

E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.

F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

2.3 SUPPORT CHANNEL, HANGERS AND SUPPORTS

A. Hangers and Supports - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
   2. Coating: Hot dip galvanized.

B. Pipe Straps: Two-hole galvanized or malleable iron.

C. Luminaire Chain: 90 lb. test with steel hooks.

D. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings that are necessary for completion of the project. The Contractor is responsible for their design.
   1. Fabricate miscellaneous units to size shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
E. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or equal.

F. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.

G. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

2.4 ROOFTOP CONDUIT SUPPORTS

A. Curb base made of 100 percent recycled rubber and polyurethane prepolymer with a uniform load

B. Capacity of 500 pounds per linear foot of support.

C. UV resistant.

D. Steel Frame: Steel, 14 gauge strut galvanized per ASTM A653 or 12 gauge strut galvanized per ASTM A653 for bridge series.

E. Continuous block channel supports with 1-inch gaps to allow water flow, bridge channel supports, extendable height channel supports and elevated single conduit supports.

F. Attaching Hardware: Zinc-plated threaded rod, nuts and attaching hardware per ASTM B633 fastened directly into rubber material with weather resistant Type 12 lag screws.

G. Provide load distribution plates when required for heavy loads.

H. Finish: Black with safety yellow striping.

I. Provide hot dipped galvanized components for items exposed to weather.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Fabrication - Miscellaneous Metals

1. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates, and similar devices. Hot dipped galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.
2. Finishes:
   a. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with one coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas in primer with same material, before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
   b. Metal in contact with Concrete, Masonry and Other Dissimilar Materials: Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
   c. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

3.2 ANCHORS, THREADED ROD AND FASTENERS INSTALLATION

   A. Safety factor of 4 required for every fastening device or support for equipment installed. Supports to withstand four times the weight of equipment it supports.

   B. Do not use other trade's fastening devices as supporting means for luminaires, equipment or materials.

   C. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

   D. Do not use supports or fastening devices to support other than one particular item.

   E. Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from floor above or roof structure to prevent sagging and swaying.

   F. Provide seismic bracing per CBC requirements.

   G. Install surface-mounted cabinets and panelboards with minimum of four anchors.

   H. Use spring lock washers under fastener nuts for strut.

   I. Cutting and Drilling
      1. Do not drill or cut structural members without prior permission from Architect.

3.3 SUPPORT CHANNEL, HANGERS AND SUPPORTS INSTALLATION

   A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.

   B. Safety factor of 4 required for every fastening device or support for equipment installed. Supports to withstand four times the weight of equipment it supports.
C. Verify mounting height of luminaires prior to installation when heights are not detailed.

D. Install vertical support members for equipment and luminaires, straight and parallel to building walls.

E. Install horizontal support members straight and parallel to ceilings or finished floor unless otherwise noted.

F. Provide independent supports to structural member for luminaires, materials, or equipment installed in or on ceiling, walls or in void spaces or over suspended ceilings.

G. Do not use other trade's fastening devices as supporting means for luminaires, equipment or materials.

H. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

I. Do not use supports or fastening devices to support other than one particular item.

J. Support conduits within 18-inches of outlets, boxes, panels, cabinets and deflections unless more stringently required by CEC.

K. Maximum distance between supports not to exceed 8 foot spacing unless otherwise required by CEC.

L. Support flexible conduits and metal clad cable within 12-inches of outlets, boxes, panels, cabinets and deflections unless otherwise required by CEC.

M. Maximum distance between supports for flexible conduits and metal clad cable not to exceed 48-inches spacing unless otherwise required by CEC.

N. Maximum distance between supports for rigid PVC conduits unless otherwise required by CEC is as follows:
   1. 1/2-inch or 3/4-inch and 1-inch conduit, 3-feet apart.
   2. 1-1/4-inch or 1-1/2-inch and 2-inch conduit, 4-feet apart.
   3. 2-1/2-inch and 3-inch conduit, 5-feet apart.
   4. 4-inch and 5-inch conduit, 6-feet apart.
   5. 6-inch conduit, 7-feet apart.

O. Maximum distance between supports for auxiliary gutters and wireways unless otherwise required by CEC is as follows:
   1. Sheet metal auxiliary gutters and wireways - 4-feet apart horizontally and 10-feet vertically.
   2. Non-metallic auxiliary gutters and wireways - 30-inches apart horizontally and 3-feet vertically.

P. Install strut hangers as instructed by strut manufacturer. Suspend strut hangers as instructed by strut manufacturer for the load, with a maximum spacing of 8-feet on center and within 2-feet of outlet box, cabinet, junction box or other channel raceway termination unless otherwise required by CEC.
Q. Coordinate routing of conduit racks with materials and equipment installed by other trades. Where conduit racks are exposed to view, coordinate location and installation with Architect for optimal appearance.

R. Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from floor above or roof structure to prevent sagging and swaying.

S. Provide seismic bracing per CBC requirements.

T. Install surface-mounted cabinets and panelboards with minimum of four anchors.

U. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

V. Wet and Damp Locations:
   1. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1-inch off wall.

3.4 **ROOFTOP CONDUIT SUPPORTS INSTALLATION**

A. Consult roofing manufacturer for roof membrane compression capacities. If necessary, provide a compatible sheet of roofing material (rubber pad) under rooftop support to disperse concentrated loads and add further membrane protection.

B. Do not use supports that will void roof warranty.

C. Install supports per manufacturer's instructions and recommendations.

D. Use properly sized clamps to suit conduit sizes.

E. Install supports for rooftop raceways to raise raceways a minimum of 4-inches above the roof structure unless otherwise noted.

**END OF SECTION**
SECTION 26 05 33

RAWEWAYS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Rigid Metal Conduit (RMC)
   2. Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Metal Conduit
   3. Electrical Metallic Tubing (EMT)
   4. Flexible Metal Conduit (FMC)
   5. Liquidtight Flexible Metal Conduit (LFMC)
   6. Electrical Polyvinyl Chloride (PVC) Conduit
   7. Conduit Fittings
   8. Surface Raceway Systems

B. Provide a complete system of conduit and fittings, with associated couplings, connectors, and fittings, as shown on drawings and described in these specifications.

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. Section 26 05 29, Hangers and Supports for Electrical Systems and Equipment
   2. Section 26 05 34, Boxes

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
1.7 DEFINITIONS

A. Raceway system is defined as consisting of conduit, tubing, duct, and fittings including but not limited to connectors, couplings, offsets, elbows, bushings, expansion/deflection fittings, and other components and accessories. Complete electrical raceway installation before starting the installation of conductors and cables.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Rigid Metal Conduit (RMC):
   1. Allied Tube & Conduit
   2. Beck Manufacturing Inc.
   3. Picoma
   4. Wheatland Tube Company
   5. Or equal.

B. Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit:
   1. Allied Tube & Conduit
   2. Thomas & Betts Corporation
   3. Robroy Industries
   4. O'kote Inc.
   5. Or equal.

C. Electrical Metallic Tubing (EMT):
   1. Allied Tube & Conduit
   2. Beck Manufacturing WL
   3. Picoma
   4. Wheatland Tube Company
   5. Or equal.

D. Flexible Metal Conduit (FMC):
   1. AFC Cable Systems Inc.
   2. Electri-Flex Company
   3. International Metal Hose
   4. Or equal.

E. Liquidtight Flexible Metal Conduit (LFMC):
   1. AFC Cable Systems Inc.
   2. Electri-Flex Company
   3. International Metal Hose
   4. Or equal.

F. Electrical Polyvinyl Chloride (PVC) Conduit:
   1. AFC Cable Systems Inc.
   2. Electri-Flex Company
   3. International Metal Hose
   4. JM Eagle
5. Or equal.

G. Conduit Fittings:
   1. Bushings:
      a. Insulated type for Threaded Rigid, IMC, or EMT without Factory Installed Plastic
         Throat Conductor Protection:
         1) Thomas & Betts 1222 Series
         2) O-Z Gedney B Series
         3) Or equal.
   2. Raceway Connectors and EMT Couplings:
      a. Thomas & Betts Series
      b. O-Z Gedney Series
      c. Or equal.
   3. Expansion/Deflection Fittings:
      a. EMT: O-Z Gedney Type TX
      b. RMC: O-Z Gedney Type AX, DX and AXDX, Crouse & Hinds XD
      c. PVC: O-Z Gedney Type DX with PVC adapters, Carlon E945 Series, Kraloy
         OPEJ Series
      d. Or equal.

H. Surface Raceway Systems:
   1. Two Channel Surface Raceway:
      a. Wiremold 4000 Series
      b. MonoSystems SMS 4200 Series
      c. Or equal.

2.2 RIGID METAL CONDUIT (RMC)

   A. UL 6, ANSI C80.1. Hot dipped galvanized steel conduit after thread cutting.
      1. Fittings: NEMA FB2.10.

2.3 POLYVINYL CHLORIDE (PVC) EXTERNALLY COATED GALVANIZED RIGID METAL CONDUIT

   A. Description: UL 6, ANSI C80.1, and NEMA RN 1; rigid steel conduit with external PVC
      coating.
      1. PVC Coating: Minimum 40 mils in thickness.

   B. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match
      conduit.

2.4 ELECTRICAL METALLIC TUBING (EMT)

   A. Description: UL 797, ANSI C80.3; steel galvanized tubing.

   B. Fittings: NEMA FB 1; steel, compression type.

2.5 FLEXIBLE METAL CONDUIT (FMC)

   A. Description: UL 1, Interlocked steel construction.
B. Fittings: NEMA FB 2.20.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Description: UL 360, inner core made from spiral wound strip of heavy gauge, hot dipped galvanized low carbon steel. 3/4-inch through 1-1/4-inch trade sizes to have a square lock core and contain an integral bonding strip of copper. 1-1/2-inch and larger to have fully interlocked core. Jacket material to be moisture, oil and sunlight resistant flexible PVC.

B. Fittings: NEMA FB 2.20.

2.7 ELECTRICAL POLYVINYL CHLORIDE (PVC) CONDUIT

A. Description: UL 651, NEMA TC 2; Schedule 40 PVC.

B. Fittings: NEMA TC 3.

2.8 CONDUIT FITTINGS

A. Bushings:
1. Insulated type for Threaded Rigid, IMC Conduit or Raceway Connectors without factory-installed plastic throat conductor protection.
2. Insulated grounding type for Threaded Rigid, IMC Conduit and Conduit Connectors.

B. Raceway Connectors and EMT Couplings:
1. Steel connectors, couplings, and conduit bodies, hot-dip galvanized.
2. Connector locknuts to be steel, with threads meeting ASTM tolerances. Locknuts to be hot-dip galvanized.
3. Connector throats (EMT, flexible conduit, metal clad cable and cordset connectors) to have factory installed plastic inserts permanently installed. For normal cable or conductor exiting angles from raceway, the cable jacket or conductor insulation to bear only on plastic throat insert.
4. Steel gland, Temic or Breagle connectors and couplings are recognized for this Contract as having acceptable raceway to fitting electrical conductance.
5. Set screw connectors and couplings, without integral compression glands, are recognized for this Contract as not having acceptable raceway to fitting electrical conductance. A ground conductor sized per this Specification must be included and bonded within raceway assembly utilizing this type connector or coupling.

C. Provide expansion/deflection fittings for EMT.

2.9 SURFACE RACEWAY SYSTEMS

A. Two Channel Surface Raceway: One channel for power, other channel for signal. Provide 20 amp multi-outlet assembly as indicated on drawings. Provide divider between channels.

B. Provide lengths scaled from drawings to tolerance of 1/2-inch, over raceway length, between end wall surface. Do not scale from Division 26, Electrical Drawings.
C. Provide prewired receptacles every 24-inches unless otherwise noted on drawings. Reference Section 26.27.26, Wiring Devices for device requirements.

D. Provide end caps, corner joints, tees, transition fittings, device brackets and like items for complete installation.

E. Verify exact mounting height with drawings.

F. Finish White.

G. Basis of Design: Surface raceway design, shown on the drawings, is based on Wiremold product line. Approved manufacturers listed are allowed on condition of meeting the specified conditions including area of fill, finish and coordination with other trades. Remove and replace raceway not meeting these conditions at no cost to Owner.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Finished Surfaces: Schedule raceway installation to avoid conflict with installed wall and ceiling surfaces. If unavoidable, coordinate work and repairs with Architect.

B. Conduit Size:
   1. Minimum Size: 3/4-inch for power and control, unless otherwise noted. 3/4-inch for communication/data, unless otherwise noted. 3/4-inch for signal systems, unless otherwise noted.

C. Underground Installations:
   1. More than 5-feet from Foundation Wall: Use PVC.
   2. Within 5-feet from Foundation Wall: Use PVC coated RMC.
   3. In or Under Slab on Grade: Use PVC.

D. In Slab Above Grade:
   1. Use PVC.
   2. Maximum Size Conduit in Slab: Contact Structural Engineer for maximum outside diameter of conduit.

E. Provide two pull strings/tapes in empty conduits. Types:
   1. Utility Company Conduit: Polyester measure/pulling tape, Greenlee 4436 or equal. Coordinate exact requirements with utility company.
   2. Feeders: Polyester measure/pulling tape, Greenlee 4436 or approved.
   3. Branch Circuits and Low Voltage: Greenlee Poly Line 431 or approved.
   4. If fish tape is used for pulling line or low voltage wiring, fiberglass type to be used. Metal fish tapes will not be allowed.
   5. Secure pull string/tape at each end.
   6. Provide caps on ends of empty conduit to be used in future.
   7. Label both ends of empty conduits with location of opposite end.

F. Elbows: Use fiberglass or PVC coated RMC for underground installations.

H. Verify that field measurements are as shown on drawings.

I. Plan locations of conduit runs in advance of the installation and coordinate with ductwork, plumbing, ceiling and wall construction in the same areas.

J. Locate penetrations and holes in advance where they are proposed in the structural sections such as footings, beams, and walls. Penetrations are acceptable only when the following occurs:
   1. Where shown on the structural drawings.
   2. As approved by the Structural Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.

K. Verify routing and termination locations of conduit prior to rough-in.

L. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

M. Install raceways securely, in neat and workmanlike manner, as specified in NECA 1, Standard Practices for Good Workmanship in Electrical Construction.

N. Install steel conduit as specified in NECA 101, Standard for Installing Steel Conduits.

O. Install nonmetallic conduit in accordance with manufacturer's instructions.

P. Inserts, anchors and sleeves.
   1. Coordinate location of inserts and anchor bolts for electrical systems prior to concrete pour.
   2. Coordinate location of sleeves with consideration for other building systems prior to concrete pour.

Q. Conduit Supports:
   1. Arrange supports to prevent misalignment during wiring installation.
   2. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
   3. Group related conduits; support using conduit rack. Construct rack using steel channel. Provide space on each for 25 percent additional conduits.
   4. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
   5. Do not attach conduit to ceiling support wires.

R. Flexible steel conduit length not-to-exceed 6-feet, 3-feet in concealed walls. Provide sufficient slack to reduce the effect of vibration.

S. Install conduit seals at boundaries where ambient temperatures differ by 10 degrees F or more as shown on the drawings. Install seals on warm side of partition.
T. Seal raceways stubbing up into electrical equipment. Plug raceways with conductors with duct-seal. Cap spare raceways and plug PVC raceway products with plastic plugs as made by Underground Products, or equal, shaped to fit snugly into the stubup.

U. Seal raceways penetrating an exterior building wall to prevent moisture and vermin from entering into the electrical equipment.

V. Use suitable caps on spare and empty conduits to protect installed conduit against entrance of dirt and moisture.

W. Keep 277/480 volt wiring independent of 120/208 volt wiring. Keep power wiring independent of communication system wiring.

X. Keep emergency system wiring independent of other wiring systems per NEC 700.

Y. Installation of conduit in structural concrete that is less than 3-inches thick is prohibited without the approval of the Structural Engineer. Maintenance pads, and curbs are exempted.

Z. Raceways Embedded in Floor Slabs:
   1. Do not install raceways in slab without the approval of the Structural Engineer.
   2. Do not let raceways interfere with placement of floor slab reinforcement components.
   3. Install raceways between the upper and the lower layers of reinforcing steel.
   4. Space raceways not less than 8-inches on centers except where they converge at panels or junction boxes.
   5. Raceways running parallel to slabs supports, such as beams, columns and structural walls, to be installed not less than 12-inches from such supporting elements.
   6. Branch circuit homeruns are not permitted in slab, route branch circuit homeruns above grade exposed in approved areas or above lay-in ceiling spaces.
   7. Route conduits in or under slabs point-to-point.
   8. Do not cross conduits in slab.
   9. Encase medium voltage feeder conduits using red concrete.

AA. Arrange conduit to maintain headroom and present neat appearance.

AB. Do not install conduits on surface of building exterior, along vapor barrier, across roof, on top of parapet walls, or across floors, unless otherwise noted on drawings.

AC. Exposed conduits are permitted only in following areas:
   1. Mechanical rooms, electrical rooms or spaces where walls, ceilings and floors will not be covered with finished material.
   2. Existing walls that are concrete or block construction.
   3. Where specifically noted on Drawings.
   4. Route exposed conduit parallel and perpendicular to walls, tight to finished surfaces and neatly offset into boxes.

AD. Do not install conduits or other electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block area passage's intended usage.

AE. Install continuous conduit and raceways for electrical power wiring and signal systems wiring.
AF. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

AG. Maintain adequate clearance between conduit and piping.

AH. Keep conduits a minimum of 12-inches away from steam or hot water radiant heating lines (at or above 104 degrees F) or 3-inches away from waste or water lines.

AI. Cut conduit square using saw or pipecutter; deburr cut ends.

AJ. Bring conduit to shoulder of fittings; fasten securely.

AK. Use conduit hubs to fasten conduit to cast boxes in damp and wet locations.

AL. Install no more than the equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams.

AM. Use hydraulic one shot bender to fabricate elbows for bends in metal conduit larger than 2-inch size.

AN. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

AO. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control, and expansion joints.

AP. Conduit Terminations for Signal Systems: Provide a plastic bushing on the end of conduit used for signal system wiring.

AQ. Feeders: Do not combine or change feeder runs.

AR. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07, Thermal and Moisture Protection.

AS. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation and installer.

3.2 RIGID METAL CONDUIT (RMC) INSTALLATION

A. Outdoor Locations Above Grade: RMC.

B. Damp Locations: RMC up to 2-inches in diameter.

C. Dry Locations:
   1. Concealed: RMC.
   2. Exposed: RMC.

D. Dry, Protected: RMC.

E. In areas exposed to severe mechanical damage: RMC.

F. For security conduits installed exposed and subject to tampering: RMC.
3.3 POLYVINYL CHLORIDE (PVC) EXTERNALLY COATED GALVANIZED RIGID METAL CONDUIT INSTALLATION

A. Use PVC coated RMC 36-inch radius ells for power service conduits and 48-inch radius ells for telephone service conduits.

3.4 ELECTRICAL METALLIC TUBING (EMT) INSTALLATION

A. Damp Locations: EMT up to 2-inches in diameter.

B. Dry Locations:
   1. Concealed: EMT.
   2. Exposed: EMT.

C. Dry, Protected: EMT.

3.5 FLEXIBLE METAL CONDUIT (FMC) INSTALLATION

A. Dry Locations: Motors, recessed luminaires and equipment connections subject to movement or vibration, use flexible metallic conduit.

B. Install 12-inch minimum slack loop on flexible metallic conduit.

3.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC) INSTALLATION

A. Use PVC coated liquidtight flexible metallic conduit for motors and equipment connections subject to movement or vibration and subjected to any of following conditions: Exterior location, moist or humid atmosphere, corrosive environments, water spray, oil, or grease.

B. Install 12-inch minimum slack loop on liquidtight flexible metallic conduit.

3.7 ELECTRICAL POLYVINYL CHLORIDE (PVC) CONDUIT INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Provide equipment grounding conductor in PVC conduit runs containing power conductors.

C. Underground Installation:
   1. Areas subject to vehicular traffic: Schedule 80 PVC.
   2. Other underground applications: Schedule 40 PVC, except where prohibited by the NEC or local codes.

D. Convert PVC conduit to Rigid Metal Conduit (RMC) prior to emerging from underground, concrete encasement, or concrete slab.

E. Provide expansion fittings to compensate for expansion and contraction per NEC 352.44.

F. PVC elbows are not acceptable. Use fiberglass or PVC coated RMC.

G. Trim cut ends inside and outside to remove rough edges.
H. Provide bushings when entering a box, fitting or other enclosure.

3.8 CONDUIT FITTINGS INSTALLATION

A. Conduit Joints: Assemble conduits continuous and secure to boxes, panels, luminaires and equipment with fittings to maintain continuity. Provide watertight joints where embedded in concrete, below grade or in damp locations. Seal metal conduit with metal thread primer. Rigid conduit connections to be threaded, clean and tight (metal to metal). Threadless connections are not permitted for RMC and IMC. Seal conduits where penetrating below raised floor area.

B. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

C. Use set screw type fittings only in dry locations. When set screw fittings are utilized provide insulated continuous equipment ground conductor in conduit, from overcurrent protection device to outlet.

D. Use compression fittings in dry locations, damp and rain-exposed locations. Maximum size permitted in damp locations and locations exposed to rain is 2-inches in diameter.

E. Use threaded type fittings in wet locations, hazardous locations, and damp or rain-exposed locations where conduit size is greater than 2-inches.

F. Use PVC coated, threaded type fittings in corrosive environments.

G. Use insulated type bushings with ground provision at switchboards, panelboards, safety disconnect switches, junction boxes that have feeders 60 amperes and greater.

H. Condulets and Conduit Bodies:
   1. Do not use condulets and conduit bodies in conduits for signal wiring, in feeders 100 amp and larger, or for conductor splicing.

I. Sleeves and Chases - Floor, Ceiling and Wall Penetrations: Provide necessary rigid conduit sleeves, openings and chases where conduits or cables are required to pass through floors, ceilings or walls.

J. Provide rigid conduit coupling flush with surface of slab or wall for conduit stubbed in concrete slab or wall to serve electrical equipment or an outlet under table or to supply shop tool, etc. Provide plug where conduit is to be used in future.

3.9 SURFACE RACEWAY SYSTEMS INSTALLATION

A. Install per manufacturer's installation instructions, perpendicular and parallel to building lines.

B. Use flat-head screws, clips, and straps to fasten raceway channel to surfaces. Mount plumb and level.

C. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
D. Close end of wireway and unused conduit openings.

END OF SECTION
SECTION 26 05 34

BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Outlet Boxes
   2. Floor Boxes and Poke-Thrus
   3. Pull and Junction Boxes
   4. Box Extension Adapter
   5. Conduit Fittings
   6. Weatherproof Outlet Boxes

B. Provide electrical boxes and fittings for a complete installation. Include but not limited to outlet boxes, junction boxes, pull boxes, bushings, locknuts and other necessary components.

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. Section 26 05 33, Raceways
   2. Section 26 05 53, Identification for Electrical Systems

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Outlet Boxes:
   1. Hubbell
   2. Thomas & Betts
   3. Cooper/Crouse-Hinds
   4. Or equal.

B. Floor Boxes and Poke-Thrus:
   1. Wiremold/Walker
   2. FSR
   3. Hubbell
   4. Thomas & Betts
   5. MonoSystems
   6. Cooper/Crouse-Hinds
   7. Or equal.

C. Pull and Junction Boxes:
   1. Cooper/Crouse-Hinds
   2. Hoffman
   3. Or equal.

D. Box Extension Adapter:
   1. Hubbell
   2. Thomas & Betts
   3. Cooper/Crouse-Hinds
   4. Or equal.

E. Conduit Fittings:
   1. O-Z Gedney
   2. Hubbell
   3. Thomas & Betts
   4. Cooper/Crouse-Hinds
   5. Or equal.

F. Weatherproof Outlet Boxes:
   1. Pass and Seymour
   2. Hubbell
   3. Thomas & Betts
   4. Cooper/Crouse-Hinds
   5. Intermatic
   6. Or equal.

2.2 OUTLET BOXES

A. Luminaire Outlet: 4-inch octagonal box, 1-1/2-inches deep with 3/8-inch luminaire stud if required. Provide raised covers on bracket outlets and on ceiling outlets.
B. Device Outlet: Installation of one or two devices at common location, minimum 4-inches square, minimum 1-1/2-inches deep. Single- or two-gang flush device raised covers.

C. Telecom Outlet: Provide 4-inches square, minimum 2-1/8-inch deep box with two-gang plaster ring.

D. Multiple Devices: Three or more devices at common location. Install one-piece gang boxes with one-piece device cover. Install one device per gang.

E. Construction: For interior locations, provide galvanized steel outlet wiring boxes, of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.

F. Accessories: Provide outlet box accessories for each installation, including mounting brackets, wallboard hangers, extension rings, luminaire studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.

G. Noise Control: Provide acoustic putty pad to back side of each outlet box installed in acoustic rated walls.

2.3 FLOOR BOXES AND POKE-THRU

A. Floor Boxes:
   1. Multi-Gang Box, Slab on Grade Basis of Design: Wiremold RFB4-CI series cast iron housing with S40CC series aluminum finish, steel flanged activation for use with matching carpet or tile insert. Rubber gasket protects interior from water and debris. Provide with two duplex receptacles and blank inserts for two future data outlets. Provide matching carpet or tile insert in activation cover.
   2. Multi-Gang Box, Slab above Grade Basis of Design: Wiremold RFB4 series steel housing with S40CC series aluminum finish, steel flanged activation for use with matching carpet or tile insert. Rubber gasket protects interior from water and debris. Provide with two duplex receptacles and blank inserts for two future data outlets. Provide matching carpet or tile insert in activation cover.
   3. Multi-Gang Box, Concrete Finish Floor Basis of Design: Same as above, except use Wiremold S40BB series aluminum finish, steel flanged activation.
   4. Single Gang Box, Slab on Grade Basis of Design: Wiremold 880CM (cast-iron) series with 817 series aluminum finish flange suitable for both carpet and tile floors, and 828GF1 aluminum finish cover plate insert.
   5. Single Gang Box, Slab above Grade Basis of Design: Wiremold 880S (stamped steel) series with 817 series aluminum finish flange suitable for both carpet and tile floors, and 828GF1 aluminum cover plate insert.
   6. Provide floor boxes sized minimum 3-7/16-inches deep with 1-inch factory knockouts.

B. Poke-Thrus: Fire rated for up to 2 hr rated floors. Suitable for air handling spaces. Meets ADA accessibility guidelines. Exceeds UL scrub water exclusion requirements for tile, carpet and wood covered floors. Where used, devices recessed below floor level.
   1. Cover Finish: Aluminum.
2. Poke-thru for furniture feed for power and communications: One 0.75-inch and one 2-inch screw plug opening. Basis of Design: Wiremold 6ATCFF series or equal.
5. Provide the following low voltage device mounting plates:
   a. Decorator Style Basis of Design: Wiremold 6DEC.
   b. Blank Basis of Design: Wiremold 6B.
   c. Any additional accessories.

2.4 PULL AND JUNCTION BOXES

A. Construction: Provide ANSI 49 gray enamel painted sheet steel junction and pull boxes, with screw-on covers; of type shape and size, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

B. Location:
1. Provide junction boxes above accessible ceilings for drops into walls for receptacle outlets from overhead.
2. Provide junction boxes and pull boxes to facilitate installation of conductors and limiting accumulated angular sum of bends between boxes, cabinets and appliances to 270 degrees.

C. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
1. Construction: Galvanized cast iron.
2. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
3. Cover Legend: ELECTRIC.

D. Fiberglass Handholes: Die molded glass fiber hand holes:
1. Cable Entrance: Pre-cut 6 x 6-inch cable entrance at center bottom of each side.
2. Cover: Fiberglass weatherproof cover with nonskid finish.
3. Cover Legend: ELECTRIC.

2.5 BOX EXTENSION ADAPTER

A. Construction: Diecast aluminum.

B. Location: Install over flush wall outlet boxes to permit flexible raceway extension from flush outlet to fixed or movable equipment.

2.6 CONDUIT FITTINGS

A. Requirements: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and plastic conduit bushings of the type and size to suit each respective use and installation.
2.7 WEATHERPROOF OUTLET BOXES

A. Construction: Provide corrosion-resistant cast metal weatherproof outlet wiring boxes, of the type, shape and size, including depth of box, with threaded conduit ends, cast metal faceplate with spring-hinged waterproof cap suitably configured for each application, including faceplate, gasket, blank plugs and corrosion proof fasteners. Weatherproof boxes to be constructed to have smooth sides, gray finish.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate locations of floor boxes and wall mounted wiring device boxes with architectural and structural floor plans prior to rough-in.

B. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1, Standard Practice of Good Workmanship in Electrical Construction.

C. Secure boxes rigidly to substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.

D. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NEC. Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.

E. Set wall mounted boxes at elevations to accommodate mounting heights specified in this Section.

F. Electrical boxes are shown on drawings in approximate locations unless dimensioned.
   1. Adjust box locations up to 10-feet if required to accommodate intended purpose.

G. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07, Thermal and Moisture Protection.

H. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

I. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

J. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12-inches of box.

K. Box Color Coding and Marking: Reference Section 26 05 53, Identification for Electrical Systems.

L. Adjust boxes to be parallel with building lines. Boxes not plumb to building lines are not acceptable.

M. Install knockout closures in unused box openings.
N. Clean interior of boxes to remove dust, debris, and other material.

O. Clean exposed surfaces and restore finish.

3.2 **OUTLET BOXES INSTALLATION**

A. Mount outlet boxes, unless otherwise required by ADA, or noted on drawings, following distances above finished floor:
   1. Control Switches:
      a. 48-inches to the top of outlet box.
      b. 4-inches above top of backsplash at countertops/workstations. not-to-exceed 44-inches above finished floor to the top of outlet box per ADA requirements.
   2. Receptacles: 15-inches to the bottom of outlet box.
   3. Telecom Outlets: 15-inches to the bottom of outlet box.
   4. Other Outlets: As indicated in other sections of specifications or as detailed on drawings.

B. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6-inches from ceiling access panel or from removable recessed luminaire.

C. Flush Outlets in Insulated Spaces: Maintain integrity of insulation and vapor barrier.

D. Coordinate electrical device locations and elevations (switches and receptacles) with architectural drawings to prevent mounting devices in mirrors, back splashes, and behind cabinets.

E. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

F. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices. Adjacent boxes not aligned vertically to be adjusted at no additional cost to Owner.

G. Use flush mounting outlet box in finished areas.

H. Do not install flush mounting box back-to-back in walls; provide minimum 6-inches separation. Provide minimum 24-inches in acoustic rated walls.

I. In acoustical walls, apply acoustic putty pad on outlet box prior to installation of acoustical blanket.

J. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

K. Use stamped steel bridges to fasten flush mounting outlet box between studs.

L. Use adjustable steel channel fasteners for hung ceiling outlet box.

M. Use gang box where more than one device is mounted together. Do not use sectional box.

N. Use gang box with plaster ring for single device outlets.

O. Adjust flush-mounting outlets to make front flush with finished wall material.
3.3 **FLOOR BOXES AND POKE-THRUS INSTALLATION**

A. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

B. Set floor boxes level.

C. Adjust floor boxes flush with finish flooring material.

D. Provide poke-thrus with fire rating equal to floor rating.

3.4 **PULL AND JUNCTION BOXES INSTALLATION**

A. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

B. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6-inches from ceiling access panel or from removable recessed luminaire.

C. Do not fasten boxes to ceiling support wires.

D. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.5 **BOX EXTENSION ADAPTER INSTALLATION**

A. Match material to box.

B. Install gaskets at exterior and wet locations.

3.6 **CONDUIT FITTINGS INSTALLATION**

A. Install set-screw fittings so the screws can be seen from below.

B. Tighten compression fittings per manufacturer's instructions.

3.7 **WEATHERPROOF OUTLET BOXES INSTALLATION**

A. Use cast outlet box in exterior locations exposed to weather and wet locations.

B. Install gaskets.

**END OF SECTION**
SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Equipment Nameplates
   2. Device Labels
   3. Wire Markers
   4. Underground Warning Tape

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals not required for this Section.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
   2. Manufacturer's standard products of categories and types required for each application as referenced in other Division 26, Electrical Sections. Where more than a single type is specified for application, provide single selection for each product category.
   3. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Equipment Nameplates:
   1. B & I Nameplates
   2. Intellieum
   3. JBR Associates
   4. Or equal.

B. Device Labels:
   1. Kroy
   2. Brady
   3. Or equal.

C. Wire Markers:
   1. Brady
   2. Panduit
   3. Sumitomo
   4. Or equal.

D. Underground Warning Tape:
   1. Allen Systems
   2. Brady
   3. Or equal.

2.2 EQUIPMENT NAMEPLATES

A. Engraved phenolic plastic, laminate, minimum 1/8-inch thick in the size indicated, with beveled edge border matching letter color. Federal specification L-P-387. All upper case letters in engraver standard letter style of the size and wording indicated. Punched for mechanical fastening, except where adhesive mounting is necessary due to substrate. Embossed tape style labels are not acceptable.

B. Color:
   1. Normal (Utility): White letters on black background.
   2. Emergency Systems: Black letters on orange background.

C. Letter Size:
   1. Use 1/2-inch letters minimum for identifying major equipment and loads, including switchgear, switchboards, etc.
   2. Use 1/4-inch or 1/2-inch letters minimum for identifying panels, breakers, etc.
   3. Use 3/16-inch minimum for identifying source, voltage, current, phase, and wire configurations.

D. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
E. The Architect, Engineer, Commissioning Agent and Owner reserve the right to make modifications to the nameplates as necessary.

F. Locations:
1. Distribution panels, and branch panels.
2. Main breakers and distribution breakers in distribution panels.
3. Equipment including, but not limited to, motor controllers, disconnects, and VFDs.
4. Low-voltage equipment enclosures including, but not limited to, fire alarm panels, access control panels, and lighting control panels.

2.3 DEVICE LABELS

A. Extra strength, laminated adhesive tape, with 3/16-inch black letters on clear background. Use only for identification of individual wall switches and receptacles. Indicate device name, source panel, and source circuits. Panel and circuit designation written in permanent marker on the back of the plate and inside the back-box. Do not provide punch tape style labels.

B. Label all junction boxes to show system identification, source circuit, or raceway origin. In finished areas, utilize device label. In unfinished areas or above ceilings, use of permanent ink marker is acceptable.

2.4 WIRE MARKERS

A. Description: Vinyl-cloth self-adhesive type wire markers.

B. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, junction boxes, and each load connection.

C. Power and Lighting Circuits: Branch circuit or feeder number as indicated on drawings and source panel.

D. Control Circuits: control wire number indicated on schematic and interconnection diagrams on drawings or shop drawings.

2.5 UNDERGROUND WARNING TAPE

A. Description: 6-inch wide inert polyethylene plastic tape, 4-mil thick, detectable type, colored per APWA recommendations unless otherwise noted with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate designations used on Drawings with equipment nameplates and device labels.

B. Install nameplates and labels parallel to equipment lines.

C. Identify empty conduit and boxes with intended use.
D. Provide typewritten branch panel schedules with protective clear transparent covers accounting for every breaker installed. Use actual room designations assigned by name or number near completion of the work, and not the designations shown on drawings.

E. Where changes are made in existing panels, distribution boards, etc., provide new labeling and typewritten schedules to accurately reflect the changes.

F. Provide color coded boxes as follows:
   1. Fire Alarm: Red.

3.2 **EQUIPMENT NAMEPLATES**

A. Degrease and clean surfaces to receive nameplates.

B. Secure equipment nameplates to equipment front using self-tapping stainless steel screws.

C. Secure equipment nameplates to inside surface of door on panelboard that is recessed in finished locations.

D. Verify emergency system distribution equipment nameplate colors with Architect/Owner.

E. Panels to include name source, voltage, current phase, wire configuration and fault current rating. Transformers to include source KVA, and secondary voltage, phase, and wire configuration.

F. Provide nameplates for flush mounted branch panelboards identifying name on front door. On inside of door provide nameplate as noted above. Verify with Architect/Owner if nameplate on outside of door is required.

G. Provide a second label at branch panelboards listing the means of identification of branch circuit conductors. This identification legend to consist of the color code used for each voltage system (208Y/120V and 480Y/277V). See Specification Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables, for required conductor color code for this project. Include identification of both voltage systems on each label, regardless of the voltage of the panelboard to which the label is affixed. Comply with requirements of NEC 210.5.

3.3 **DEVICE LABELS**

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Degrease and clean surfaces to receive labels.

3.4 **WIRE MARKERS**

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.
C. Provide wire markers on each conductor for power, control, signalling and communications circuits.

D. Where switches control remote lighting or power outlets, or where switches or outlets in same location serve different purposes, such as light, power, intercom, etc. or different areas, such as corridor and outside, provide plates with 1/8-inch black letters indicating function of each switch or outlet. Also label the function of light switches where two or more are mounted in same locations.

3.5 UNDERGROUND WARNING TAPE

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Identify underground raceways using underground warning tape. Install one continuous tape per underground raceway at 6- to 8-inches below finish grade. Where multiple underground raceways are buried in a common trench and exceeds 16-inch width, install multiple warning tapes not over 10-inches apart (edge to edge) over the entire group of underground raceways.

END OF SECTION
SECTION 26 08 10
BUILDING LIGHTING ACCEPTANCE TESTING AND DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Duties of the Team
   2. Time Schedule
   3. Acceptance Testing - Phase I - Documentation
   4. Acceptance Testing - Phase II - Documentation
   5. Acceptance Testing - Phase III - Documentation
   6. This Section describes the acceptance testing and documentation of the lighting system(s) and outlines the duties and responsibilities of the contracting team for acceptance testing.
   7. Supply the acceptance requirements to products, equipment and systems provided under this Division, where indicated on Drawings, and where required by California Title 24 requirements.
   8. Engage the services of a firm specializing in commissioning of lighting systems or submit contractor qualifications for review by architect where testing and documentation is to be performed by contractor.

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 COMMISSIONING TEAM

A. Form the Commissioning Team of:
   1. Electrical Contractor's Representative
   2. Lighting Controls Manufacturer's Representative
   3. Inspector of Record
4. Owner's Staff Representative

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 DUTIES OF THE TEAM

A. The duties of the Team are as outlined in the Title 24 Requirements and summarized below:
   1. Plan, organize and implement the acceptance testing process and within 1 month of the award of the contract, submit the names and addresses of the Testing team member(s).
   2. The acceptance testing team to submit a complete description of the testing procedures and systems to be tested to the architect for review.
   3. The acceptance testing team to coordinate tests of systems and equipment and assemble documentation related to tests. Submit documentation relative to tests and proposed procedures to design engineer for review prior to submitting documentation to Authority Having Jurisdiction (AHJ). Team responsible for performing data analysis, calculation of performance indices and cross-checking of results with the requirements of Title 24 and the Contract documents. The installing contractor or agent responsible for testing and documentation to record their State of California Contractor's license number or their State of California Professional Registration License number on each Certificate of Acceptance for submittal.
   4. Responsible for submitting Certificate of Acceptance including paper and electronic copies of measurements and monitoring results and supporting documentation to the AHJ. Where AHJ questions results or requires additional testing, complete additional testing and provide required documentation at no additional cost to the Owner.

3.2 TIME SCHEDULE

A. Determine the time period of the commissioning of the systems by the general contractor and acceptance testing team. It is important to note that AHJ will not release a final Certificate of Occupancy until a Certificate of Acceptance is submitted that demonstrates that the specified systems and equipment have been shown to be performing in accordance with the California Title 24 standards.

3.3 ACCEPTANCE TESTING - PHASE I - DOCUMENTATION

A. Team to assemble documentation showing lighting fixture locations, lighting control device locations, control sequences and notes.

B. Per California Title 24 requirements, team to provide record drawings to building Owner within 90 days of receiving a final occupancy permit (reference other specification Sections for requirements on record drawings.)

C. Per California Title 24 requirements, team to provide operating and maintenance manuals to the building Owner (reference other specification Sections for requirements on operation and maintenance manuals.)
3.4 ACCEPTANCE TESTING - PHASE II - INSPECTION AND TESTING

A. Team to review the installation, perform acceptance testing and document results for the following systems:
   1. Occupancy Sensors
   2. Manual Daylight Controls
   3. Automatic Daylight Controls
   4. Automatic Time Switch Controls

B. Review of installation to confirm lighting fixtures and lighting controls are properly located, identified, calibrated, and set points and schedules programmed per contract document requirements.

3.5 ACCEPTANCE TESTING - PHASE III - CERTIFICATION

A. Team to document operating and maintenance information, complete installation certificate, and indicate test results on the Certificate of Acceptance, and submit the Certificate to the AHJ prior to receiving final occupancy permit.

B. Team to submit forms LTG-1-A through LTG-3-A as required by California Title 24 requirements.

3.6 ACCEPTANCE TESTS AND DOCUMENTATION

A. Reference State of California requirements for specific testing procedures and documentation requirements. Contractor is responsible for reviewing and complying with standards as required by Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements Basic Electrical Requirements as well as State and governmental standards related to this work.

B. Reference California Title 24, 2016 Nonresidential Compliance Manual and Documents for specific testing procedures and documentation requirements. Contractor is responsible for reviewing and complying with these standards. The detailed requirements can be found at: http://www.energy.ca.gov/title24/2016standards/index.html.

END OF SECTION
SECTION 26 09 00

CONTACTORS AND CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Electronic Time Switches
   2. Photoelectric Switches
   3. Emergency Lighting Relays

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1.4 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Shop Drawings: Submit to NEMA ICS 1 indicating control panel layouts, wiring connections and diagrams, dimensions, support points.
   2. Product Data: Provide for each component showing electrical characteristics and connection requirements.
   3. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements apply to this Section.

1.6 WARRANTY

A. Warranty of materials and workmanship as outlined in Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Electronic Time Switches:
   1. Intermatic
   2. Paragon
   3. Sangamo
   4. Tork
   5. Or equal.

B. Photoelectric Switches:
   1. Precision
   2. Paragon
   3. Tork
   4. Or equal.

C. Emergency Lighting Relay:
   1. Nine 24
   2. Bodine
   3. Wattstopper
   4. Or equal.

2.2 ELECTRONIC TIME SWITCHES

A. Double pole, single throw; one N.O. contact, one N.C. contact. 24 hour digital. Battery power source to provide minimum of 3 years of memory back-up. Eight event setpoints. Provide enclosure with separate hinged door, recessed or surface as indicated on Drawings.

2.3 PHOTOELECTRIC SWITCHES

A. Characteristics:
   1. Hermetically sealed light sensitive element installed in die cast weatherproof enclosure.
   2. Adjustable external light level slide.
   3. Swivel adjustable enclosure.

B. Electrical Rating: 120VAC, 1800VA, connected for pilot duty unless otherwise indicated.

2.4 EMERGENCY LIGHTING RELAY

A. UL924 listed for connected load of 20 amps at 277 volt or 120 volt.

B. UL rated N.C. contacts, minimum 20 amps rating.

C. Integral surge protection.

D. Two separate status emergency lighting indicators for troubleshooting:
   1. Amber LED indicates presence of normal utility power.
   2. Red LED indicates presence of unswitched emergency power.
E. Manual and/or automatic diagnostic testing feature.

F. Dimming control: Where 0-10 volt dimming control is connected to emergency lighting, supply and connect auxiliary relay to open dimming 0-10 volt control circuit upon loss of normal power, or else supply emergency lighting relay with integral contact to open 0-10 volt control circuit.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Testing:
   1. Test to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with approved drawings and specifications.
      a. Daylight sensing automatic lighting controls.
      b. Occupant sensing automatic lighting controls.
      c. Automatic time switches for lighting control.
      d. Emergency lighting controls.
   2. Functionally test all control devices to ensure operation in accordance with approved drawings and specifications.
   3. Prepare and complete report of test procedures and results and file with the Owner.

B. Install items per manufacturers written instructions.

3.2 ELECTRONIC TIME SWITCHES

A. Install time switches and other automatic control devices in accessible locations near the source of power or grouped at a common location in mechanical rooms or similar spaces.

3.3 PHOTOELECTRIC SWITCHES

A. Install photoelectric control devices at such locations as necessary to be most effective. Avoid locating photoelectric devices in or at locations where they can be influenced by other than natural light or under eaves. Verify location of equipment with Architect.

3.4 EMERGENCY LIGHTING RELAYS

A. Emergency Relay (UL924):
   1. Provide unswitched emergency circuit, and unswitched and switched normal circuit to UL924 relay for control of emergency luminaires with remaining room luminaires on normal power.
   2. Install each relay within dedicated 4-1/16-inch junction box with double-gang plaster ring for wall or ceiling flush-mount as indicated on Drawings. Where location in ceiling would interfere with removal of ceiling tiles, install relay flush-mounted in nearest wall at ceiling level. Do not locate behind wall switch.
   3. Where 0-10 volt dimming control is connected to emergency lighting, supply and connect auxiliary relay to open dimming 0-10 volt control circuit upon loss of normal power.

END OF SECTION
SECTION 26 09 23

OCCUPANCY AND VACANCY SENSORS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Occupancy/Vacancy Sensors (Ceiling and Wall mounted)
   2. Combined Occupancy Sensor/Wall Switches ("Sensor/Switches")
   3. Automatic Switches

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Provide wiring diagrams indicating low voltage and line voltage wiring requirements.
   2. Provide, on reproducible architectural floor plan, a layout of sensors indicating their sensing distribution.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Use manufacturer's published testing and adjusting procedures to adjust sensors time delay, daylight sensitivity, and passive infrared sensitivity to satisfaction of the Owner, in accordance with California Title 24 requirements.
   2. Prepare and complete report of test procedures and results. Submit these test procedures and results to Owner and Architect.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Occupancy/Vacancy Sensors (Ceiling and Wall mounted):
   1. Passive Infrared Occupancy/Vacancy Sensors:
      a. nLight
      b. WattStopper
      c. Leviton
      d. Hubbell
      e. Or equal.
   2. Ultrasonic Occupancy/Vacancy Sensors:
      a. nLight
      b. WattStopper
      c. Leviton
      d. Hubbell
      e. Or equal.
   3. Dual Technology Occupancy/Vacancy Sensors:
      a. nLight
      b. WattStopper
      c. Leviton
      d. Hubbell
      e. Or equal.

B. Combined Occupancy/Vacancy Sensor:
   1. nLight
   2. WattStopper
   3. Leviton
   4. Hubbell
   5. Or equal.

C. Automatic Switches:
   1. nLight
   2. WattStopper
   3. Leviton
   4. Hubbell
   5. Or equal.

D. Basis of Design: Occupancy/Vacancy sensor layout on Drawings are designed based on nLight product line. Approved manufacturers listed are allowed on condition of meeting the specified conditions including complete sensor coverage of the area controlled and switching of luminaires in the area controlled. Provide additional sensors and power switch packs as needed to provide the same level of functionality as shown on Drawings or required in Specifications. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.
2.2 GENERAL

A. Occupancy sensor designation indicates sensors automatically turn lights ON when the sensor detects the presence of a person and will automatically turn lights OFF when no presence is detected for a specified amount of time (automatic-on and automatic-off).

B. Vacancy sensor designation requires someone to manually turn the lights ON. The sensor will then automatically turn the lights OFF when no presence is detected for a specified amount of time (manual-on and automatic-off). These sensors must meet California Title 24 requirements.

C. Provide occupancy sensors to sense presence of human activity within desired space and enable or disable on/off manual lighting control function provided by local switches.

D. Upon detection of human activity by detector, sensor initiates time delay to maintain lights on for present period of time. Field adjustable time delay setting from 30 seconds to 15 minutes.

E. Factory set sensors for maximum sensitivity.

F. LED lamp built into sensor indicates when occupant is detected.

G. Provide zero cross relay control with sensors and sensor-switched; relay contacts close and open with AC voltage signal is at zero.

H. Where line voltage sensors and sensor-switches are used, provide to match voltage of controlled circuit.

I. Line Voltage Sensors, Control Units, and Relays: UL listed.

2.3 OCCUPANCY/VACANCY SENSORS (CEILING AND WALL MOUNTED)

A. Passive Infrared Sensors:
   1. Sensor Function: Detects human presence in floor area being controlled by detecting changes in Infrared energy. Sensor detects small movements, i.e., when people are writing while seated at a desk.
   2. Provide temperature compensated dual element pyro-electric sensor and with multi element Fresnel lens.
   4. Provide daylight filter to ensure that sensor is insensitive to short-wavelength infrared waves, i.e., those emitted by sun.
   5. Adjustments and mounting hardware under removable cover to prevent tampering with adjustments and hardware.
   6. Sensor utilizes advanced digital signal processing technology to reduce false offs without reducing sensitivity.
   7. Ceiling-Mounted Sensor:
      a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
      b. 360 degree sensor range; coverage: 1200 SF, unless otherwise noted on drawings.
c. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel to allow coverage of large areas.
d. Provide internal form C dry contacts for HVAC control.

8. Wall-Mounted Sensor:
a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
b. 90 degree sensor range with dense wide angle lens; coverage: 1000 SF for desktop motion, unless otherwise noted on Drawings.
c. Swivel mounting bracket for corner mounting to wall or ceiling.
d. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel to allow coverage of large areas.
e. Provide internal form C dry contacts for HVAC control.

B. Ultrasonic Occupancy/Vacancy Sensors:
1. Sensor Function: Detects human presence in controlled floor area by detecting Doppler shifts in 40kHz ultrasound created by sensor.
2. Sensors are precision crystal controlled and do not interfere with each other when two or more are placed in same area. Sensor includes advanced digital signal processing to reduce false on signals without decreasing sensitivity, as well as immunity to RFI/EMI sources.
4. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel to allow coverage of large areas.
5. Provide adjustments and mounting hardware under removable cover to prevent tampering.
6. Ceiling-Mounted Sensor:
a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
b. Maximum protrusion of 1.1-inches and blend in aesthetically with ceiling.
c. Coverage: 360 degree sensor range; coverage: 2,000 SF, unless otherwise noted on Drawings.
d. Provide internal form C dry contacts for HVAC control.
e. Basis of Design: Acuity nLight.
7. Ceiling Mounted Sensor - Hallway Sensor Coverage:
a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
b. Maximum protrusion of 1.5-inches and blend in aesthetically with ceiling.
c. Coverage: 90 linear feet.
d. Provide internal form C dry contacts for HVAC control.
e. Basis of Design: Acuity nLight.

C. Dual Technology Sensors:
1. Sensor Function: Combined capability of passive infrared with ultrasonic or microphonic technology as described above.
2. Function: Upon a person entering a space, motion must be sensed by both technologies before lighting will be turned on. After this has occurred, detection by either technology
will hold lighting on. Sensors retrigger time delay where only one motion is necessary to turn on lights within 5 seconds after turning off.

3. Wall-Mounted Sensor:
   a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
   b. 90 degree sensor range with dense wide angle lens, coverage; 1000 SF for desktop motion, unless noted on drawings.
   c. Swivel mounting bracket for corner mounting to wall or ceiling.
   d. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
   e. Provide internal form C dry contacts for HVAC control.

4. Ceiling-Mounted Sensor:
   a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
   b. 360 degree sensor range; coverage: 1000 SF for half-step motion, unless otherwise noted on Drawings.
   c. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
   d. Provide internal form C dry contacts for HVAC control.
   e. Basis of Design: Acuity nLight.

2.4 COMBINED OCCUPANCY/VACANCY SENSOR/WALL SWITCHES ("SENSOR/SWITCHES")

A. Completely self-contained sensor system that fits into standard single gang box. Internal transformer power supply, latching dry contact relay switching mechanism compatible with electronic ballasts, compact fluorescent, and inductive loads. Triac and other harmonic generating devices are not allowed.

B. Passive infrared sensor technology includes advanced signal processing to reduce false triggers without increasing sensitivity. LED indicator blinks when occupant sensed.

C. Rated to switch loads: 800 watts incandescent or 120-volt ballast; 1000 watts 277 volt ballast. Zero-crossing technology switches lighting off when AC voltage is at zero, minimizes contact wear.

D. Provide adjustable daylight feature that holds lighting "off" when desired footcandle level is present.

E. Provide integral off override switch with no leakage current to load or ground.

F. Vandal-resistant lens.

G. Includes neutral wire to meet NEC 2014 Code.

H. Finish: White.

I. Alerts for impending shut-off: light flash, audible, both or none.
J. Standard Sensor/ Switch:
   1. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a
   2. 180 degree sensor range; coverage: 150 SF for desktop activity.

K. Dual Relay Sensor/ Switch:
   1. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a
      vacancy sensor (manual-on and automatic-off).
   2. Dual auto-off buttons on face of switch allow end-user to turn off two switch legs in
      room space. Built-in light adjustable level sensor only turns off second of two relays
      when desired footcandle level is present. Otherwise similar to specifications above for
      single-zone sensor/switch.
   3. Defaults to Manual-ON to 50% operation for maximum energy savings.
   4. 180 degree sensor range; coverage: 150 SF for desktop activity.

L. Sensor/ Slide Dimmer:
   1. Line voltage slider dimmer allows for manual adjustment of lighting levels from 100
      percent to 10 percent; compatible with two-wire line voltage 100 percent to 10 percent
      electronic dimming ballasts. Separate manual button for override 'off' control.
   2. 180 degree sensor range; coverage: 300 SF for desktop activity.

M. Passive Infrared Wall Switch Vacancy-Only Sensors:
   1. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with
      California Title 24 requirements.
   2. Adjustable sensitivity (high, low presets).

N. Dual Technology Wall Switch Vacancy-Only Sensors:
   1. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with
      California Title 24 requirements.
   2. Adjustable sensitivity (high, medium, low, and off presets) individually for passive
      infrared and ultrasonic sensing.

O. Passive Infrared Wall Dimmer Vacancy-Only Sensors:
   1. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with
      California Title 24 requirements.

P. Passive Infrared 0-10 V Wall Dimmer Vacancy-Only Sensors:
   1. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with
      California Title 24 requirements.
2.5 AUTOMATIC SWITCHES

A. Automatic ("Sentry") Switch:
   1. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a
      vacancy sensor (manual-on and automatic-off).
   2. Controls up to 1800 watts at 120-volt, 4100-watts at 277-volt, suitable for ballast and
      motor loads.
   3. Compatible with Decora style faceplate.
   5. Finish: Match wiring devices unless selected otherwise by Architect.
   6. Capable of being connected with other sentry switches to produce 3 and 4 way
      switching.
   7. Based on power interruptions of following durations from an upstream control panel, 
      produces following effects:
      a. 5 Seconds: Turns lighting off with no delay.
      b. 3 Seconds: Turns lighting on with no delay.
      c. 1 to 2 Seconds: Delayed off. Blinks lights and provides audible signal to room
         occupant. If switch push button is not pressed within 5 minutes, lights are turned
         off.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install occupancy/vacancy sensors as directed by manufacturer’s instructions. Complete 
   connections to control circuits, occupancy sensors, power supply pack and low voltage wiring.

B. Provide power packs for sensor to control number of circuits and/or switch legs within its area 
   of coverage.

C. Field adjust each sensor to maximize its coverage of room space.

D. Relocate sensors with ultrasonic technology to avoid being closer to HVAC diffusers and 
   power packs than recommended by manufacturer.

E. Field set time delay for each device as noted below:
   1. Classrooms and Conference Rooms: 30 minutes.
   2. Restrooms: 15 minutes.
   3. Storage Rooms, Janitor’s Closets, Unisex Restrooms: 5 minutes.
   4. All Other Spaces: 15 minutes.
   5. Time Switches: 2-hours.

F. Prior to applying dimming controls, maintain fluorescent lighting at full output for minimum of 
   100 hours. If this is not done, replace lamps and ballasts of affected luminaires at no cost to 
   Owner.

G. Coordinate HVAC control requirements with controls contractor prior to installation.
H. Lighting System Testing and Commissioning:
1. Test lighting controls to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with Drawings and Specifications. Provide functional testing of sequences of operation to ensure operation in accordance with Drawings and Specifications. Provide complete report of test procedures and results to engineer and insert approved copy into project closeout documents.
2. Testing includes:
   a. Daylight Automatic Controls
   b. Occupant Sensing Automatic Controls
   c. Automatic Time and Override Controls for Interior Lighting

END OF SECTION
SECTION 26 09 24
DAYLIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Local Continuous Dimming Photosensor
   2. Local Switched Photosensor

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards per Division 01, General Requirements and Section 26 00 00, Electrical Basic Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Wiring diagrams indicating low voltage and line voltage wiring requirements.
   2. A layout of sensors indicating their sensing distribution on reproducible architectural floor plan.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Daylighting controls that carry a factory warranty for a minimum 5-year duration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Local Continuous Dimming Photosensor:
   1. nLight
   2. WattStopper
3. Greengate
4. Or equal.
5. Basis of Design: Daylighting sensor layout on Drawings are designed based on Acuity nLight Lighting Control product line. Approved manufacturers listed below are allowed on condition of meeting specified conditions including complete sensor coverage of area controlled and switching of luminaires in area controlled. Provide additional sensors and power switch packs as needed to provide same level of functionality as shown on Drawings. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.

B. Local Switched Photosensor:
1. nLight
2. WattStopper
3. Greengate
4. Or equal.
5. Basis of Design: Daylighting sensor layout on Drawings are designed based on Acuity nLight Lighting Control product line. Approved manufacturers listed below are allowed on condition of meeting specified conditions including complete sensor coverage of area controlled and switching of luminaires in area controlled. Provide additional sensors and power switch packs as needed to provide same level of functionality as shown on Drawings. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.

2.2 LOCAL CONTINUOUS DIMMING PHOTOSENSOR

A. Provide low voltage, indoor photocell to interface with electronic dimming ballasts using low voltage (0 to 10VDC) control signal.

B. Spectral filtering system to measure relative levels of daylighting and indoor lighting within control space. Measures light as human eye perceives; linear photocell response with greater than 1 percent accuracy.

C. Ceiling-mounted 2.4-inch diameter, 0.875-inch depth white housing.

D. 10VDC input voltage, 0.2 to 10VDC output voltage. 20 to 60 footcandle adjustable range with plus or minus 3 percent accuracy. One photocell controls up to 50 ballasts. 5 year warranty. White finish.

E. Automatic Off Control.

F. Provide with separate handheld remote controller to field program target lighting levels for daytime and nighttime (i.e. when plenty of daylighting is available and when no daylighting is available).

G. Basis of Design: Acuity nLight Lighting Controls.

2.3 LOCAL SWITCHED PHOTOSensor

A. Low voltage, indoor photosensor to switch lighting using power pack; integrate with room occupancy sensors.
1. LCD display under removable cover to display four user-adjustable parameters:
   a. ON Setpoint.
   b. 1-850 footcandles.
   c. OFF Setpoint (25 percent to 100 percent above ON Setpoint).
   d. OFF Setpoint time delay (3 to 30 minutes).
2. Dimensions: 2.4-inches diameter by 0.7-inches deep.
3. White finish; surface mounted. Mountable in top-lit or side-lit position.
4. Voltage: 12/24VDC. LED status indicator.

B. Basis of Design: Acuity nLight Lighting Controls.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install photocells as directed by manufacturer's instructions. Complete connections to control circuits, photocells, control modules, power supply pack and low voltage wiring.

B. Photocell placement and wiring:
   1. Drawings are schematic, and show photocell quantities together with the daylighting zones that they control.
   2. Reference manufacturer installation instructions for the recommended location and orientation of photocell with respect to exterior glazing and both interior and exterior lighting.
   3. Reposition sensor at no additional cost to Owner to avoid conflict between sensor and object obscuring its view, and between sensor and both interior and exterior lighting that causes daylighting controls to repeatedly increase and decrease in brightness (i.e. "cycling").
   4. Field wire photocell for correct footcandle range (i.e., WattStopper LS-290C photocell has three jumper selectable footcandle ranges: 3 to 300 fc, 30 to 3000 fc, 60 to 6000 fc).

3.2 LIGHTING SYSTEM CALIBRATION, DEMONSTRATION, TRAINING, TESTING AND COMMISSIONING

A. Prior to adjusting and calibrating daylighting control system and local photocell field adjustable settings, contact local manufacturer representative and arrange for representative to visit site to educate both field installer and Owner representative on the operation of the controls.

B. Use manufacturer's published testing and adjusting procedures to adjust sensors and daylight sensitivity to the satisfaction of Owner.

C. Daylight Dimming Zone Calibration:
   1. After all furniture is installed, all daylighting zones are to be field calibrated using a digital photometer. Adjust photocell and control system parameters to maintain an even light level at the work plane.
   2. Single and dual daylighting zones are to be adjusted to maintain an even light level at the work plane throughout connected zones and adjoined areas.

D. Daylight Dimming Zone Lighting Level Setpoints:
<table>
<thead>
<tr>
<th>Area</th>
<th>Setpoint (Average Footcandles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Offices</td>
<td>40 FC</td>
</tr>
<tr>
<td>Corridors</td>
<td>5 FC</td>
</tr>
<tr>
<td>Lobby</td>
<td>10 FC</td>
</tr>
<tr>
<td>Classrooms</td>
<td>30 FC</td>
</tr>
<tr>
<td>Labs</td>
<td>50 FC</td>
</tr>
<tr>
<td>Library</td>
<td>30 FC</td>
</tr>
<tr>
<td>Storage</td>
<td>10 FC</td>
</tr>
</tbody>
</table>

E. Prepare and complete report of test procedures and results including the final daylighting level setpoints as set while using a digital photometer. Submit these test procedures and results to Engineer and Commissioning Authority.

F. Test lighting controls to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with Drawings and Specifications. Provide functional testing of sequences of operation to ensure operation in accordance with Drawings and Specifications. Provide complete report of test procedures and results to Engineer and Commissioning Authority and insert approved copy into project closeout documents.

G. Testing Includes:
1. Daylight Automatic Controls
2. Occupant Sensing Automatic Controls
3. Automatic Time and Override Controls for Interior Lighting
4. Automatic Time and Photo Controls for Exterior Lighting

H. Training: Provide minimum 2-hour training session to Owner representatives at a time approved by Owner after Owner has received approved operation and maintenance manuals. Training to include discussion of operation, adjustment, and replacement of sensors, photocells and control.

END OF SECTION
SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provision of materials, installation and testing of:
   1. Wall Switches
   2. Receptacles
   3. Finish Plates
   4. Wall Dimmers
   5. Surface Covers

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Wall switches and Dimmers
   2. Receptacles
   3. Wall Plates
   4. In-Use Cover

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Wall Switches:
1. Decorative AC Rocker Switch Characteristics:
   a. Cooper
   b. Hubbell
   c. Leviton
   d. Legrand P&S
   e. Or equal.

B. Receptacles:
1. Commercial Grade:
   a. 20 Amp:
      1) Cooper 5362
      2) Hubbell 5362
      3) Bryant CBRS20
      4) Leviton 5362S
      5) Legrand P&S 5362
      6) Or equal.

2. Ground Fault Circuit Interrupter (GFCI) Receptacle:
   a. Cooper TWRSGF20
   b. Hubbell GFTWRST20
   c. Legrand P&S 2097TRWR
   d. Or equal.

3. Specification Grade USB Charger Tamper-Resistant Duplex - 20 Amp:
   a. Cooper TR7756
   b. Hubbell USB20X2
   c. Leviton T5832T
   d. Legrand P&S TR5362USB
   e. Or equal.

4. Federal Specification Grade Plug Load Control Duplex Receptacle:
   a. Half Controlled, 20 amp:
      1) Legrand P&S 26352CH
      2) Leviton 163521P
      3) Hubbell DR20C1
      4) Legrand P&S PLT26351
      5) Or equal.
   b. Dual Controlled, 20 amp:
      1) Legrand P&S 26352CD
      2) Leviton 163522P
      3) Hubbell DR20C2
      4) Or equal.

5. Plug Load RF Controlled Duplex Receptacle:
   a. Half Controlled, 20 amp:
      1) Legrand P&S RF26352CH
      2) Or equal.
   b. Dual Controlled, 20 amp:
      1) Legrand P&S RF26362DH
      2) Or equal.
   c. RF Signal Pack:
      1) Legrand P&S RFP
      2) Wattstopper DLM WRC-TXLM
3) Or equal.

C. Finish Plates:
   1. Bryant
   2. Cooper
   3. Hubbell
   4. Leviton
   5. Legrand P&S
   6. Or equal.

D. Wall Dimmers:
   1. Acuity nLight Controls
   2. Or equal.

E. Surface Covers:
   1. Aluminum with Gasket, Blanks, Single Gang:
      a. Bell 240-ALF
      b. Carlon
      c. Or equal.
   2. 2-Gang:
      a. Bell 236-ALF
      b. Carlon
      c. Or equal.
   3. While-in-Use Weatherproof Cover:
      a. Die Cast Cover:
         1) Intermatic
         2) Hubbell
         3) Cooper
         4) Or equal.

F. Provide lighting switches and receptacles of common manufacturer and appearance.

2.2 WALL SWITCHES

A. Characteristics: Decorative AC Rocker Switch Characteristics: Quiet acting, 20 amp, 120/277 volt, UL Listed for motor loads up to 80 percent of rated amperage.

B. Finish: White.

2.3 RECEPTACLES

A. Duplex Receptacles Characteristics: Straight parallel blade, 125 volt, 2 pole, 3 wire grounding.

B. Ground Fault Circuit Interrupter (GFCI) Receptacle: Feed through type, back-and-side wired, tamper-resistant, weather resistant self-testing, 20 amp, 125VAC.


E. Finish:
   1. Same exposed finish as switches.
   2. Receptacles installed in surface raceway to match raceway finish. See Section 26 05 33, Raceways.
   3. All automatically controlled, nonlocking type, 125 volt, 15 amp and 20 amp rated receptacles to be permanently marked by the manufacturer with the "universal power" symbol and the word "controlled."

2.4 FINISH PLATES

A. Finish Plates: Commercial grade thermoplastic with same finish as devices.

B. Provide telephone/signal device plates; activated outlets to have coverplates to match modular jack.

2.5 WALL DIMMERS

A. Provide wall dimmers compatible with type of load controlled (i.e. line voltage, low voltage, 2-wire, 3-wire, 0-10v). Finish to match wall switches. Size dimmers to accept connected load. Do not cut fins. Where dimmers are ganged together, provide a single multi gang coverplate.

B. LED indicator dots show by what percentage controlled lighting is dimmed. Programmable settings for maximum and minimum trim settings, and rate of change in lighting levels.

2.6 SURFACE COVERS

A. Material: Galvanized steel, 1/2-inch raised industrial type with openings appropriate for devices installed on surface receptacles.

B. Cast Box and Extension Adaptors: Aluminum with gasket, blanks single gang or 2-gang.

C. While-in-Use Weatherproof Cover: NEMA 3R when closed over energized plug. Vertical mount for duplex receptacle. Provide continuous use cover with cover capable of closing over energized cord cap with bottom aperture for cord exit.
   1. Die cast cover with closed cell neoprene foam gasket: Capable of being locked closed to prevent tampering or unauthorized use.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. See Architectural elevations for location and mounting height of wiring devices. Review Architectural elevations prior to rough-in and contact Architect immediately if conflicts are
found between Architectural and Electrical Drawings. Do not rough-in devices until conflicts are resolved.

B. Install wiring devices and finish plates plumb with building lines, equipment cabinets and adjacent devices. Devices not plumb will be fixed at no additional cost to Owner.

C. Orientation:
1. Install wiring devices with long dimension oriented vertically at centerline height shown on drawings or as specified.
2. Vertical Alignment: When more than one device is shown on drawings in close proximity to each other, but at different elevations, align devices on a common vertical center line for best appearance. Verify with Architect.
3. Horizontal Alignment: When more than one device is shown on drawings in close proximity to each other with same elevation, align devices on a common horizontal center line for best appearance. Verify with Architect.

D. Provide labeling per Section 26 05 53, Identification for Electrical Systems.

E. Test wiring devices to ensure electrical continuity of grounding connections, and after energizing circuitry, to demonstrate compliance with requirements. Test receptacles for line to neutral, line to ground and neutral to ground faults. Correct any defective wiring.

3.2 WALL SWITCHES INSTALLATION

A. At time of substantial completion, replace those items which have been damaged.

3.3 RECEPTACLES INSTALLATION

A. Upon installation, adhere to proper and cautious use of convenience receptacles. At time of substantial completion, replace those items which have been damaged, including those burned and scored by faulty receptacles or cord caps.

B. GFCI Receptacles: One GFCI receptacle may not be used to provide GFCI protection to downstream duplex receptacles on the same branch circuit.

C. Provide a split wired receptacle or one controlled receptacle within 6 feet of each uncontrolled receptacle for the following areas: Offices, reception lobbies, conference rooms, kitchens, copy rooms.

3.4 FINISH PLATES INSTALLATION

A. Do not install items until finish painting is complete. Replace scratched and paint splattered finish plates and wiring devices.

3.5 WALL DIMMERS INSTALLATION

A. Install per manufacturer's recommendations and wiring diagrams.
3.6 SURFACE COVERS INSTALLATION

A. Do not install items until finish painting is complete. Replace scratched and paint splattered finish plates and wiring devices.

END OF SECTION
SECTION 26 28 00
OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Fuses
   2. Molded Case Circuit Breakers

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Product data and instantaneous let-through current curves and average melting time current curves for fuses supplied to project.
   2. Product data and time/current trip curves for circuit breakers supplied to project.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements apply to this Section.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fuses:
   1. Bussmann
   2. Ferraz-Shawmut
   3. Littelfuse
   4. McGraw-Edison
5. Or equal.

B. Molded Case Circuit Breakers:
   1. Eaton Electrical
   2. General Electric
   3. Siemens
   4. Schneider Electric/Square D
   5. Or equal.

2.2 **FUSES**

A. Characteristics:
   1. Dual element, time delay, current limiting, nonrenewable type, rejection feature.
   2. Combination Loads: UL Class RK1, RK5, or J, 1/10 to 600 amp. UL Class L, above 600 amps.
   3. Motor Loads: UL Class RK5, 1/10 to 600 amp.
   4. Fuse pullers for complete range of fuses.

2.3 **MOLDED CASE CIRCUIT BREAKERS**

A. 1-, 2- or 3-pole bolt-on, single handle common trip, 600VAC or 250VAC as indicated on Drawings.

B. Overcenter toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.

C. Calibrate for operation in 40 degrees C ambient temperature.

D. 15 to 150 Amp Breakers: Permanent trip unit containing individual thermal and magnetic trip elements in each pole.

E. 151 to 400 Amp Breakers: Adjustable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.

F. Greater than 401 Amp: Electronic trip type with adjustments for long-time, instantaneous, and short-time functions.

G. Provide ground fault function for breakers greater than 800 amps where applied at 480 volts line-to-line; and where indicated on drawings.

**PART 3 - EXECUTION**

3.1 **GENERAL INSTALLATION REQUIREMENTS**

A. Coordination:
   1. Obtain and review the submitted product data for equipment furnished by the Owner, and furnished under other Divisions of this contract, particularly under Divisions 22 and 23.
   2. Confirm the equipment nameplate maximum overcurrent protection (MOCP) and make accommodations and adjustments to overcurrent protective devices as necessary to coordinate with the nameplate rating.
B. Install all items in accordance with manufacturers written instructions.

3.2 FUSES

A. Fuses: For each class and ampere rating of fuse installed, provide the following quantities of spares for quantity of fuses installed:
   1. 0 to 24: Provide 6 spare.
   2. 25 to 48: Provide 9 spare.
   3. 49 and Above: Provide 12 spare.

3.3 MOLDED CASE CIRCUIT BREAKERS

A. Provide testing of ground fault interrupting breakers.

B. Provide circuit breakers, as specified and on Drawings, for installation in panelboards, individual enclosures or combination motor starters.

C. Provide ground fault interrupter circuit breakers for equipment in damp or wet locations.

D. Provide device on handle to lock breaker in "ON" position for breakers feeding time switches, night lights and similar circuits required to be continuously energized.

E. Shunt Trip Circuit Breakers: Provide wiring to remote trip switch/contacts as indicated on Drawings.

F. Provide multi-pole branch circuit breakers for multiwire branch circuits for simultaneous disconnection of circuits.

END OF SECTION
SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Toggle Type Disconnect Switches
   3. Safety Switches
   4. Enclosed Circuit Breakers
   5. Molded Case Switches

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. Section 26 28 00, Overcurrent Protective Devices.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Toggle Type Disconnect Switches:
   1. Cooper
   2. Hubbell
   3. Leviton
4. Pass & Seymour
5. Slater
6. Or equal.

B. Manual Motor Starters:
1. Eaton Electrical
2. General Electric
3. Siemens
4. Schneider Electric/Square D
5. Or equal.

C. Safety Switches:
1. Eaton Electrical
2. GE Industrial
3. Siemens
4. Schneider Electric/Square D
5. Or equal.

D. Enclosed Circuit Breakers:
1. Eaton Electrical
2. GE Industrial
3. Siemens
4. Schneider Electric/Square D
5. Or equal.

E. Molded Case Switches:
1. Eaton Electrical
2. General Electric
3. Siemens
4. Schneider Electric/Square D
5. Or equal.

2.2 TOGGLE TYPE DISCONNECT SWITCHES

A. Rating: 120 or 277 volt, 1 or 2 pole, 20 amp, 1 hp maximum.

B. Enclosure:
1. NEMA 1: Dry locations/Indoors.
2. NEMA 3R: Damp or wet locations/Outdoors.

C. Handle lockable in 'off' position.

2.3 MANUAL MOTOR STARTERS

A. Quick-Make, Quick-Break. Thermal overload protection. Device labeled with maximum
   voltage, current, and horsepower.

B. Enclosure:
1. NEMA 1: Dry locations/Indoors.
2. NEMA 3R: Damp or wet locations/Outdoors.
2.4 SAFETY SWITCHES

A. Heavy duty fusible type and non-fusible type (as indicated on drawings), dual rated, quick-make, quick-break with fuse rejection feature for use with Class R fuses only, unless other fuse type is specifically noted.

B. Clearly marked for maximum voltage, current, and horsepower.

C. Operable handle interlocked to prevent opening front cover with switch in 'on' position.

D. Switches rated for maximum available fault current.

E. Handle lockable in 'off' position.

F. Enclosure:
   1. NEMA 1: Dry locations/Indoors.
   2. NEMA 3R: Damp or wet locations/Outdoors.

G. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Provide fuse rejection feature for Class R or J fuses up to 600 amp. Remove if circuit breaker type is used. Provide switches of 30 to 200 amp with plug-on line side connections.

H. Fusible Switch Assemblies, 800 Amperes and Larger: Bolted pressure contact switches. Fuse Clips: Designed to accommodate Class L fuses. Provide with shunt-trip and ground fault capabilities. Remove if circuit breaker type is used.

2.5 ENCLOSED CIRCUIT BREAKERS

A. Molded case circuit breakers:
   1. 1-, 2-, or 3-pole bolt on, single-handle common trip, 600VAC or 250VAC as indicated on drawings.
   2. Overcenter toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.
   3. Calibrate for operation in 40°C ambient temperature.
   4. 15 to 150 Amp Breakers: Permanent trip unit containing individual thermal and magnetic trip elements in each pole.
   5. 151 to 400 Amp Breakers: Variable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.
   7. Provide handle mechanisms that are lockable in the open (off) position.
   8. Circuit breakers to have minimum symmetrical interrupting capacity as indicated on Drawings.

B. Enclosure:
   1. NEMA 1: Dry locations/Indoors.
2. NEMA 3R: Damp or wet locations/outdoors.

2.6 MOLDED CASE SWITCHES

A. Removable cover, galvanized steel enclosure, powder coat painted.

B. Provide cover padlock provision.

C. Provide trip unit with no overcurrent, overload, or low level fault protection. Trip unit to be high instantaneous magnetic fixed trip type with magnetic trip reset at factory to interrupt high fault currents at or above preset level.

D. Enclosure:
   1. NEMA 1: Dry locations/Indoors.
   2. NEMA 3R: Damp or wet locations/Outdoors.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Obtain and review the submitted product data for equipment furnished by the Owner, and furnished under other Divisions of this contract, particularly under Divisions 22 and 23.

B. Confirm the equipment nameplate maximum overcurrent protection (MOCP) and make accommodations and adjustments to switches, fuses and circuit breakers as necessary to coordinate with the nameplate rating.

C. Install in accordance with manufacturer's instructions.

D. Provide engraved nameplates per Section 26 05 53, Identification for Electrical Systems.

E. Apply neatly typed adhesive tag on inside door of each fusible switch indicating NEMA fuse class and size installed.

3.2 TOGGLE TYPE DISCONNECT SWITCHES

A. Install fuses in fusible disconnect switches. Coordinate fuse ampere rating with installed equipment. Do not provide fuses of lower ampere rating than motor starter thermal units.

B. Install products, systems and equipments in accordance with manufacturers written instructions and requirements.

C. See General Installation Requirements above.

3.3 MANUAL MOTOR STARTERS

A. Provide disconnecting means within sight of each motor controller and of each motor. Motor controller disconnecting means equipped with lock-out/tag-out padlock provisions do not require a disconnect switch at the controlled motor location. Locate disconnect means in view of and not inside of equipment, such that tools are not needed to remove covers to access the disconnecting means.
B. Install products, systems and equipments in accordance with manufacturers written instructions and requirements.

C. See General Installation Requirements above.

3.4 SAFETY SWITCHES

A. Install products, systems and equipments in accordance with manufacturers written instructions and requirements.

B. See General Installation Requirements above.

3.5 ENCLOSED CIRCUIT BREAKERS

A. Install products, systems and equipments in accordance with manufacturers written instructions and requirements.

B. See General Installation Requirements above.

3.6 MOLDED CASE SWITCHES

A. Install products, systems and equipments in accordance with manufacturers written instructions and requirements.

B. See General Installation Requirements above.

END OF SECTION
SECTION 26 51 00
LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Luminaires
   2. LED Drivers
   3. Lamps
   4. Emergency LED Luminaire Power Supply

B. Provide wiring for complete and operating lighting system.

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. NECA 500 - Commercial Lighting.
   2. UL 8750 – Light Emitting Diode (LED) equipment for use in lighting products.

1.4 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Submit:
      a. LED Luminaires: Electrical ratings, dimensions, mounting, material, clearances, terminations, wiring, connection diagram, LM-79 photometric data, LM-80 lumen depreciation data.
      b. LED Drivers
      c. Lamps
      d. Emergency LED Luminaire Power Supply
   2. Submittal Cutsheets: Highlight, circle or otherwise graphically indicate which option(s) are being selected for the products submitted. Cutsheets that are not edited to indicate which products and options are submitted for this project or that list only catalog numbers to identify submitted options are not acceptable.
   3. Specified manufacturers are approved to submit bid. However, inclusion does not relieve manufacturer from supplying product as described.
   4. Provide the following operating and maintenance instructions as required by Section 26 00 00, Electrical Basic Requirements:
1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
1. Provide luminaires acceptable to code authority for application and location installed.
2. Comply with applicable ANSI standards.
3. Comply with applicable NEMA standards.
4. Provide luminaires and lampholders that comply with UL standards and have been listed and labeled for location and use indicated by a testing agency acceptable by the AHJ (e.g., UL, ETL, and the like).
5. Comply with CEC as applicable to installation and construction of luminaires.
6. Comply with fallout and retention requirements of CBC for diffusers, baffles, and louvers.
7. Provide LED luminaires from the same manufacturer and manufacturing LED source batch for similar applications (e.g., all LED downlights from a single manufacturer and batch, all linear LED products from single manufacturer and batch).

1.6 WARRANTY

A. Warranty as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
1. LED Luminaire Manufacturer's Warranty: Not less than 5 years for luminaire based on date of substantial completion. Includes normal cost of labor to replace luminaire. Replacement luminaire will match physical dimensions, physical appearance, chromaticity, lumen output and photometric characteristics of original installed equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Luminaires:
1. Reference description and manufacturers in Luminaire Schedule on Drawings.
2. Or equal.

B. LED Drivers:
1. Indoor Drivers:
   a. eldoLED Series
   b. Advance/Philips
   c. Osram Sylvania
   d. Or equal.
2. Outdoor Drivers:
   a. Advance/Philips
   b. Osram Sylvania
   c. LG
   d. Or equal.

C. Lamps:
   1. LED (Light Emitting Diode) Lamps:
      a. Nichia
      b. Cree
      c. Osram Sylvania
      d. GE Lumination
      e. Or equal.
   2. Unless specific manufacturer not shown on this list is indicated in the Luminaire Schedule.
   3. Special types as indicated in Luminaire Schedule.
   4. Or equal.

D. Emergency LED Luminaire Power Supply:
   1. Bodine
   2. Hatch
   3. Fulham
   4. Or equal.

2.2 LUMINAIRE

A. Luminaires: Reference description and manufacturers in Luminaire Schedule on drawings.

B. Where recessed luminaires are installed in cavities intended to be insulated, provide IC rated luminaires or other code approved installation.

C. UL label luminaires installed under canopies, roof or open porches, and similar damp or wet locations, as suitable for damp or wet location.

D. Suspended luminaires: Provide minimum 24-inch adjustability in aircraft cable length where used.

E. Recessed Luminaires: Frame compatible with ceiling material installed at particular luminaire location. Provide proper factory trim and frame for luminaire to fit location and ceiling material. Verify with Architectural Reflected Ceiling Plan prior to submittals.

F. Finishes:
   1. Manufacturer's standard finish (unless otherwise indicated) over corrosion resistant primer.
   2. Interior Light Reflecting Finishes: White or specular finish with not less than 85 percent reflectance.
   3. Exterior Finishes: As detailed in Luminaire Schedule or on drawings. Refer cases of uncertain applicability to Architect for resolution prior to release for fabrication.

G. Light Transmitting Components:
1. Plastic diffusers, molded or extruded of 100 percent virgin acrylic.
2. Prismatic acrylic, extruded, flat diffusers, 0.125-inch overall thickness, unless otherwise noted.

H. LED Luminaires:
1. UL listing of luminaire includes drivers, transformers, enclosures, rated wire, communications devices and accessories needed for a complete and functional system.
2. LM-79: Testing and measurement of absolute photometry, chromaticity (CCT) and luminaire power. Report provided by DOE certified independent testing laboratory. CCT as specified in Luminaire Schedule.
5. LEDs in one module/luminaire: Supplied from same batch/bin and fall within 3-step MacAdam Ellipse, or as described in Luminaire Schedule, whichever is the more stringent requirement.
6. Provide luminaires with integral LED thermal management system (heat sinking).
7. Luminaires to be equipped with an LED driver that accepts 120V through 277V, 50Hz to 60Hz (universal). Component-to-component wiring within the luminaire will carry no more than 80 percent of rated current and be listed by UL for use at 600VAC at 302 degrees F/150 degrees C or higher. Plug disconnects to be listed by UL for use at 600VAC, 15A or higher.
8. Provide luminaires with individual LED arrays/modules and drivers that are accessible and replaceable from exposed side of the luminaire.

2.3 LED DRIVERS

A. General:
1. Performance: Meet dimming range called out in Luminaire Schedule, free from perceived flicker or visible strobooscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.
2. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
3. Minimum efficiency of 85 percent, power factor greater than or equal to 0.90, compliance with reduction of hazardous substances (RoHS). Rated for operating temperature range of area in which driver is installed.
4. Limit inrush current to minimize breaker tripping.
   b. Preferred Specification: Meet or exceed 30 milliamp-squared-seconds at 277VAC for up to 50 watts of load and 75 amps at 240 microseconds at 277VAC for 100 watts of load.
5. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
6. No visible change in light output with a variation of plus/minus 10 percent line voltage input.
7. Total Harmonic Distortion less than 20 percent percent and meet ANSI C82.11 maximum allowable THD requirements at full output. THD at no point in the dimming curve allows imbalance current to exceed full output THD.

8. Support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:
   a. Adjustment of forward LED voltage, supporting 3V through 55V.
   b. Adjustment of LED current from 150mA to 1.4A at the 100 percent control input point in increments of 1mA.
   c. Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.

9. Operate for a (+/- 10 percent) supply voltage of 120V through 277VAC at 60Hz.

10. UL Recognized under the component program and modular for simple field replacement. Drivers that are not UL Recognized or not suited for field replacement will not be considered.

11. Ability to provide no light output when the analog control signal drops below 0.3 V, or the DALI/DMX digital signal calls for light to be extinguished and consume 0.5 watts or less in this standby. Control dead band between 0.3V and 0.65V included to allow for voltage variation of incoming signal without causing noticeable variation in luminaire to luminaire output.

B. Light Quality:
   1. Over the entire range of available drive currents, driver to provide step-free, continuous dimming to black from 100 percent to 0.1 percent and 0 percent relative light output, or 100 percent to 1 percent light output and step to 0 percent where indicated. Driver to respond similarly when raising from 0 percent to 100 percent.
      a. Driver must be capable of 20 bit dimming resolution for white light LED drivers or 15 bit resolution for RGBW LED drivers.
   2. Driver must be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels.
   3. Drivers to track evenly across multiple luminaires at all light levels, and must have an input signal to output light level that allows smooth adjustment over the entire dimming range.
   4. Driver and luminaire electronics to deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100 percent to 0.1 percent luminaire will have:
      a. LED dimming driver to provide continuous step-free, flicker free dimming similar to incandescent source.
      b. Base specification: Based on IEEE PAR1789, minimum output frequency should be greater than 1250 Hz.
      c. Preferred specification: Flicker index to be equal to incandescent, less than 1 percent at all frequencies below 1000 Hz.

C. Control Input:
   1. Provide control protocol to match lighting control system specified for use with luminaire.
   2. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers:
b. Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 mA per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.

c. Meet ESTA E1.3 for RGBW LED drivers.

2.4 LAMPS

A. Provide lamps for luminaires.

B. Provide lamp catalogued for specified luminaire type.

C. Incandescent Lamps: Not allowed unless noted in Luminaire Schedule.

D. LED (Light Emitting Diode):
   1. LED manufacturer will include, but not be limited to, light source, luminaire, power supply and control interface with added components as needed for complete and functioning system.
      a. Comply with ANSI chromaticity standard for classifications of color temperature. See Luminaire Schedule for specified LED lamp color and color temperature. UL or ETL listed and labeled.
      b. Luminaire testing per IESNA LM-79 and LM-80 procedures.
      c. Lamp life for white LEDs: 50,000 plus hours with lamp failure occurring when LED produces 70 percent of initial rated lumens.
      d. Lamp life for color LEDs: 30,000 plus hours with lamp failure occurring when LED produces 50 percent of its initial rated lumens.
      e. LED Drivers: Reverse polarity protection, open circuit protection, require no minimum load. Minimum 80 percent efficiency. Class A noise rating.
      f. Dimming: LED system capable of full and continuous dimming.
      g. Correlated Color Temperature (CCT): See Luminaire Schedule for selection of color temperature for each luminaire. Ranges given below reflect maximum allowable tolerances for color temperature range for each nominal CCT.
         1) Nominal CCT:
            a) 2700 K (2725 ± 145)
            b) 3000 K (3045 ± 175)
            c) 3500 K (3465 ± 245)
            d) 4000 K (3985 ± 275)
      h. Color Rendering Index (CRI) to be greater than or equal to 80.

2. Special types as indicated in Luminaire Schedule.

2.5 EMERGENCY LED LUMINAIRE POWER SUPPLY

A. Internal Type: Self-contained, modular, battery unit, factory mounted within luminaire body and compatible with driver. Comply with UL 924.
   1. Emergency Connection: Operate one LED module continuously at a minimum output of 1400 lumens each. Connect unswitched circuit to battery unit and switched circuit to luminaire driver.
   2. Test Push Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
      a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
b. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.


B. External Type: Self-contained, modular, battery unit, suitable for powering one or more LED modules, remote mounted from luminaire. Comply with UL 924.
   1. Emergency Connection: Operate one LED module continuously. Connect unswitched circuit to battery unit and switched circuit to luminaire driver.
   2. Charger: Fully automatic, solid-state, constant-current type.
   3. Housing: NEMA 250, Type 1 enclosure.
   4. Test Push Button: Visible and accessible without entering ceiling space.
      a. Push-to-test type, in remote unit housing, simulates loss of normal power and demonstrates unit operability.
      b. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
      c. Faceplate Finish: Verify finish with Architect for each room prior to ordering materials.
   5. Battery: Sealed, maintenance-free, nickel-cadmium type. Sized for a minimum output of 90 minutes.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install per manufacturer's written installation instructions and requirements.

B. Install luminaires securely, in neat and workmanlike manner.

C. Install luminaires of types indicated where shown and at indicated heights in accordance with manufacturer's written instructions and with recognized industry practices to ensure that luminaires comply with requirements and serve intended purposes.

D. Wiring:
   1. Recessed luminaires to be installed using flexible metallic conduit with luminaire conductors spliced to branch circuit conductors in nearby accessible junction box over ceiling. Junction box fastened to building structural member within 6-feet of luminaire.
   2. Luminaires for lift out and removal from ceiling pattern without disconnecting conductors or defacing ceiling materials.
   3. Flexible connections where permitted to exposed luminaires; neat and straight, without excess slack, attached to support device.
   4. Install junction box, flexible conduit and high temperature insulated conductors for through wiring of recessed luminaires.

E. Relamp luminaires which have failed lamps at substantial completion.

F. Replace LED drivers deemed as excessively noisy by Architect, Engineer, or Owner.
G. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

H. Support luminaires larger than 2- by 4-foot size independent of ceiling framing.

I. Locate recessed ceiling luminaires as indicated on architectural reflected ceiling plan.

J. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

K. Exposed Grid Ceilings:
   1. Support surface mounted luminaires in grid ceiling directly from building structure.
   2. Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires.
   3. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.

L. Install recessed luminaires to permit removal from below.

M. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

N. Install clips to secure recessed grid-supported luminaires in place.

O. Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated on Architectural Drawings.

P. Install accessories furnished with each luminaire.

Q. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

R. Bond products and metal accessories to branch circuit equipment grounding conductor.

S. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.

T. Where manufactured wiring assemblies are used, ensure that wiring assembly manufacturer sends components to appropriate luminaire manufacturer for respective installation of proper components.

U. Coordination:
   1. Coordination of Conditions: Coordinate ceiling construction, recessing depth and other construction details prior to ordering luminaires for shipment. Refer cases of uncertain applicability to Architect for resolution prior to release of luminaires for shipment. Where luminaires supplied do not match ceiling construction, replace luminaires at no cost to Owner.
   2. Electrical drawings are schematic, identifying quantity and type of luminaires used and their approximate location, but are not to be used for dimensional purposes. Reference architectural drawings for exact locations, including mounting heights.
3. Provide lighting indicated on drawings with luminaire of the type designated and appropriate for location.
4. Provide LED luminaires with driver compatible to lighting control system as shown in drawings and as specified.
5. Where remote drivers are required, ensure adequate accessibility to driver. Upsize conductors between luminaire and driver to accommodate voltage drop.

V. Field Quality Control:
1. Perform field inspection in accordance with Division 01, General Requirements.
2. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

W. Cleaning:
1. Clean electrical parts to remove conductive and deleterious materials.
2. Remove dirt and debris from enclosures.
3. Clean paint splatters, dirt, dust, fingerprints, and debris from luminaires.
4. Clean photometric control surfaces as recommended by manufacturer.
5. Clean finishes and touch up damaged finishes per by manufacturer's instructions.

X. Demonstrate luminaire operation for minimum of two hours.

3.2 LUMINAIRES

A. Install per manufacturer's written installation instructions and requirements.

B. Align, mount and level luminaires uniformly. Use ball hangers for suspended stem mounted luminaires.

C. Avoid interference with and provide clearance from equipment. Where indicated locations for luminaires conflict with locations for equipment, change locations for luminaire by minimum distance necessary as directed by Architect.

D. Suspended Luminaires: Mounting heights indicate clearances between bottom of luminaire and finished floors.

E. Emergency Egress Luminaires: Provide unswitched circuit for battery charging and autotransfer circuiting for exit signs and luminaires with integral batteries. Where test switch cannot be integral to luminaire, mount remote test switch flush-to-ceiling and adjacent to egress luminaire.

F. Interior Luminaire Supports:
1. Support Luminaires: Anchor supports to structural slab or to structural members within a partition, or above a suspended ceiling.
2. Maintain luminaire positions after cleaning and relamping.
3. Support luminaires without causing ceiling or partition to deflect.
4. Provide mounting supports for recessed and pendant mounted luminaires as required by CBC.

G. Adjusting:
1. Aim and adjust luminaires as indicated.
2. Focus and adjust floodlights, spotlights and other adjustable luminaires, with Architect, at such time of day or night as required.
3. Align luminaires that are not straight and parallel/perpendicular to structure.
4. Position exit sign directional arrows as indicated.

3.3 LED DRIVERS

A. Install lamps per manufacturer's installation instructions and requirements.

B. Where driver is remote mounted, size wiring based on type of driver, driver distance from luminaire, and voltage/power level, and manufacturer's installation instructions.

C. Protect 0-10V input from line voltage mis-connection, and so it will be immune and the output unresponsive to induced AC voltage on the control leads.

END OF SECTION
SECTION 27 00 00

COMMUNICATIONS GENERAL

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes general information that applies to all Division 27 specifications.

B. Contractor shall furnish and install a Structured Cabling System including, but not necessarily limited to, copper cabling for the voice, data and wireless systems.

C. Contractor shall provide and install all materials and hardware necessary for a complete cabling system within parts of the renovation including any necessary accessory hardware in the existing telecommunications equipment rooms referenced in the drawing set accompanying these specifications.

D. Provide a certified Structured Cabling System with a 25-year Category 6 channel performance compliance warranty.

E. Contractor shall be a Certified Installation Company of the Structured Cabling System manufacturer.

F. Related Sections:
   1. 270820: Copper Testing
   2. 271500: Communications Horizontal Cabling
   3. 271600: Communications Connecting Cords Devices & Adapters

1.02 REFERENCES – TO BE CONSIDERED AS A PART OF THIS SPECIFICATION

A. Most recent editions and addenda of the following documents:

B. Contra Costa Community College District – Districtwide Technology Infrastructure Standard

C. TIA-526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

D. TIA-526-14-B Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; IEC 61280-4-1 edition 2, Fibre-Optic Communications Subsystem Test Procedure-Part 4-1: Installed cable plant- Multimode attenuation measurement

E. TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises

F. TIA-568-C.1 Commercial Building Telecommunications Cabling Standard

G. TIA-568-C.2 Balanced Twisted Pair Cabling Components

H. TIA-568-C.3 Optical Fiber Cabling Components Standard

I. TIA- 568-C.4 Broadband Coaxial Cabling and Components Standard
J. ANSI/TIA/EIA 569-B Commercial Building Standards For Telecommunications Pathways And Spaces

K. TIA-598-C Optical Fiber Cable Color Coding

L. ANSI/TIA/EIA 606-B The Administration Standard For The Telecommunications Infrastructure Of Commercial Building


N. ANSI/TIA—607-B & B1 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

O. TIA-758-B Customer-Owned Outside Plant Telecommunications Infrastructure Standard

P. ANSI/TIA/EIA-862 Building Automation Systems Cabling Standard for Commercial Buildings

Q. ANSI/TIA-942 Telecommunications Infrastructure Standard for Data Centers

R. TSB-4979 - Practical Considerations for Implementation of Encircled Flux Launch Conditions in the Field. This bulletin outlines precise specifications that define the launch condition of test sources into multimode fiber which have been standardized and are mandatory for testing optical attenuation of installed multimode cabling per TIA-568.

S. BICSI Telecommunications Distribution Methods Manual (TDMM) 11th Edition

T. BICSI Information Transport Installation Manual (ITSM)


W. ISO/IEC 11801 – Information Technology – Generic Cabling for Customer Premise

X. IEEE 802.3 Standard for Information technology -Telecommunications and information exchange between systems - Local and metropolitan area networks – Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications


AA. NECA/BICSI-568-A Standard for Installing Commercial Building Telecommunications Cabling

BB. NESC – National Electrical Safety Code
CC. Federal Communications Commission Part 15 and Part 68
DD. UL 444 – Standard for Safety of Communications Cable
EE. UL 1666 – Standard for Safety of Flame Propagation Height
FF. NFPA 262 – Flame Travel and Smoke of Wires and Cables
GG. IBC 714.3.2
HH. ASTM E 814 / UL 1479
II. Local Authority Having Jurisdiction

1.03 DEFINITIONS / TERMS / ACRONYMS

A. ANSI American Northern Standards Institute
B. AWG American Wire Gauge
C. BICSI Building Industry Consulting Service International
D. BCTBonding Conductor for Telecommunications
E. COTS Common Off The Shelf Technologies
F. EIA Electronics Industry Alliance
G. ETL Intertek Semko Labs
H. FCC Federal Communications Commission
I. GE: Grounding Equalizer
J. IEC International Electrotechnical Commission
K. IEEE Institute of Electrical and Electronic Engineers
L. IDC Insulation displacement contact
M. ISO International Standards Organization
N. J-STD Joint Standard
O. NECA National Electrical Contractors Association
P. NFPA National Fire Protection Agency
Q. NRTL Nationally Recognized Testing Laboratory
R. SC TIA Standard duplex connector
S. TIA Telecommunications Industry Association

T. UL Underwriters Laboratory

U. As Necessary: That work which is required for completed construction, but is not necessarily shown or described in the Contract Documents.

V. As Required: That work which is required for completed construction and is shown on the drawings or described in the project Specification.

W. Cabling: Cable assembly, raceway, conductors, fittings and any other necessary accessories to make a complete wiring system.

X. Backbone: A facility (e.g., pathway, cable or conductors) between telecommunications rooms, or floor distribution terminals, the entrance facilities and equipment rooms within or between buildings.

Y. Backbone Cabling: Cabling and connecting hardware that provides interconnections between telecommunications rooms, equipment rooms, and entrance facilities.


AA. Concealed: Hidden from sight, buried as in chases, furred spaces, shafts, fixed ceiling or embedded in construction.

BB. Contractor: The installation Contractor responsible for the furnishing and installation of all work indicated within this Specification.

CC. Construction Manager: The Owner’s appointed representative.

DD. Equipment Outlet (EO): A device also known as the outlet or information outlet placed at the user workstation for termination using connectors (jacks) of horizontal media for connectivity of data and voice at teacher work area outlet, multimedia equipment. These outlets provide the connection point to voice, data, and other media services.

EE. Exposed: Bare, open to the elements, out in the open, uncovered.

FF. Furnish: Purchase, supply, provide and deliver to the project site, protect and provide interim storage and be ready for unloading, unpacking, assembly, installation, and similar operations in accordance with Manufacturer's specifications."

GG. GE Grounding equalizer: Employed in a multistory building to interconnect multiple TBBs on the same floor. Sized equal to TBB.

HH. Horizontal Cabling: Cabling between and including the work area outlet/connector and the horizontal cross-connect/patch cord in the telecommunications room.

II. Install: Describes operations at project site including the actual "unloading, unpacking, rigging in place, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations".
JJ. Installer: Contractor, Subcontractor and/or supplier who uses their own employees for performance of all construction activity related to their specified responsibilities, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform and the "Installers" must be an authorized Manufacturers representative, certified, experienced and qualified to provide, install, program, troubleshoot, train, warrant and service all the systems in this section in their entirety.

KK. If Applicable: That work which may be required for completed construction at applicable locations, but is not necessarily shown or described in the Contract Documents.

LL. Owner: Person or entity for which the building and construction is being done; and/or that will take possession of the property once the construction is complete.

MM. Owner Representative: The person or entity representing the Owner on contractual matters.

NN. Product: Any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.

OO. Provide: To "furnish and install, complete and ready for the intended use".

PP. RCDD: Registered Communications Distribution Designer (RCDD).

QQ. Substantial Completion: The project is sufficiently complete to be utilized for its intended use as stated in the body of this written Specification.

RR. TBB: Telecommunications Bonding Backbone

SS. TGB: Telecommunications Grounding Busbar

TT. TMGB: Telecommunications Main Grounding Busbar

UU. Words in the singular: Will also mean and include the plural, wherever the context so indicates, and words in the plural will mean the singular, wherever the context so indicates.

1.04 SUBMITTAL REQUIREMENTS

A. General
   1. Provide required submittals in accordance with Conditions of the Contract, and Division 1 Submittal Procedures Section.
   2. Format:
      a. For this section furnish submittal data neatly bound in an 8 1/2" x 11" folder or binder for each specification section with a table of contents listing materials by Section and paragraph number.
      b. Project name and address
      c. Number of submittal
      d. Name and address of the contractor
      e. Date of submittal
      f. Table of contents with material page numbers listed
      g. Page number of the corresponding specification or drawing numbers in the contract documents.
   3. Submittals to consist of:
a. Detailed shop drawings,
b. Product specifications,
c. Block wiring diagrams,
d. "Catalog cuts" and data sheets containing physical and dimensional information,
e. Performance data,
f. Electrical characteristics
g. Materials used in fabrication, and material finish.

4. Clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories which are included and those which are excluded.

B. Material submittals
   1. Label each submittal with the Specification Section Number and provide a cover letter or stamp stating that the submittal has been thoroughly reviewed by the Contractor and complies with the requirements of the Contract Documents. Failure to comply with this requirement will constitute grounds for rejection of data.
   2. For each product, indicate where it is intended to be installed.
   3. Resubmittals: Provide a cover letter with the resubmittal that lists the action taken and revisions made to each product submittal in response to Submittal Review Comments, indicating the page in the resubmittal that the new information occurs. Failure to include this cover letter will constitute rejection of the resubmittal package and no review will occur.

C. Under the provisions of this request for proposal, prior to the start of work the Structured Cabling System Contractor will:
   1. Submit copies of the certification of the company and names of staff that will be performing the installation and termination of the installation to provide proof of compliance of this spec.
   2. Submit proof from Manufacturer of Contractor’s good standing in Manufacturer’s program where contractor is authorized by manufacturer to do warranted work.
   3. Submit appropriate cut sheets and samples for all products, hardware and cabling.
   4. Work will not proceed without the Owner's approval of the submitted items.
   5. The Structured Cabling Systems Contractor will submit in writing any material substitutions they propose and receive approval from the Owners on all substitutions of material in writing prior to purchase and installation. No substituted materials will be installed except by written approval from the Owner.
   6. Refer to other applicable sections for additional submittals requirements.

D. Submit a work plan for installation and testing of the structured cabling system, including time lines for milestones, coordination with other trades, etc.

E. Shop drawings
   1. Obtain electronic files containing the contract documents drawing files for use in preparing the shop drawings from the Engineer.
   2. Use of CAD Files: Should the Contractor need the Engineer’s CAD files to produce shop drawings and/or as-built drawings, the Engineer requires the Contractor sign a CAD files release agreement.
   3. Submit the following for review and approval prior to the installation of equipment:
      a. Floor Plans: 1/8 inch scale floor and site plans showing the locations of devices and cable routing paths with cable types and quantity called out.
   4. Submit Shop drawings for the entire structured cabling system, identifying such items as rack fills, cabling pathways and pathway fills, ladder and other cable raceways,
coordination with other trades, etc. These drawings and support narratives must completely describe the intended build for the project.

F. Provide Indexed Project Manual composed of Test Results, As-Built drawings, material cut sheets, maintenance instructions, Parts List (with part numbers) of all materials installed, etc., at the completion of project.

G. Certification letters from manufacturers of major system components stating the Contractor is an authorized reseller, installer, and extended warranty provider for the specified security systems.

H. Final close out documents including but not limited to bound indexed test results, project manual that includes such items as manufacturer and contractor warranties, product cut sheets, material submittals, etc.
   2. Hard copy documentation of test results for every cable segment and link in 3- ring binder. Documents will include measured values as well as whether or not the test passed.
   3. Provide "As-Built" Drawings on AutoCAD Version the same as provided by architect to the Owner. Obtain copy of original Drawings from the Architect.
      a. "As-Built" drawings indicating location of all equipment including but not limited to work area outlets, patch panels, cross connect blocks, on each segment and cable routing outlet and identifiers. Indicate labeling for each piece of equipment.
      b. Provide respective copies mounted in each telecommunications room, and the main cross connect.
      c. As-Built drawings will contain all installed cabling and materials. Outlets will be numbered with each cable associated with the work area outlet.
   4. Place a laminated ½ or full-size floor plan of these drawing (coordinate with Owner) on the wall of each communications room.

I. Submit NRTL certification that the structured cabling system meets the transmission requirements of TIA-568-C.0.

1.05 QUALITY ASSURANCE

A. The Telecommunications Subcontractor shall have total responsibility for the coordination and installation of the work shown and described in the telecommunications drawings and specifications. The Telecommunications Subcontractor shall be a company specializing in the design, fabrication and installation of integrated telecommunications systems.

B. Telecommunications Systems specified shall be engineered, assembled and installed under the direction of a pre-qualified Telecommunications Subcontractor. Pre-qualification requirements shall include submittal by the Telecommunications Subcontractor to the Architect of the following:
   1. List of previous projects of this scope and nature, including names and sizes of projects (to include square footage and construction cost – overall and that of the Telecommunications Subcontractor), description of work, times of completion, and names of contact persons for reference.
   2. Installers shall certify that they are manufacturer-authorized or trained for work to be performed.
C. The Installer (Firm and Employees) will be experienced in the operations they are engaged to perform. Demonstrate at least five years of continuous recent experience on similar projects. The Installer will hold recent, up-to-date licenses, certifications and training certificates in the area the project is located and for the equipment to be installed.

D. Provide names of contacts from the last five similar projects including the General Contractor, Owner's Representative, Architect and Engineer. Indicate project locations, scope and current phone numbers that the contacts can be reached at.

E. Qualified Structured Cabling System Installation firms will have demonstrable design and installation training with certifications of competence. Certified training will be industry recognized and at least equal to:
   2. Registered Communications Distribution Designer (RCDD).
   3. Manufacturer Certified Installer

F. Provide a full time on site foreman who personally has been certified as described above. Submit all documentation under this Section.

G. Provide an on-call Project Manager to supervise the project.

H. Each Foreman and Installer working on this project will be trained to the qualified level as specified by the Manufacturer(s) for installation and maintenance of equipment being provided on this project. The training will consist of at least a minimum of proper installation techniques of their specific equipment in order to have a complete operating system meeting or exceeding the requirements as specified herein. Each Foreman and Installer working on this project will have documentation from the Manufacturer indicating that they have been adequately trained prior to the start of the project. Only Foreman and Installers who have been properly trained and documented by the Manufacturer whose equipment is being provided on this project will be allowed to install.

I. Separate Qualifications Requirements:

J. Installers will be specifically qualified for each system being installed under this section. Provide documentation for each installer including:
   1. State of CA License as required
   2. Registered Telecommunications Installer Apprentice Certificate

K. Maintain at the site an updated copy of the Manufacturer Trained Installers list including a copy of their training documentation from the Manufacturer. This documentation will be made available to the Architect upon request.

1.06 BIDDER QUALIFICATIONS

A. Bidding Contractor shall be licensed to install telecommunications systems in the state where work will be performed.

B. Bidding Contractor shall have a minimum of 5 years of experience installing structured cabling for telecommunications.

C. Bidding Contractor shall have the capability to bond project in its entirety.
D. Bidding Contractor shall be able to provide insurance at the request of the owner.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Contractor shall ensure that materials delivery to work area shall be coordinated with construction site manager responsible for materials distribution to all trades.

B. Contractor is responsible for all materials, tools and vehicles left on the job site.

C. Contractor shall coordinate a disposal bin for the removal of all trash produced by the Contractor’s associated personnel during the project.

D. Contractor shall ensure materials are stored in an environmental area where:
   1. Temperature does not exceed 120 degrees Fahrenheit nor below 32 degrees Fahrenheit.
   2. Humidity does not exceed 80%.
   3. No direct exposure to sunlight.

E. Cable shall be stored according to Manufacturer’s recommendations as a minimum. In addition, cable must be stored in a location protected from vandalism and weather. If cable is stored outside, it must be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection from weather. If air temperature at cable storage location will be below 40 degrees F., the cable shall be moved to a heated (50 degrees F. minimum) location. If necessary, cable will be stored off site at the Contractor’s expense.

F. Deliver equipment in individual shipping splits for ease of handling, mount on shipping skids and wrap for protection.

G. Inspect and report concealed damage to carrier within specified time.

H. Store in a clean, dry space. Maintain factory protection or cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic. Heat enclosures to prevent condensation. Meet the requirements and recommendations of NFPA 70B and the Manufacturer. Location will be protected to prevent moisture from entering enclosures and material.

I. Handle in accordance with NEMA and the Manufacturer’s recommendations and instructions to avoid damaging equipment, installed devices and finish.

J. The equipment will be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the Manufacturer will be required to brace the equipment suitably to ensure that the tilting does not impair the functional integrity of the equipment.

1.08 PROJECT CONDITIONS

A. Environmental Requirements
   1. Contractor shall ensure that any pollutants produced during the work are disposed of according to local, state or national regulations. Follow the most stringent guidelines.
   2. It is preferred that the Communications Contractor recycle any used or un-used components during the course of the construction project.
   3. Coordinate with LEED project manager if cabling system or components will used for points in a LEED certified project.
B. Existing conditions
   1. Prior to bid, Telecommunications Subcontractor is to visit the existing building and evaluate all existing conditions. Bring to the attention of the Owner and Design Team any cause for concern or apparent conflicts with the contract documents as soon as practically possible.
   2. See Section 01 51 33 for Temporary Telecommunications requirements.

C. Field Measurements
   1. Contractor shall coordinate with electrical engineer on project that the main electrical service ground has a resistance to earth of less than 5 ohms.
   2. Contractor shall ensure that all grounding bus bars for all equipment network rooms shall have a resistance of less than 1 ohm back to the main electrical service ground.
   3. Contractor shall ensure that all field testers have been calibrated from the Manufacturer within 1 year.
   4. Refer also to grounding specification 27 05 26

1.09 PRE-CONSTRUCTION MEETING

A. If not called by GC contractor shall call a meeting with GC, Owner’s representative, design consultant, and others deemed necessary by Owner &/or GC.

B. At the meeting, project schedule and phasing will be discussed. In addition, any constructability issues, or questions about the bid documents will be presented verbally and in writing. This is in addition to the standard RFI process established by project manual.

1.10 SEQUENCING

A. Contractor shall coordinate with Owner’s project manager on sequencing of various trades and construction teams for the lifecycle of the project.

B. Cooperation and coordination with other trades.
   1. The work will be so performed that the progress of the entire building construction, including all other trades, will not be delayed and not interfered with. Materials and apparatus will be installed as fast as conditions of the building will permit and must be installed promptly when and as directed.
   2. Keep fully informed as to the shape, size and position of all openings required for all apparatus and give information in advance to build openings into the work. Furnish and set in place all sleeves, pockets, supports and incidentals.
   3. Coordinate exact locations and roughing in dimensions of all work before installation and make all final connections as required. Any changes required to avoid interferences or to provide adequate clearances for Code and maintenance requirements will be made at no additional costs.
   4. Structural elements of the project will not be relocated, altered or changed to accommodate the work without written authorization from the Owner/Architect.
   5. Work that is installed before coordination with other trades or that causes interference with the work of other trades will be changed to correct condition at no additional cost to the Owner.
   6. Obtain a complete set of Project Drawings and Specifications for coordination and to determine the full scope of work.
   7. Attend project coordination meetings to coordinate work of this Section, pathways, work of other trades phasing and other project requirements.
1.11 CONTINUITY OF SERVICE AND SCHEDULING OF WORK

A. Contractor shall provide a detailed construction schedule with hard dates for completion of roughing in cables, terminations and testing once scheduling sequence has been determined to the Owner’s Project Manager.

B. Cabling schedule shall be in a software program designated by the Owner’s Project Manager.

C. Continuity of all services will be maintained in all areas that will be occupied or temporarily relocated during the construction period. If an interruption of service becomes necessary, such will be scheduled in advance, made only upon consent of the Owner and at a time outside normal working hours as the Owner will designate. The Contractor will schedule the shutdown with seven days in advance. Arrange work to minimize shutdown time.

D. Should services be inadvertently interrupted, immediately notify the Owner. Be prepared to immediately furnish labor, materials and the equipment necessary for prompt restoration of interrupted service.

E. Refer to the overall scheduling of the work of the project. Schedule work, process Submittals and order materials and equipment to conform to this schedule and install work to not delay nor interfere with the progress of the project.

F. Inform General Contractor and Architect immediately of any delays or potential delays. Furnish Manufacturer’s letter to verify order date, equipment delays, expected shipment date, order number, and potential remedies to speed up delivery. Any costs to speed up delivery will be implemented at no cost to the project if the equipment or material was not ordered as soon as possible after Contract award or within the time frames indicated with the Submittals.

G. Include premium time required to comply with the project scheduling and phasing.

H. Be aware of, and plan for, project scheduling and phasing. Provide for complete continuous operation of all systems. Coordinate scheduling and phasing with the Architect, Owner, other Trades, and the General Contractor.

I. Demolition of existing systems being updated will take place only after the new or replacement system is completely installed, operational, tested and certified. This work may be required on a "per-phase" basis.

1.12 LABELING

A. Label all major elements in communications infrastructure as defined in TIA 606B.

B. Document and place on full and half size set of plans all elements with their unique numbers.

C. Provide a definition or labeling matrix with As-Built/Document Close-Out submittals that defines each labeling element with examples of each field defined.

D. Submit complete labeling scheme for all elements with initial submittals for project.

E. Confirm with Owner prior to implementation, the proposed labeling scheme you are intending to implement.
F. Ensure labeling for backbone cables includes information on the space name/number of the cable’s opposite end. This requirement includes buss bar, bonding conductor, and bonding backbone cable labeling.

G. As a part of the close-out submittal package, provide riser cable and bonding conductors drawings (full and half size as well as editable soft copy) showing the cables, their installed routes, and the cable numbers. These documents will be in addition to the As-Built floor plan submittals that identify work area outlet placement with their respective identification numbers.

1.13 POST CONSTRUCTION

A. Meeting: Subsequent to substantial completion and testing, call a meeting with GC, Owner’s representative, design consultant, and others deemed necessary by Owner &/or GC.
   1. At the meeting, contractor shall present a DRAFT of AS-Built drawings, test results, and any other material contractor deems appropriate to completing the project for review by other attendees.
   2. Any comments or requests for correction shall be noted by the contractor during the meeting. Corrections to all documents shall be made and final copies shall be submitted within 1 week of meeting.

B. Punch Walk: Arrange with Owner’s project team, GC, and consultant a final punch-walk to review completed installation.
   1. Document all discussion, comments, and requests by Owner’s team, noting outstanding items that must be ameliorated.
   2. Complete all tasks on punch-list.

C. Notification of completion of work: Notify Owner in writing when installation is complete. Arrange for a site walk thru with the Owner demonstrate that all punch list items have been completed.
   1. Record any Owner comments on items that may have been left incomplete whether or not they were a part of punch list.
   2. Complete any outstanding items.

1.14 PROTECTION OF WORK AND PROPERTY

A. Be responsible for the care and protection of all work included under this Section until it has been tested and accepted.

B. Protect all equipment and materials from damage from all causes including theft. All materials and equipment damaged or stolen will be replaced with equal material or equipment at the option of the Architect and Owner.

C. Materials and equipment stored for this project will be protected and maintained according to the Manufacturer’s recommendations and requirements and according to the applicable requirements of NFPA 70B.

D. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen and make good any damage caused.
E. Use caution to avoid damage to existing work, and to prevent harm to personnel working in all areas.

F. Observe all safety precautions and requirements for the construction.

G. The General Contractor and the Installer are responsible for initiating, maintaining, and supervising all safety precautions and requirements during construction.

H. Coordinate installations with all other trades in order to not damage equipment or cables during construction. Any work that is damaged during construction will not be repaired. Replace damaged work completely, with no splices in cabling, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 REFER TO 27 15 00 FOR COMMUNICATIONS HORIZONTAL CABLING

2.02 REFER TO 27 16 00 FOR COMMUNICATIONS CONNECTING CORDS, DEVICES AND ADAPTERS

2.03 LABELING

A. Horizontal and grounding cabling: 1” white with black lettering. Dymo Rhino P/N 1734821
   1. Approved equal

B. Backbone cabling: 1” white nylon with black lettering: Dymo Rhino P/N 1734524
   1. Approved equal

C. Racks, patch panels, cabinets, fire stop systems: ½” white permanent polyester with black labeling. Dymo Rhino P/N 18483
   1. Approved equal

2.04 FIRE STOP

A. Provide thru-partition penetrations for all division 27 infrastructure that are listed systems for the intended purpose of the penetration.

B. Fire stop sleeves must not only be UL listed systems for installed locations but must also be designed to stop the passage of smoke through the device, by their design reduce or mitigate the passage of sound through the device, and to maintain the fire rating of the partition.
   1. Install fire stop systems that pass into spaces that are rated. Ensure system maintains partition’s fire and STC rating, while not de-rating or changing the sleeves’ UL Listing.

C. Per IBC 714.3.2, membrane penetrations firestop systems must be tested to ASTM E 814 / UL 1479
   1. Recessed fixtures shall be installed such that the required fire resistance will not be reduced.
   2. Sumtotal area of openings does not exceed 100 square inches for any 100 sq. ft. of wall.
   3. Steel electrical boxes, or steel boxes installed for Div. 27 infrastructure, installed on opposite sides of a wall must be separated by a horizontal distance greater than 24”.
D. Acceptable Manufacturers: Subject to compliance with requirements, provide products from manufacturers or approved equal as further defined in the Systems and Applications Schedule in Part 3 of this section.
   1. Hilti
   2. EZpath
   3. 3M

2.05 CABLE SUPPORTS

A. Provide 3/8” threaded rod or drop wire for support of J-Hooks when conduit not utilized.
   1. Acceptable manufacturer for drop wire hooks: Erico, or approved alternate, sized for cable bundles.
   2. Drop Wire / Rod Securing Clip: Eaton B-Line BA311, or appropriate size for wire/rod size.
   3. Utilize existing horizontal cabling pathways as possible throughout the renovated areas of the project
      a. If existing horizontal cabling pathways appear to be damaged or no longer grounded and bonded, provide the necessary repairs to the horizontal cabling pathway and ensure proper bonding and grounding of the telecommunications system.

2.06 CABLE LUBRICANT

A. Acceptable Manufacturer
   1. Maxlub
   2. Approved alternate

B. Acceptable Product
   1. MXC-Lube-35LR
   2. MXC-Lube-D20

C. Product Requirements
   1. Rated for fiber, and copper cables
   2. Compatible with common cable jackets including Polyethylene
   3. Rated for OSP, riser, and Plenum applications
   4. Non-staining

PART 3 - EXECUTION

3.01 GENERAL

A. Verify the exact location prior to bid of all items that may be indicated and determine exact location of all electrical items that are not indicated on the Drawings.

B. Include the cost of all work including sub-letting of any work that may be required to complete the work indicated in order to avoid work stoppages and jurisdictional disputes. The work to be sublet will conform to precedent agreements and decisions of record. Jurisdictional assignment will be a responsibility under this Section's contractual obligation.

C. Do not install equipment and materials that have not been reviewed by the Architect. Equipment and materials which are installed without the Architect's review or without
complying to comments issued with the review will be removed from the project when so instructed by the Architect. No payment will be made for unapproved or removal if it is ordered removed. The Installer will be responsible for any ancillary costs incurred because of its removal and the installation of the correct equipment and materials.

D. Obtain detailed information on installation requirements from the Manufacturers of all equipment to be furnished, installed or provided. At the start of construction, check all Contract Documents, including all Drawings and all Sections of the specifications for equipment requiring electrical connections and service and verify electrical characteristics of equipment prior to roughing.

E. Equipment and systems will not be installed without first coordinating the location and installation of equipment and systems with the General Contractor and all other Trades.

F. Any and all material installed, or work performed in violation of above requirements will be re-adjusted and corrected by the Installer without charge.

G. Refer to all Drawings associated with the project, prior to the installation or roughing-in of the electrical outlets, conduit and equipment, to determine the exact location of all outlets.

H. Label all equipment as herein specified.

I. After installation, equipment will be protected to prevent damage during the construction period. Openings in conduits and boxes will be closed to prevent the entrance of foreign materials.

J. Home runs indicated are not to be combined or reduced without written consent from the Architect.

K. All connections to equipment will be made as required, if applicable, and in accordance with the approved submittal and setting drawings.

L. Site Observation:
   1. Site observation visits will be performed randomly during the project by the Architect. Reports will be generated noting observations. Deficiencies noted on the site visit reports will be corrected. All work will comply with the Contract Documents, applicable Codes, regulations and local Authorities whether or not a particular deficiency has been noted in a site visit report.
   2. Be responsible to notify the Architect ten working days prior to closing in work behind walls, raised access floors, ceilings, etc., so that installed work can be observed prior to being concealed.
   3. Areas will stay accessible until deficiencies are corrected and accepted. Notify the Architect when all deficiencies are corrected. Return reports with items indicated as corrected prior to re-observation by the Architect.

M. Change Orders, Modifications, Revisions and Directives:
   1. When change orders, modifications, revisions or Architect's Directives are issued or authorized, provide the required additional material, equipment, personnel and workers to prevent delays in the work, and to complete the work within the time limit of the Contract unless a specific time extension is requested with the change and accepted. Include costs for expediting deliveries where required.
2. Requests for additional compensation will be submitted broken down and associated by item, tasks and Drawing or sketch number with material and labor costs, so quantities can be easily verified.

3. Requests will be properly and adequately identified so the scope of work can be clearly determined. Indicate who originated change in work.

4. Submit on all credits broken down as requested for adds. Credits will be separately identified and accounted for. Do not indicate as net changes with adds.

5. Unit costs for labor and material will be equal for adds, deletes and credits.

N. Loose materials will not be stored on-site. A "gang box" is acceptable to be placed in a location agreeable to the Owner and the General Contractor. The Installer is responsible for all equipment and materials and for their delivery until the system is deemed complete and accepted by the Owner.

O. A trailer may be used for the storage of materials to be located on the Owner's property at a location designated by the Owner and the General Contractor. Such on-site storage will be kept locked by the Installer. Security for the trailer and its contents will be strictly the responsibility of the Installer.

P. Protect existing spaces where work is being performed; protect it from damage and from the accumulation of dirt and debris.

Q. Any ceilings, walls, floors, furniture, equipment, furnishings, etc., damaged by the work of this Section will be replaced, or at the Owner's option, repaired with similar materials, workmanship and quality.

R. Work includes field survey of existing conditions, systems, equipment and tracing of existing circuits to determine scope of work.

S. Maintain the existing building in operation at all times during the entire construction period. If it is necessary to have a system shutdown, a written request for approval will be submitted in advance stating the estimated shutdown time. Work will be planned to minimize shutdown. Shutdowns will be at the convenience of the Owner and, if necessary, on premium time.

T. Clean and touch up all equipment, materials and work sites at the completion of work in each area.

U. Certain portions of the work area may be occupied during construction. Determine which areas and schedule work accordingly and include necessary premium time.

V. Make sure necessary provisions to provide continuous service of all existing systems throughout all occupied areas.

3.02 CABLE PATHWAYS

A. Install cables in pathways designed to support the cables per manufacturer instructions.

B. Provide all equipment and cabling for a complete installed operating system. Cable tray pathways, outlet boxes and grounding are provided by the Electrical Subcontractor unless otherwise noted.
C. All pathways provided under this Section will comply with fill capacities as per Code, TIA/EIA 569 and BICSI. Coordinate with electrical contractor prior to pathway installation to verify capacity.

D. Cable bending radius will not be less than minimum required by TIA/EIA and BICSI.

E. Cabling installed concealed will be supported from the building structure (e.g. cable trays, J-Hooks, etc.).

F. Cables will be installed no closer than 12 inches (305mm) to electrical equipment and wiring. When cables are required to cross power wiring, they will only do so perpendicular to the power wiring. Cable and power wiring will only cross each other the minimal number of times as required due to building design limitations.

G. Clearances: Clearances between cabling and other building systems as required by TIA/EIA 569 and BICSI will be maintained throughout the building.

H. All cables will be installed in a neat and workman-like manner. Cables will be installed parallel and perpendicular to building elements.

I. Provide expansion fittings and adequate cable slack at all building expansion joints.

J. Fire/smoke seal around all conduits, raceways, sleeves, slots, etc. where cables pass from one location to another.

3.03 FLOOR BOXES

A. Finish or close up all opening in floor boxes or poke throughs so that they maintain their fire ratings.

B. Refer to AV for box specs.

C. Coordinate with electrical contractor for conduit routing to TR prior to boxes installation.

3.04 WORK AREA OUTLETS

A. All work area outlet locations will be as indicated on the Drawings. Uniquely label each work area outlet and jack within the outlet according to the numbering convention outlined in the section on labeling.

B. Labeling shall be sequential in order, do not reuse a number throughout the entire infrastructure.

C. Work area outlets installed in casework will have their cables installed within the conduit or raceway provided.

D. Install jack and connector modules as indicated in the details and on the Drawings.

E. Work area outlets will be seated properly and will be installed level on walls and parallel to building elements as required.
3.05 INSTALLATION PRACTICES

A. Follow and adhere to installation practices specified by the applicable Telecommunications Industry Association standards.


E. Follow and adhere to installation practices specified by the Manufacturers.

F. Innerduct
   1. Provide innerduct in all conduits 2" and larger.
   2. Install Armored and non-armored fiber in fabric innerduct when placed in conduit.
   3. Armored fiber outside of conduit does not require innerduct.
   4. Install Non-armored fiber within rigid wall innerduct when outside of conduit, except within a telecommunications equipment room.
      a. Secure rigid wall innerduct to innerduct support so it does not slip or move during installation of cabling
      b. Transition from fabric to rigid innerduct, if it occurs, must be made so rigid innerduct is butted to fabric innerduct and secured to occur within conduit.
   5. Inner duct shall not be kinked or tightly bent in any way.

G. The general topology will be a "hierarchal star" configuration. All segments will originate in NRTL listed patch panels located in the telecommunication equipment racks/cabinets and end at the work area outlets.
   1. Routing:
      a. All cabling will be installed in conduit.
      b. Cables will be routed, in large groups, down main cable pathways, until a direct path to the point of access to the workstation outlet can be taken. At that point, cables will be routed, above all building systems, to the outlet location in accordance with standard installation practices, as described herein.
      c. Multiple cables to individual rooms will be pulled as a bundle and terminated at each end in sequential order so that labeling within a room location is in sequence.
      d. When not in conduit or tray, cables will be supported to the deck and/or beams, per Part 310 this specification. Hangers, clips, and other methods of grouping the cables and keeping them away from other systems installed in the building are to be provided and installed. Ensure that hangers and other methods of securing cable do not compress cable or damage insulation.
      e. Cables hanger will be attached to beams prior to fire proofing applications and with minimal disruption of the fireproofing. The Contractor will be responsible for restoring the fireproofing to appropriate levels. Restoration will be verified by the General Contractor. Provide documentation that installation or restoration of fire stop systems is acceptable to Owner and PM.
      f. Cable routes will be with 90-degree angles whenever possible, following building lines. Cables will not be installed randomly or diagonally through the building.
g. Cables installed partially or fully within the telecommunications room will be routed through and secured in the cable tray wherever possible. No cables are to be routed across the rooms at angles, or are the cables to be run from one portion of the room or tray to another. Cables placed in the cable tray are to be laced frequently to keep them neatly bundled and not permitted to shift from one side of the tray to the other as they are routed in the tray.

h. Station cables will be routed to fixed wall locations through EMT to back box. Secure and store four feet of slack cable above ceiling at cable entrance to EMT.

2. Separation from EMI Sources:
   a. Comply with BICSI TDMM and TIA-569-C recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
   b. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment will be as follows:
   c. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   d. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   e. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
   f. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment will be as follows:
   g. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   h. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   i. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
   j. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures will be as follows:
   k. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   l. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   m. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
   n. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
   o. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3. All cables will have both ends completely terminated at their respective patch panel and work area outlet. Individual conductors will be trimmed flush with IDC block.

4. The total length of permanently installed cable for any complete segment will not exceed 295 feet (90m). Do not splice or otherwise re-terminate any cable used, terminate only at the patch panels, cross connect blocks and work area outlets. Route cables [minimum of 12 inches (305mm) away] to avoid light ballasts, transformers, power wiring and other electrical devices so that there is no EMI or RFI interference with data transmission. Permanently label all cables six inches from the connector at each end, according to the numbering convention outlined in the section on labeling. All cables will be terminated at outlets, patch panels or cross-connect blocks ONLY.

5. Maximum pulling tension will not exceed 25 lbs./ft. when installing cables.
3.06 LABELING

A. Labeling procedure will meet EIA/TIA 568C, 606-B (Class 2 Administration) and BICSI Standards.

B. The labeling scheme will be provided as follows at all locations within the cable infrastructure:

C. Labeling will be as follows:
   1. Location identification will start from the left, as you walk in the doorway, and continue around the room in a clockwise direction.
   2. Data drops will be labeled with the room number and sequential letters; starting with 'A' (e.g. the first three data drops in Room 201 would be labeled 201A, 201B and 201C). Skip the letter 'V'.
   3. Voice drops will be labeled with the room number and the letter 'V' (e.g. the telephone drop in Room 128 would be 128V).
   4. Labeling shall be sequential in order, do not reuse a number throughout the entire infrastructure.
   5. Hand-written and embossed type labels are specifically prohibited. In addition, provide the following:
      a. Label each outlet with permanent self-adhesive label with minimum 3/16 in. high characters.
      b. Label each cable with permanent self-adhesive label with minimum, 1/8 in. high characters, in the following locations:
      c. Inside receptacle box at the work area.
      d. Behind the communication room patch panel or punch block.
      e. Use labels on face of data patch panels. Provide facility assignment records in a protective cover at each telecommunications room location that is specific to the facilities terminated therein.
      f. Use color-coded labels for each termination field that conforms to ANSI/TIA/EIA-606(A) standard color codes for termination blocks.
      g. Mount termination blocks on color-coded backboards.
      h. Labels will be machine-printed. Hand-lettered labels will not be acceptable.
      i. Use industry standard EIA/TIA and BICSI color codes as specified herein and maintain consistent color-coding throughout the building.

3.07 FIRE STOPPING

A. Work, in general, includes furnishing and installing fire and smoke barrier penetration sealing systems for openings in floor, walls, and other elements of construction.

B. Comply with requirements in Division 07 Section "Penetration Fire stopping".

C. Comply with TIA/EIA-569-A, Annex A, "Fire stopping."

D. Comply with BICSI TDMM, "Fire stopping Systems" Article.

E. Applicator Qualifications: Two years of experience installing UL classified fire stopping.

F. Performance of materials will have been tested to provide fire rating equal to that of the construction.
G. Provide standard firestop details in shop drawings that are intended for use in this project for review and approval of relevant authority.

3.08 SHOP DRAWINGS:

A. Submit complete shop drawings coordinated where required with work of other sections.
   1. Shop drawings shall show layout, spacing, sizes, thicknesses, and types of fabrication, fastening and anchorage details, including welded connections and mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachments to other units or Work, and other details required for proper installation.

B. Submit shop drawings showing each condition requiring penetration seals indicating proposed UL systems materials, anchorage, methods of installation, and actual adjacent construction.

C. Include details of cuts, connections, splices, bridging, accessories and other pertinent data required for a complete and proper installation.

D. Include items not shown and special components and installations not fully dimensioned or detailed in manufacturer’s product data.

E. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

F. Provide setting diagrams, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other sections.

G. Submit a copy of UL illustration of each proposed system indicating Manufacturer approved modifications.

H. Manufacturer’s Data: Submit copies of Manufacturer’s specifications, recommendations, installation instructions, and maintenance data for each type of material required. Include letter indicating that each material complies with the requirements and is recommended for the applications shown.

I. Provide stamped drawings and structural calculations signed by a structural engineer registered in the State of installation. Provide calculations for loading and stresses of specially fabricated, designed framing. Clearly indicate all loads imposed on primary building structure.

J. Existing Project Conditions:
   1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
   2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

K. Materials:
   1. Provide materials classified by UL to provide for intended use. For Fire Barriers it must be equal to time rating of construction being penetrated.
   2. Provide asbestos free materials that comply with applicable codes and have been tested in accordance with UL 1479 or ASTM E-814.
I. Preparation: Clean surfaces to be in contact with penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

M. Installation:
1. Install penetration seal materials in accordance with printed instructions of the UL Building Materials Directory and in accordance with Manufacturer’s instructions.
2. Seal holes or voids made by penetration to ensure an effective smoke barrier.
3. Where floor openings without penetrating items are more than four inches in width and subject to traffic or loading, install fire stopping materials capable of supporting same loading as floor.
4. Protect materials from damage on surfaces subject to traffic.

N. Field Quality Control:
1. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.
2. Keep areas of work accessible until inspection by applicable code authorities.
3. Perform under this section patching and repairing of fire stopping caused by cutting or penetration by other trades.

O. Adjusting and Cleaning:
1. Clean up spills of liquid components.
2. Neatly cut and trim materials as required.
3. Remove equipment, materials and debris, leaving area in undamaged clean condition.

P. Environmental Requirements:
1. Furnish adequate ventilation if using solvent.
2. Furnish forced air ventilation during installation if required by Manufacturer.
3. Keep flammable materials away from sparks or flame.
4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by fire stopping materials.

3.09 SEALING OF PENETRATIONS AND OPENINGS

A. All fire stop systems will be installed in accordance with the Manufacturer’s recommendations and will be completely installed and available for inspection by the local inspection authorities prior to cable system acceptance.

B. Where possible, utilize fire stop systems that have intumescent material built in as a part of the system.

C. Where systems with built in intumescent material are not provided, provide a seal around raceways or cables penetrating full height walls (slab to slab), floors or ventilation or air handling ducts so that the spread of fire or products of combustion will not be substantially increased, and that also maintains partition’s STC rating.

D. Penetrations through fire-resistant-rated walls, partitions, floors or ceilings will be fire stopped using approved systems and methods and NRTL listed products to maintain the fire resistance rating.
E. Installation restrictions of the listing agencies will be strictly adhered to {e.g. 24 inch (610 mm) minimum horizontal separation between boxes on opposite sides of the wall, maximum square inch opening in wall).

F. Fire stopping in sleeves or in areas having small openings that may require the addition or modification of installed cables or raceways will be soft, pliable, non-hardening fire stop putty. Putty will be water resistant and intumescent.

G. Fire stopping in locations not likely to require frequent modification will be NRTL listed putty or caulk to meet the required fire resistance rating.

H. Box penetrations into a fire rated wall or shaft will have a fire-stopping pad installed on the back of the box.

I. Fire stopping of cable trays through walls will be with NRTL listed intumescent bricks to meet the required fire resistive rating and that will not allow products of combustion to pass through the protected opening. The NRTL listed bags will be installed inside and on both sides of the opening as required to meet the required resistive fire rating of the wall.

J. Fire stopping materials will be NRTL listed to UL 1479 (ASTM E814). Installation methods will conform to a UL fire stopping system. Submit specifications and installation drawings for the type of material to be used. Fire stopping materials will be as manufactured by 3M, International Protective Coatings Corp., Specified Technologies, Inc., Carborundum Company, RayChem, Nelson Fire Stop or approved equal.

3.10 WARRANTY REQUIREMENTS

A. Project Warranty
1. Equipment and materials required for installation under these specifications shall be the current model and new (less than one [1] year from date of manufacture), unused and without blemish or defect, and are to be guaranteed to be free from defect for a minimum of one year from date of project’s substantial completion.
2. When a defect or problem is observed within the first year after substantial completion, the Owner will notify the governing subcontractor through the proper channels. The appropriate Subcontractor then has 48 hours to fix the defect or furnish and install a replacement part/system, all at no cost to the project or Owner.

B. Advanced System Warranty for Telecommunications (Copper and Fiber Systems)
1. Beyond the initial one year project warranty, the Copper and Fiber Telecommunications Systems shall be warrantied for a minimum of 25 years by a national and reputable connectivity or cabling manufacturer.
   a. This warranty shall to cover any material defect, as well as the performance of the cabling system. (Example: A Category 5e cabling system is to deliver 1000BASE-T speed, or 1 “Gig” performance for the entire length of the warranty period.)
   b. This warranty shall cover both material and labor for the full length of the warranty period.
2. Submit copies of written warranty, minimum of one year, agreeing to repair or replace joint sealers which fail in joint adhesion, cohesion, abrasion residence, weather resistance, extrusion residence, migration residence, stain resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted
Manufacturer’s data as an inherent quality of the material for the exposure indicated. The guarantee period will be one year from date of substantial completion.

a. The Telecommunications Subcontract shall be certified by this manufacturer.
b. The following manufacturers are conditionally approved to provide the system warranties (subject to specific project requirements):
   1) Copper Connectivity Manufacturers
      a) Systimax
      b) Approved alternate
   2) Fiber Connectivity Manufacturers
      a) Systimax
      b) Approved alternate
   3) Cabling Manufacturers
      a) Systimax
      b) Approved alternate

3.11 CABLE SUPPORTS

A. Provide hook and loop (Velcro) cable wraps at all panels, equipment racks, cabinets and J-hook supports. Tie wraps are specifically prohibited.

B. For horizontal cables, secure with minimum required compression in order to secure the cables properly without impeding the signal transmission rating (geometry) of the cable. Hook and loop (Velcro) cable wraps may be used in lieu of cable ties for copper cables only.

C. Provide J-Hook supports from the building structure as required for cable runs to the cable drop location. Maximum distance between supports will be from 3.5 to 5.5 feet (with spacing randomly determined) depending on the structural elements of the building.
   1. Comply with maximum number of cables per support specified by manufacturer.
   2. Provide additional supports as required when cable quantities exceed manufacturer’s data, and to maintain required bending radius of cables.
   3. Cables installed exposed or in areas subject to abuse {below 10 feet (3m) above finished floor} or in accessible areas will be installed in conduit.
   4. All J-Hooks supported by drop wire must be stabilized at the lower end to a fixture such as T-Bar grid. The T-Bar attachment is not meant for ceiling support. It may not be used for that purpose, but only to stabilize the hangar per NEC 300.11.

D. All cables will be supported directly from building structure. Under no circumstance will cable be installed using cross bracing, plumbing/sprinkler pipes, ceiling systems or any other system that is not a specifically approved method to independently support cables. Cables will not be allowed to rest on ceiling tiles, duct work, piping, etc. Supports will be provided as required in order for cables to avoid contact with any other building system. Bundle cables in groups by Room.

3.12 CABLE PROTECTION

A. Provide bushings in all metal studs and the like where cables will pass through. Bushings will be of two (2)-piece construction with one piece inserted through the opening and the second piece locking it into place. Single piece bushings with locking tabs or friction fit are specifically prohibited.
B. Cables to be installed in existing enclosed open bays or furred spaces where conduit stubs are not provided, will be protected from chafing or any damage. The Installer will verify that the warranty will not be violated before installing any cabling in these locations.

C. Provide cutting, coring, sleeves and bushings and seal as required at all penetrations.

D. Cables damaged during installation will not be repaired. They will be completely replaced with new cable at no cost to the Owner.

3.13 GROUNDING & BONDING

A. Refer to section 27 05 26 for Grounding and Bonding requirements. Work under section 27 05 26 is not anticipated, however; it should be verified in-field that the existing telecommunications infrastructure is properly grounded and bonded per the instructions and standards within this specification section.

3.14 DOCUMENTATION

A. Label all equipment as herein specified.

B. Provide:
   2. Hard copy documentation of test results for every cable segment and link in 3- ring binder. Documents will include measured values as well as whether or not the test passed.
   3. "Record" drawings indicating location of all equipment including but not limited to work area outlets, patch panels, cross connect blocks, on each segment and cable routing. Indicate labeling for each piece of equipment.
   4. Record drawings indicating actual cable routes and outlet identifiers. Provide respective copies mounted in each telecommunications room, and the main cross connect.

C. Provide "as-built" Drawings on AutoCAD Version 12 or higher to the Owner. Obtain copy of original Drawings from the Architect.

D. Submit NRTL certification that the structured cabling system meets the transmission requirements of TIA-568-C.0.

3.15 TRAINING

A. The appropriate Telecommunications Subcontractor shall be responsible for training of facility personnel in accordance with requirements of this Section and Division.

B. Training shall take place within 2 weeks after substantial completion and shall include programs for on-site operations and maintenance of telecommunications and audio/video systems. Training shall be for not more than ten people, shall be held at the Owner's site, and shall be of sufficient duration and depth to ensure that the trained personnel can operate the installed systems and can perform usual and customary maintenance actions.

C. As a minimum training sessions will consist of the following:
   1. General project information and review will be by the General Foreman or Superintendent of the Trade.
2. Specific system training will be by a Factory Trained Representative.
3. Provide a complete review of the project and systems including, but not limited to, the following:
   a. Review each As-Built Drawing (use of ‘typicals’ is acceptable).
   b. Note equipment layouts, locations and control points.
   c. Review each system.
   d. Review system design operation and philosophy.
   e. Review areas served by equipment.
   f. Identify color codes used.
   g. Review features and special functions.
   h. Review maintenance requirements.
   i. Review operation and maintenance manuals.
   j. Respond to questions (record questions and answers).
4. After training, walk the entire project, review each equipment room and typical locations. Explain equipment and proper operation.

D. During the instruction period the Owner and Maintenance Manual will be used and explained.

E. The Owner and Maintenance Manual material will be bound in 3-ring binders and indexed. On the edge of the binder provide a clear see-through plastic holder with a typed card indicating the Project name, the Architect's name, the installer's name and the Volume number (e.g., Vol. No.1 of 2).

F. Provide name, address and telephone number of the Manufacturer’s representative and Service Company for all items supplied so that the source of replacement parts and service can be readily obtained.
   1. Include copies of Manufacturer’s and installer’s warranties and maintenance contracts and performance bonds properly executed and signed by an authorized representative.
   2. Include copies of all test reports and certifications.

3.16 CLEANING

A. In all telecom room spaces - a thorough sweeping, vacuuming and wet mopping shall be performed on a weekly basis or more frequently as directed by the owner. Cleaning shall include floors, rafters, floor joists, exposed structural members, exposed mechanical/electrical equipment and ductwork/piping/conduits, walls, ladder trays, tops of cabinets/racks, existing/new passive and active components, or per manufacturer recommendations.

B. All cable managers and snap covers shall be wiped clean, both inside and outside of front, including rear channels. All clear covers and doors shall be cleaned, both front and rear per manufacturer recommendations.

C. Inside of fiber optic enclosure and patch panels shall be blown clean of settled dust. Cleaning shall be performed for all new construction projects or where gypsum sanding has been performed.

D. NOTE: During installation and prior to final handoff to Owner, keep all open fiber and copper ports covered utilizing plastic or tape that leaves no sticky residual.

E. All scraps, boxes, spools, pull-line and trash shall be removed and properly disposed of.
F. All residual cable lubricant shall be cleaned from floors and walls with an appropriate degreaser.

3.17 PROJECT CLOSEOUT

A. Provide close out submittals as required herein and include the following close out submittals.
   1. Operation and Maintenance Manuals
   2. Record Drawings
   3. Test Reports
   4. Warranty certification from Manufacturer’s
   5. Extra Materials
   6. Provide factory calibration report of field test equipment

B. Obtain written receipts of acceptance close out submittals submitted. Receipts will specifically detail what is being delivered (description, quantity and specification section) and will be dated and signed by firm delivering materials and by the Owner's Representative.

C. Provide As-Built drawings indicating actual cable routing and cable terminations including all required identifiers.

D. Provide a half size laminated set of drawings mounted in the Main Equipment Room.

E. All sketches, drawings, and charts herein are for the purpose of providing for specifications in a simplified format. Errors and omissions in such do not relieve the Contractor of the responsibility for providing a fully complete, secure and properly operating structured cabling system suitable for the intended use. Bidders must obtain a complete set of Project Drawings and Specifications to determine the full scope of work. In case of conflict, the Project Drawings and Specifications will prevail.

END OF SECTION
SECTION 27 05 26

COMMUNICATIONS GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

A. This section governs the products and execution requirements relating to furnishing and installing grounding and bonding for the communication systems, and supplements requirements found in related sections.

B. Specifications and drawing package in its entirety, conditions set forth in base contract, exhibits, etc. as the items pertain to this project.

C. Description of work:
   1. Grounding and Bonding of the existing telecommunications system including horizontal cabling pathways is complete. The scope of work includes verifying that the telecommunications infrastructure is properly bonded and grounded per the following specifications and industry standards.
      a. Coordinate with electrical contractor including:
         1) Pathways, termination points, buss bar locations, and connections to the main electrical service ground and electrical distribution panels, conduit, fittings and bodies; bonding, Grounding cable and fittings; junction boxes; pull boxes; gutters; and measured pull tape.

D. Related Sections:
   1. 270000: Communications
   2. 270820: Copper Testing
   3. 271500: Communications Horizontal Cabling
   4. 271600: Communications Connecting Cords Devices & Adapters

1.2 ADDITIONAL INFORMATION

A. Refer to Section 27 00 00 for Part 1 General information

1.3 RELATED DOCUMENTS

A. The most recent versions of all related documents apply to this project.

B. Comply with the following codes and standards:
   3. IEEE 1100 – 2005 - (Emerald Book) - Recommended Practice for Powering and Grounding Electronic Equipment

C. The following guidelines shall be followed:
1. BICSI, Telecommunications Distribution Methods Manual (TDMM)
2. BICSI, Information Transport Systems Installation Methods Manual (ITSIMM)
3. The following related project specifications shall be followed:
4. Specification 27 00 00 Communications

D. References:
1. American National Standards Institute (ANSI):
   a. C80.1 Rigid Steel Conduit – Zinc Coated.
   b. C80.4 Fittings for Rigid Metal Conduit.

E. Federal Specifications (FS):
1. W-C-58C Conduit Outlet Boxes, Bodies Aluminum and Malleable Iron.
3. WW-C-566C Flexible Metal Conduit.
4. WW-C-581D Coatings on Steel Conduit.

F. National Electrical Manufacturers Association (NEMA):
1. RN1 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Electrical metallic Tubing.
2. TC2 Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
3. TC3 PVC Fittings for Use with Rigid PVC Conduit and Tubing.
4. NEMA VE 1 – Metal Cable Tray Systems.
5. NEMA VE 2 – Metal Cable Tray Installation Guidelines.

2. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Gal annealed) by the Hot-Dip Process.

H. Underwriters Laboratories Inc. (UL):
1. 6 Rigid Metal Electrical Conduit.
2. 514 B Fittings for Conduit and Outlet Boxes.
3. 651 Schedule 40 and 80 Rigid PVC Conduit.
4. 651A Type EB and A Rigid PVC Conduit and HDPE Conduit.
5. 1666 Standard for Riser Application for Optical Fiber Raceway.

I. Local, county, state and federal regulations and codes in effect as of date of purchase.

J. Equipment of foreign manufacture must meet U.S. Codes and standards. It will be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.
1.4 IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

A. The publications listed herein 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 will 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 and contract documents: Comply with the one establishing the more stringent requirements or greater quantity as per context of the document.

1.5 SUBMITTALS

A. The Contractor will perform no portion of the work requiring submittal and review of record drawings, shop drawings, product data, or samples until the respective submittal has been approved by the Owner. Such work will be in accordance with approved submittals.

B. Qualifications: The Contractor will submit qualification data sheets for firms and persons as specified in the “Quality Assurance” article of this specification to demonstrate their capabilities and experience.

C. Proposed product data sheets: The Contractor will submit catalog cut-sheets that include manufacturer, trade name, and complete model number for each product specified. Model number will be handwritten and/or highlighted to indicate exact selection. Identify applicable specification section reference for each product.

D. The following submittals are due at the Pre-Construction Phase, in accordance with submittal requirements in Section 27 00 00 Communications:
   1. Product Information
      a. Provide manufacturer’s product information cut-sheet or specifications sheet with the specific product number identified.
   2. Shop Drawings
   3. Provide scaled drawings (floor plans not less than 1/16" = 1'-0") indicating the location and size, dimensions, type of connection (e.g., mechanical, exothermic weld of each bonding buss bar (e.g., TMGB, TGB), conductor (e.g., BCT, GE, TBB), connections (e.g., lugs), and splice points.
   4. Provide scaled plan and elevation drawings of telecommunications rooms (not less than 1/4" = 1'-0") indicating locations of buss bar (e.g., TMGB, TGB, UBC, RGB).
   5. Bonding and Grounding shall have its own separate drawing(s).

E. The following submittals are due Post-Construction, in accordance with the submittal requirements in Section 27 00 00 Communications:
   1. As-Built Drawings
   2. Furnish CAD drawings of completed work including cable ID numbers following the Owner’s labeling standards. Submit in hardcopy (two full size and two half size) and electronic formats:
a. Provide scaled drawings (floor plans not less than 1/16" = 1'-0") indicating actual location and size/length of TMGB, TGBs, BCT, GE and TBB conductors and all splice points.
b. Provide scaled plan and elevation drawings of telecommunications rooms (not less than 1/4" = 1'-0") indicating actual locations of TMGB and TGBs.
c. Bonding and Grounding shall have its own separate drawing(s).

3. Manufacturer and Maintenance Manuals for all installed equipment. This is to include:
   a. Manufacturer specification sheets (cut sheets) and installation instructions/manuals for all installed products.

4. A letter from the contractor Project RCDD stating that the grounding system has been installed in accordance with the project documents and the referenced codes, standards, and guidelines. This letter is to also specifically acknowledge that the telecommunications grounding system has been fully tested according to these specifications. The required contents of this letter may be incorporated into the letter required from the Project RCDD in section 27 00 00.

1.6 PROJECT CONDITIONS

A. Field Measurements: 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: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

1.7 COORDINATION

A. The Electrical Contractor shall furnish and install telecommunications grounding buss bar, telecommunications bonding backbone(s), grounding equalizer(s), and equipment bonding conductors to install a complete telecommunications grounding system.

B. Field coordinate installation of conduit and cable with other trades to ensure clearance requirements are met.

C. Coordinate with all contractors providing equipment outside the scope of this contract.

PART 2 - PRODUCTS

2.1 GENERAL

A. All components shall be listed by a NRTL.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work are included in each product type, but are not limited to those listed.
2.2 TELECOMMUNICATIONS MAIN GROUNDING BUSS BAR (TMGB)

A. Provide a telecommunications main grounding buss bar (TMGB) at the telecommunications service entrance (or as indicated on the drawings).

B. The TMGB shall be located within each building entrance point (BDF) or main telecommunications equipment room

C. The TMGB shall:
   1. Be a predrilled copper buss bar with holes for use with correctly matched Listed lugs and hardware.
   2. Have minimum dimensions of 0.25” thick by 4” wide by 20” long. Increase length as necessary to provide all connections plus 25% spare capacity.
   3. Be listed by a NRTL.
   4. Be manufactured by:
      a. Chatsworth P/N 40153-020
      b. Or approved alternate

2.3 TELECOMMUNICATIONS GROUNDING BUSS BAR (TGB)

A. Provided a telecommunications grounding buss bar (TGB) in each telecommunications room.

B. The TGB shall:
   1. Be a predrilled copper buss bar with holes for use with correctly matched listed lugs and hardware.
   2. Have minimum dimensions of 0.25” thick by 4” wide by 10” or 12” long. Increase length as necessary to provide all connections plus 25% spare capacity.
   3. Be listed by a NRTL.
   4. Be manufactured by:
      a. Chatsworth P/N 40153-012
      b. Or approved alternate

2.4 BONDING CONDUCTOR FOR TELECOMMUNICATIONS (BCT)

A. BCT shall:
   1. Be copper must be insulated with green insulation
   2. Be Listed for the application when insulated.
   3. As a minimum, the same size as the largest TBB.

B. The manufacturer shall be:
   1. Harger
   2. Or approved equivalent

2.5 TELECOMMUNICATIONS BONDING BACK BONE (TBB)

A. The TBB shall:
   1. Be copper and may be insulated.
   2. Be Listed for the application when insulated.
   3. Be sized at 3 kcmil per linear foot of conductor length up to a maximum size of 750 kcmil.
2.6 RACK BONDING CONDUCTOR (RBC)

A. An RBC shall:
   1. Be copper and may be insulated.
   2. Be Listed for the application when insulated.
   3. Be sized as a No. 6 AWG.

B. The manufacturer shall be:
   1. Hager
   2. Or approved equivalent

2.7 RACK GROUNDING BUSS BAR (RGB)

A. Description: grounding Strip for 2-post and 4-post Communications Racks.

B. A RGB shall:
   1. Be wrought copper and tin plated.
   2. Be capable of supporting multiple unit bonding conductors.

C. The manufacturer shall be:
   1. Hager
   2. Panduit, Grounding Strip Kit, RGS134-1Y
   3. Or approved equivalent

2.8 GENERAL BONDING CONDUCTORS OR JUMPERS

A. Provide and install general bonding conductors and jumpers per construction documents.
   Refer to drawings and execution section for required locations.

B. For all conductors and jumpers connecting equipment located in the same room as the
   TMGB/TGB, conductors/jumpers shall be in a green insulated jacket. This jacket shall include
   markings that indicate conductor size (minimum of #6 AWG), manufacturer and UL listing.

C. Manufacturer shall be:
   1. Hager
   2. Panduit
   3. Or approved equivalent

2.9 BONDING ACCESSORIES

A. Grounding Lugs
   1. Shall be Listed for the application.
   2. Shall be two holes compression crimp with inspection window, unless otherwise noted.
   3. Copper or tin plated copper.
   4. Manufacturers shall be:
      a. Erico, Cadweld Telecom Lugs
      b. Hager
      c. Framatome Connectors/Brundy Electrical.
      d. Panduit
      e. Or approved equivalent
B. Unit Bonding Conductor (UBC)
   1. Shall be Listed for the application.
   2. Shall be a minimum No. 12 AWG
   3. Copper with 90-degree bent lugs installed.
   4. Manufacturers shall be:
      a. Erico, Cadweld Telecom Lugs
      b. Hager
      c. Panduit
      d. Or approved equivalent

2.10 MATERIALS

A. All conduits, fittings, junction and pull boxes will be UL rated.

B. All conduits, fittings, junction and pull boxes will comply with the NEC.

C. PVC-Coated Rigid Steel Conduit and Fittings: Follow NEMA RN1 (Type A).

D. Non-metallic Conduit and Fittings: Pass NEMA TC2, UL 651 and 651A and FS W-C- 1094A. EMT fittings will be formed steel compression ring type. Die cast fittings are not allowed.

E. Rigid Steel Galvanized Conduit and Fittings Before Coating
   1. Follow FS WW-C-581d, ANSI C80.1, and UL 6.
   2. Pass bending, ductility, and thickness of zinc coating in ANSI C80.1.

F. Electrical Metallic Tubing (EMT):
   1. EMT fittings will be formed steel compression ring type. Die cast fittings are not allowed.
   2. EMT will be UL listed and conform to NEC Article 300.22.
   3. Will be used inside buildings only.
   4. Only manufacturer’s fittings, transition adapters, terminators and fixed bends will be used.
   5. All transition junction and pull boxes, fittings terminators and adapters will be a metallic material.
   6. Minimum average tensile strength will be 1250 lbs. For 1½-inch and smaller conduits and inner duct.
   7. Minimum average tensile strength will be 1800 lbs. For conduits larger than 1½ inch.

G. Conduit Bodies: Follow UL 514B and FS W-C-58C. Furnish sufficient coating for touch up after installation.

H. Conduit Fittings
   1. All fittings will be compression or threaded.
   2. Fittings will provide a secure connection for pulling communications cables.
   3. Setscrew fittings are not permitted.

I. Conduit “condulets” are not permitted. Smart LB’s are permitted.

J. Flexible conduit is not permitted.

K. Non-metallic conduits are not permitted in above ground installations. Conversion fittings are required for non-metallic (below ground) to metallic (above ground) transitions.
L. Buss bars:
   1. Electrotin-plated for reduced contract resistance

M. Telecommunications Bonding Backbone (TBB)
   1. All Telecommunications Bonding Backbone (TBB) Cables will be insulated and installed
      in conduit between manholes, telecommunications closets, building steel frame and
      building electrical grounding system.
   2. TBB cables will interconnect all Telecommunications Grounding Buss bar (TGB) with
      the Telecommunications Main Grounding Buss bar (TMGB). The TBB will originate at
      the TMGB and extend throughout the building and connects to all the TGB’s in
      telecommunications closets and equipment rooms.
   3. The TBB will be installed without splices, where practicable
   4. Joined segments (conductors to buss bars) will be connected using irreversible connectors
      such as exothermic welding or equivalent.
   5. The TBB will be sized per table below. The TBB from TGB to the panel board in the
      same telecommunications space will be No. 6 AWG. All TBB connections to the TGB
      will utilize exothermic weld connectors.
   6. Approved bonding (Exothermic welds or double lug crimp) will be used to connect TBB
      from TMGB or TGB and building steel frame. All other connections will use 2-hole
      compression connectors.
   7. UL Listed with Flame Propagation compliant with UL 2024.

N. Antioxidant Joint Compound for use with copper to copper bonding
   1. Approved manufacturer: Harger P/N HCAJC8

O. Pull Boxes, Junction Boxes and Gutters
   1. All junction boxes, gutters and pull boxes will comply with NEC Article 314.
   2. All junction boxes, gutters and pull boxes will meet the following minimum material
      requirements:
      a. 16-gauge steel or heavier.
      b. Seams will be continuously welded and ground smooth.
      c. External screws and clamps.
      d. External mounting feet (where possible).
      e. Oil-resistant gasket and adhesive.
      f. ANSI 61 gray polyester powder coating inside and out over phosphatized surface.
      g. UL 50 type 12.
   3. All junction boxes, gutters and pull boxes will be provided with bushings for conduits
      and/or cabling.
   4. All junction boxes, gutters and pull boxes will be securely installed.
   5. All junction boxes, gutters and pull box sizes for single and multiple conduit runs will
      comply with BICSI TDMM.
   6. All bonding conductors and connectors will be listed for the purpose intended and
      approved by a Nationally Recognized Testing Laboratory (NRTL).
   7. All bonding conductors will be insulated and copper. The minimum bonding conductor
      size will be a No. 6 AWG.
PART 3 - EXECUTION

3.1 GENERAL

A. Locate TMGB and TGBs so that they are permanently accessible to telecommunications personnel.

B. At a minimum, follow all manufacturer instructions. In case of discrepancy between manufacturer and contractor requirements, the more stringent shall apply. In the case of conflicting instructions, report any discrepancy to the Design Engineer in a timely fashion so as not to impact the construction timeline.

C. At a minimum, provide exothermic welds as identified on the drawings or required in the specifications. For all other connections, irreversible compression connections are sufficient.

D. Identification
1. All telecommunications grounding and bonding conductors shall be labeled within 6” of each end. Labels shall be nonmetallic and read as follows:

IF THIS CONNECTOR OR CABLE IS FOUND TO BE LOOSE OR MUST BE RECONFIGURED OR REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER PRIOR TO ANY FURTHER WORK

E. Testing
1. All grounding connections shall be tested for continuity and resistance after installation but prior to substantial completion. Refer to drawings for grounding riser and test measures. The telecommunications contractor is to invite the Design Engineer and ITS representative to witness a portion of this testing while it is being performed.

2. The test performed shall use an earth ground resistance tester that is configured for a continuity test otherwise known as a two-point test or a “dead earth” test. Tests shall be conducted between the electrical entrance ground and the TMGB as well as at each TGB. This resistance shall be less than 0.050ohms.

3. Coordinate with the electrical installer for the test of the Building’s Grounding Electrode System and its resistance at earth. It is recommended that this resistance measure be equal to or less than 5 ohms. Include in the grounding test report the measured resistance at the Building’s Grounding Electrode System as reported by the entity performing the test.

3.2 TMGB

A. All metallic raceways for telecommunications cabling located within the same room or space as the TMGB shall be bonded to the TMGB.

B. Insulate the TMGB 2” from the wall.
C. For outside plant cables entering a building with a cable shield isolation gap, bond the cable shield (on the building side of the gap) to the TMGB. Outside plant protectors shall be bonded to the TMGB with a No. 6 AWG conductor.

D. Connections to the buss bar shall be made with 2-hole lugs.

E. Connections shall be made by cleaning the area of connection on the buss bar and on the two-hole lug and then applying a thin coating of anti-oxidant compound.

3.3 TGB

A. All metallic raceways for telecommunications cabling located within the same room or space as the TGB shall be bonded to the TGB.

B. Insulate the TGB 2" from the wall.

C. Connections to the buss bar shall be made with 2-hole lugs.

D. Connections shall be made by cleaning the area of connection on the buss bar and on the two-hole lug and then applying a thin coating of anti-oxidant compound.

3.4 BCT

A. Route BCT in conduit from telecommunications service entrance room to the main electrical service ground connection.
   1. Label conduit at telecommunications service entrance with tag or adhesive label that states "Building Conductor for Telecommunications (BCT) to Main Electrical Service Ground Connection".
   2. Label conduit at main electrical service ground connection with tag or adhesive label that states "Building Conductor for Telecommunications (BCT) to Telecommunications Main Grounding Buss bar (TMGB)".
   3. BCT shall not be run in a metallic conduit and shall not be completely encircled by metallic clamps.

3.5 TBB

A. Where following the same routing as cable tray, attach TBB on the outer side of the cable tray to minimize contact with communications cabling.

B. Size the grounding conductors according to the following table, except as it varies in the grounding riser diagram:

<table>
<thead>
<tr>
<th>TBB Length in Linear meters (feet)</th>
<th>TBB Size AWG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 4 (13)</td>
<td>6 (16mm²)</td>
</tr>
<tr>
<td>4-6 (14-20) 4</td>
<td>4 (25mm²)</td>
</tr>
<tr>
<td>6-8 (21-26)</td>
<td>3 (25mm²)</td>
</tr>
<tr>
<td>8-10 (27-33)</td>
<td>2 (35mm²)</td>
</tr>
<tr>
<td>10-13 (34-41)</td>
<td>1 (35mm²)</td>
</tr>
<tr>
<td>13-16 (42-52)</td>
<td>1/0 (50mm²)</td>
</tr>
<tr>
<td>16-20 (53-66)</td>
<td>2/0 (70mm²)</td>
</tr>
</tbody>
</table>
3.6 GENERAL BONDING CONDUCTORS OR JUMPERS

A. General bonding conductors or jumpers are to be utilized in each telecommunications room between the TMGB/TGB and the following components:
   1. The communications building entrance protectors.
   2. Electrical panel board (if in same room as TMGB/TGB).
   3. Building steel (if available in same room as TMGB/TGB).
   4. Telecommunications ladder rack and cable tray.
      a. Bonding jumpers are to be utilized to ground adjacent pieces of ladder rack and cable tray together, reducing the need to a single conductor back to the TMGB/TGB.
      b. In cases where ladder rack or cable tray is painted, prepare each section by removing paint at the connection point to ensure a completely bonded connection. If the contractor believes this is not necessary, submit documentation from manufacturer indicating NRTL testing was done in regards to grounding without removal of the paint.
   5. Telecommunications equipment racks and cabinets.
      a. Each cabinet and rack shall be bonded to the TMGB/TGB by bonding to the row’s bonding conductor with a #6 AWG RBC from the Rack Grounding Buss bar (RGB). All conductors are to be of equal length and bonded with non-reversible bonds.
      b. In cases where racks or cabinets are painted, prepare each item by removing paint at the connection point to ensure a completely bonded connection. If the contractor believes this is not necessary, submit documentation from manufacturer indicating NRTL testing was done in regards to grounding without removal of the paint.
      c. Bond adjacent racks and cabinets in an approved manner with #6 AWG insulated green conductor.
      d. Telecommunications Equipment Bonding Conductor (TEBC) bonds components within a rack or cabinet. Install a minimum of #12 AWG insulated green conductor.

B. Row bonding conductor
   1. Install the rack or cabinet row bonding conductor sized as indicated on bonding riser and bonding detail.
   2. The default size for row bonding conductors is #2/0 AWG.

3.7 GROUNDING LUGS

A. Wires shall be inserted to the full depth of the lug.

B. Space between wire insulation and the body of the compression lug shall be kept to a maximum of 1/4 inch.

C. Lug must agree with wire size.
D. To assure proper die is used with the specified connector, manufacturer’s embossed coding systems shall be adhered to.

E. Connectors shall not be modified in any way.

F. Daisy chaining and stacking (piggy backing) of ground lugs is prohibited.

G. Bolts, nuts, washers used to secure ground connections shall match the diameter of the hole.

3.8 PREPARATION

A. Contractor’s on-site RCDD supervisor will review, approve and stamp all shop drawings, coordination drawings and record drawings.

B. Verify conduit system is properly sized for cables (minimum one inch, unless otherwise noted in Drawings).

C. Verify general conduit route following Drawings.

D. Verify substrates to which work is connected and determine detail requirements for proper support.

E. Verify proper location and type of rough-in for conduit, cable terminations and ground buss bar.

3.9 INSTALLATION

A. Coordinate locations with other trades prior to installation.

B. Install work following drawings, manufacturer’s instructions and approved submittal data.

C. Installation plans and requests for information (RFIs) will be reviewed by contractor’s on-site RCDD.

D. All work will be supervised and reviewed by contractor’s on-site RCDD.

E. Check all bonds for loose connections in walk-thru prior to testing system.

F. Test bonding of system for all metallic components back to buss bar for conformance to a 0.01 ohms maximum resistance.

G. Locations and Types:
   1. Install PVC coated conduits in outdoor above-ground locations, inside valve vaults and wet wells, and in corrosive and wet environments.
   2. Install PVC conduits in buried duct banks or encased in concrete. Use PVC coated rigid steel for footing, slab, or other stub-outs.
   3. Install exposed conduit parallel or perpendicular to lines of existing construction and grouped together where possible, without interfering with use of premises or working areas. Prevent safety hazards and interference with operating and maintenance procedures.
   4. Conduit may pass through areas with temperature differential of 20 degrees F or more. Seal with proper fitting at barrier between areas of differing temperature.
5. Do not install conduit in interference with equipment placement or operation; piping; structural members; maintenance access; indicated future equipment.
6. Contractor’s RCDD supervisor will coordinate with drawings of other disciplines to determine availability of space for installation.

H. Design Considerations
1. Conduit fill will comply with ANSI/TIA/EIA-569-C.
2. The minimum bend radius is ten (10) times the conduit outside diameter (OD) for conduits 2” and greater.
3. Below grade conduit will extend four inches above finished floor (AFF) with a bushing.
4. Ceiling conduit or sleeves will extend six inches below finished ceiling with a bushing.
5. All stubbed conduit ends will be provided with a ground bushing.
6. All conduit penetrations will comply with all applicable fire codes. All conduit penetrations in fire-rated walls or floors will be sealed and fire proofed to at least the rating of the penetration area.
7. Conduits will be routed in the most direct route, with the fewest number of bends possible.
8. There will be no continuous conduit sections longer than 100 feet. For runs that total more than 100 feet, insert junction or pull boxes (or gutters if appropriate) so that no continuous run between pull boxes is greater than 100 feet.
9. There will be no more than two 90-degree bends (180 degrees total) between conduit pull boxes.
10. Changes in direction will be accomplished with sweeping bends observing minimum bend radius requirements above. Do not use pull boxes for direction changes unless specifically designated otherwise in the Drawings.
11. Unless otherwise noted in the Drawings, conduits entering pull boxes will be aligned with exiting conduits.

I. Telecommunication Bonding Backbone (TBB) Installation
2. TBB placed in ferrous metallic conduit that exceeds 1m (3 ft.) in length, will be bonded to each end of the conduit with a conductor sized as a NO. 6AWG, minimum.
3. The TBB conductor for telecommunications will bond the TMGB to the service equipment (power) ground.

J. Antioxidant Joint Compound for use with copper to copper bonding
1. Utilize for copper to copper connections, copper threads and all grounding/bonding applications

K. Identification: Refer to Section 27 00 00 for labeling requirements.

3.10 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. Acceptance will be subject to completion of all work and submittal and approval of complete as-built documentation as described above, and MAA final inspection of the work for compliance with the approved as-built documentation.
END OF SECTION
SECTION 27 08 20
COPPER TESTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes: Products and execution requirements relating to testing and documentation for copper cabling for the communication systems, and supplements requirements found in related sections.

B. Test measurements shall be taken for all balanced-twisted pair cabling, including horizontal and backbone copper cables and wall-to-rack cables. Test all category cables in accordance with current TIA measurement specifications for that category of cabling with a field-test instrument meeting or exceeding Level III
test accuracy. Provide test measurement results (in electronic format) a minimum of three weeks prior to substantial completion.

1.02 RELATED DOCUMENTS

A. Related Sections:
   1. 270000: Communications
   2. 270526: Grounding and Bonding of Communication Systems
   3. 270810: Optical Fiber Testing and Measurement
   4. 271100: Communications Equipment Room Fittings
   5. 271300: Communications Backbone Cabling
   6. 271500: Communications Horizontal Cabling
   7. 271600: Communications Connecting Cords Devices & Adapters

B. The latest versions of the following codes, standards, and guidelines shall be followed. Bring to ITS immediate attention where construction documents or conditions differ from requirements in codes, standards, guidelines and specifications.

C. The following standards:
   1. ANSI/TIA-568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standard
   2. ANSI/TIA-1152 – Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
   3. TIA TSB-155-A - Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T

D. The following guidelines:
   1. BICSI, Telecommunications Distribution Methods Manual (TDMM)
   2. BICSI, Information Transport Systems Installation Methods Manual (ITSIMM)

1.03 QUALITY ASSURANCE

A. All testing procedures and field-test instruments shall comply with applicable requirements of referenced standards.
B. Test measurements shall be performed by trained technicians who have successfully attended manufacturer training or BICSI Installer 2 copper training.

C. The Owner or the Owner’s Representative shall be invited to witness, review or both witness and review field-testing.
   1. Notify Owner’s Representative and Design Engineer of the testing start date, five (5) business days before testing commences.
   2. After final test measurements have been completed and submitted, the Owner’s Representative or Design Engineer will select a random sample of up to 10% of the installed links that the telecommunications contractor is to retest at no cost to the Owner. If more than 2% of the sample results differ in terms of the pass/fail determination, the contractor, under supervision of the Owner’s Representative, shall repeat 100% of the testing at no cost to the Owner.

1.04 SUBMITTALS

A. The following submittals are due at the Pre-Construction Phase, or prior to start of testing, in accordance with submittal requirements in Section 27 00 00 Communications:
   1. Names of individuals that will be performing the testing and their training certificates (from BICSI or manufacturer).
   2. Manufacturer’s cutsheet or specifications sheet for the field-test instrument to be used, along with calibration data sheet, including date of calibration.
   3. Sample Test Report, which shall show that the field-test instrument software and firmware is up-to-date (the most recent version). This sample test report shall also show all required test parameters as required by the referenced standards.

B. The following submittals are due a minimum of three weeks prior to substantial completion, in accordance with the submittal requirements in Section 27 00 00 Communications:
   1. Complete test measurement results indicating that all cable permanent links have passed. Submit (2) electronic versions on (2) CD/DVD-R or USB Flash Drive (one for the Owner’s Representative and one for the Design Engineer):
      a. Microsoft Excel 2007 (Manifest)
      b. Test measurement results in their native format and the manufacturer’s PC software to read test results.
      c. Test shall be organized by media in binders with index and pagination
      d. Manufacturer factory cable spec sheet and test results for shipped cable.

C. The following submittals are due Post-Construction, in accordance with the submittal requirements in Section 27 00 00 Communications:
   1. On final electronic file submittal (CD/DVD-R or USB Flash Drive), which is to include record drawings, O&M manuals, etc., also include files for all valid test results (as submitted previously).

PART 2 - PRODUCTS

2.01 FIELD-TEST INSTRUMENT

A. The field-test instrument shall:
   1. Be calibrated field-test instruments as recommended by the manufacturer, or at least within one year of project test measurements.
2. Contain the most recent software and firmware provided by the manufacture prior to testing.
3. Be Level IIIe accuracy.

B. Administration
1. The test measurement result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test.
2. The test result records saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records.

C. Approved Products:
1. Fluke DSX-5000 and all associated modules
2. Or Pre-Approved Equivalent: Provide supporting documentation that substantiates claim.

PART 3 - EXECUTION

3.01 GENERAL

A. All outlets, cables, patch panels and associated components shall be fully assembled, secured/affixed to final mount location, and labeled prior to field-testing. Any test measurements performed on incomplete systems shall be redone on completion of the work.

B. Tester shall be configured with the manufacturer and model number of cable and connectors, where applicable.

C. The installed twisted-pair links shall be tested from the telecommunications room to the telecommunication wall outlet in the work area for compliance with the “Permanent Link” performance specification.

D. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. The test equipment (tester), including the appropriate interface adapter, shall comply with the accuracy requirements for Level IIIe field-test instruments as defined in ANSI/TIA-1152. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 2 of ANSI/TIA-1152 (Table 2 in this TIA document also specifies the accuracy requirements for the Channel configuration).

E. One hundred percent of the installed cabling links shall pass the requirements of the referenced standards. Diagnosed and correct any failing link.
1. Note and follow with a new test measurement the corrective action to prove that the corrected link meets the performance requirements.

F. A PASS or FAIL result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field-test instrument manufacturer must provide documentation as an aid to interpret results marked with asterisks. To which extent '*' results shall determine approval or disapproval of the element under test shall be defined in the relevant detail specification, or agreed on as a part of a contractual specification.
G. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. Any FAIL, FAIL* or PASS* result is considered a FAIL for the link-under-test for this contract. In order to achieve an overall Pass condition, the results for each individual test parameter must yield a rating of PASS. The “*” shall not be turned off on the test instrument.

H. The records for each cable test measurement shall be provided to the owner a maximum of two weeks after substantial completion in Excel format (manifest) and the native format to the field-test instrument. The Owner can supply an Excel spreadsheet template (manifest) upon request for the contractor’s use.

3.02 PERFORMANCE TEST PARAMETERS

A. Test parameters for category 3 Cables:
   1. Wire map
   2. Length
   3. Propagation delay
   4. Delay skew
   5. DC Loop Resistance

B. Test parameters for Category 5e cables (up to 100 MHz) and Category 6 cables (to 250 MHz):
   1. Wire Map
   2. Length
   3. IL - Insertion Loss
   4. NEXT – Near End Cross-Talk
   5. PSNEXT - Power Sum Near End Crosstalk
   6. ACRF - Attenuation to Crosstalk Ratio – Far End
   7. PSACRF - Power Sum Attenuation to Crosstalk Ratio – Far End
   8. Return Loss
   9. Propagation Delay
   10. Delay Skew
   11. DC Loop Resistance for balanced and unbalanced signals
       a. Max 21 ohms

C. Test parameters for Category 6A cables (up to 500 MHz):
   1. Wire Map
   2. Length
   3. IL - Insertion Loss
   4. NEXT – Near End Cross-Talk
   5. PSNEXT - Power Sum Near End Crosstalk
   6. ACRF - Attenuation to Crosstalk Ratio – Far End
   7. PSACRF - Power Sum Attenuation to Crosstalk Ratio – Far End
   8. PSANEXT - Power Sum Alien Near End Crosstalk
   9. PSAACRF - Power Sum Alien Attenuation-to-Crosstalk-Ratio from the Far End
   10. RL - Return Loss
   11. Propagation Delay
   12. Delay Skew
   13. DC Loop Resistance for balanced and unbalanced signals
       a. Max 21 ohms

D. Alien Crosstalk sampling
1. Shall be performed for Category 6 cables used for 10Gb/s, and all Category 6 cables in the same bundle as well as adjacent links, using a sampling plan. An acceptance quality level (AQL) of 0.4 %, normal inspection, general inspection level I as defined in ISO 2859-1 for populations of up to 500,000 links shall be used. The following table represents this sampling level:

<table>
<thead>
<tr>
<th>Total number of links (N)</th>
<th>Sample size (No. of links to test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 – 33</td>
<td>3 or 0.1 x N (whichever is greatest)</td>
</tr>
<tr>
<td>34 – 3,200</td>
<td>33</td>
</tr>
<tr>
<td>3,201 – 35,000</td>
<td>126</td>
</tr>
<tr>
<td>35,001 – 150,000</td>
<td>201</td>
</tr>
<tr>
<td>150,001 – 500,000</td>
<td>315</td>
</tr>
</tbody>
</table>

E. Test parameters for other cables:
1. Continuity to the remote end;
2. Shorts between any two or more conductors;
3. Crossed pairs;
4. Reversed pairs;
5. Split pairs; and,
6. Any other miss-wiring.

3.03 CATEGORY 6A FIELD INSTALLABLE MODULAR PLUG

A. Modular plugs shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.

B. 100% of all installed cable segments shall be tested, partial or sample testing shall not be acceptable.

C. Test procedure shall adhere to the method for testing a Modular Plug Terminated Link as described in TIA-568.2-D Annex F.

D. The MPTL shall be tested with a Permanent Link Adapter on the Main Unit and a Patch Cord Adapter Suitable for Category 6A testing on the Far End or Remote Test Equipment. Channel adapters shall not be used.

E. Test limits shall be set to meet the MTPL performance requirements defined in TIA-568.2-D Annex F.

F. The patch cord adapter used on the far end of the MPTL shall meet the requirements for Category 6A patch cord test head as qualified per TIA 568.2-D Annex C or D.

G. The detailed test results are to be provided to owner and submitted electronically to Manufacturer for warranty acceptance for each tested link and shall contain the following information
1. The overall Pass/Fail evaluation of the link-under-test
2. The date and time the test results were saved.
3. The identification of the customer site as specified by the end-user
4. The name of the test limit selected to execute the stored test results
5. The name of the person(s) performing the test
6. The version of the test firmware and the version of the test limit database held within the test instrument
7. The manufacturer, model and serial number of the field-test instrument
8. The adapters used
9. The factory calibration date
10. Specific performance tests shall include:
   a. Wire Map
   b. Propagation Delay values, for all four pairs
   c. Delay Skew values, for all four pairs
   d. DC Resistance values, for all four pairs
   e. Insertion Loss, worst case values for all four pairs
   f. NEXT, worst case margin and worst case values, both directions
   g. PS NEXT, worst case margin and worst case values, both directions
   h. ACR-N, worst case margin and worst case values, both directions
   i. PS ACR-N, worst case margin and worst case values, both directions
   j. ACR-F, worst case margin and worst case values, both directions
   k. PS ACR-F, worst case margin and worst case values, both directions
   l. Return Loss, worst case margin and worst case values, both directions
   m. Time domain Crosstalk data if the link is marginal or fails
   n. Time Domain Reflectometer data if the link is marginal or fails

3.04 ADMINISTRATION

A. Test results documentation
   1. Test results saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e., “as saved in the field-test instrument”.
   2. The test results documentation shall be available for inspection by the Owner or the Owner’s representative during the installation period. The contractor shall retain a copy to aid preparation of as-built information.
   3. The records for each test shall be provided to the owner a maximum of one week after substantial completion in Excel format and the native format to the test instrument. The Owner can supply an Excel spreadsheet template upon request for the contractors use.
   4. Circuit IDs reported by the field-test instrument shall match the label ID specified by the Owner.
   5. The detailed test results documentation data is to be provided in an electronic database for each tested link and shall contain the following information
      a. The identification of the customer site as specified by the end-user
      b. The name of the standard selected to execute the stored test results
      c. The name of the test personnel
      d. The date and time the test results were saved in the memory of the tester
      e. The manufacturer, model and serial number of the field-test instrument
      f. The version of the test software and the version of the test standards database held within the test instrument
      g. The copper identification number
      h. The length for each copper cable
      i. The overall Pass/Fail evaluation of the channel test.
   6. Provide summary report of all cables tested in PDF format.
   7. Provide full tester report for each cable tested in PDF format.
8. Ensure that sweep frequency measure graphs are included in reports.

B. As indicated in 27 00 00, all documentation will be provided in soft and hard bound copies. Hard copies are to be included in an indexed binder with each test or document residing in its own section and listed in the table of contents for easy reference.

END OF SECTION
SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLEING

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes information on horizontal communications cabling supplementing requirements found in the related sections.

B. Most of the campus horizontal cabling is installed and functional. The scope of work includes verification of functionality of the existing horizontal cabling as it pertains to areas of renovation within the project (as indicated on the plans).
   1. Contractor shall provide and furnish all necessary cabling system accessories required for a fully-functional horizontal cabling system for the renovated areas of the project. Refer to plans for more information.

C. Related Sections
   1. 270000: Communications
   2. 270526: Grounding and Bonding of Communication Systems
   3. 270820: Copper Testing
   4. 271100: Communications Equipment Room Fittings
   5. 271600: Communications Connecting Cords Devices & Adapters

1.02 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

A. Conduit and EMT required for Communications cabling pathway in/out of cross connect closets and in/out of wall cavities at the work area where ceiling is inaccessible.

B. Rings (and strings) with conduit connecting tabs for the mounting of NEMA rated faceplates where required.

C. Drag line or pull string at the ring fished through EMT or conduit to the other end for installing 4 pair and multi-pair cables.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all the required material whether specifically addressed in the Specification or not. Verify in-field and with the Owner’s IT representative that the existing in-place telecommunications horizontal cabling system is fully operational.
   1. The horizontal portion of the telecommunications cabling system extends from the work area outlet (WAO) to the termination to the nearest Telecommunications Room. Refer to the drawings for more information regarding locations.

B. This document specifies the products and methods of execution required to support a Category 6A Modular Plug Terminated Link (MPTL) in accordance with TIA 568.2-D Annex F. The use of a MPTL should be limited to those applications where termination of horizontal cables on a
Telecommunications Outlet (jack) has been determined to be impractical and when the device being serviced is not often moved or rearranged.

1.04 SYSTEMS DESCRIPTION

A. Horizontal copper cabling system consists of rated cables with four unshielded twisted pairs of solid annealed copper wrapped in plenum rated insulation with an overall plenum rated jacket with a wire thickness of 23 AWG. Each four-pair cable is terminated onto 8 position 8-conductor rated connectors using 110 style IDCs. Connectors are placed into NEMA rated faceplates at the work area and placed into rack mounted patching panels in the equipment / networking rooms.

B. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
   1. TIA-568 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
   2. Horizontal cabling will contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
   3. Bridged taps and splices will not be installed in the horizontal cabling.
      a. A work area includes the components that extend from the telecommunications outlet/connectors to the station equipment.
      b. The maximum allowable horizontal cable length is 290 feet. This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 18 feet in the horizontal cross-connect.

1.05 MANUFACTURER QUALIFICATIONS

A. Manufacturer shall be a telecommunications product manufacturer with at least 20 years of experience.

B. Manufacturer shall be ISO 9001 certified manufacturer and shall employ Six Sigma methodology in its manufacturing process.

C. Where a specific manufacturer is called out by name, this is the preferred standard. If substitutions are allowed, they are at the discretion of the Owner and based on performance, suitability, quality, administrative requirements, warranty and other factors deemed important to the Owner.

D.

1.06 TESTING AGENCY QUALIFICATIONS

A. Independent testing agencies shall be nationally recognized as having the expertise to independently verify copper and optical fiber cabling systems and components.

B. Testing Agency Qualifications: Must be a NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
C. 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.

D. Telecommunications Pathways and Spaces: Comply with TIA-569.

E. Grounding: Comply with TIA-607.

1.07 WARRANTY

A. Contractor shall provide a 1 year parts and labor warranty against defective workmanship and/or system component failure.

B. Contractor shall execute a Limited Lifetime Product & Performance Warranty covering all components, equipment and workmanship which shall be provided to the Owner, submitted in writing with system documentation. The warranty period shall begin on the system’s first use by the owner.

C. Horizontal channels shall be completed with end to end solutions, such as the Berk-Tek Leviton Technologies Solutions. Factory-terminated copper and/or fiber optic patch cords from the solutions provider must be used in order to be eligible for the applicable channel performance guarantees.

D. As further described below, the “Supplier” shall warrant to the customer (“Buyer”) that the CAT 6 certified network installations will exceed the defined TIA-568 series industry specifications in force at the time of product purchase. Furthermore, the products that comprise the certified Cabling System will meet or exceed the applicable product performance specifications in effect at the time of manufacture.

E. This warranty covers the copper and fiber optic permanent links of the network as defined by TIA-568 which includes the cable and connecting hardware. This warranty will be extended to include the entire channel provided that the applicable patch cords and equipment cords are utilized, and all products are installed within areas protected from outside elements.

PART 2 - PRODUCTS

2.01 GENERAL

A. The Electrical Code referred to in these specifications is the National Electrical Code as currently adopted by the State of CA. All work will be provided in strict compliance with the Electrical Code and all regulations that may apply.

B. Where standards exist, for a particular category, products used on this project will be listed by an OSHA approved Nationally Recognized Testing Laboratory (NRTL), and be approved or listed for the intended service and application.

C. These specifications do not undertake to repeat the requirements of codes, regulations or NRTL listing or labeling instructions. The Specifications or Drawings may require items or work beyond the requirements of applicable codes or regulations. The stricter, higher quality, greater quantity or higher cost will be provided. It is incumbent on the Installer, material and equipment
suppliers to meet these specifications, applicable codes, regulations, and NRTL listing agency restrictions.

2.02 MANUFACTURER

A. The word "Manufacturer" will include the Manufacturer, the Manufacturer’s Representative, the Distributor, the Fabricator, and the Supplier of the particular classification of equipment, system, product, and material.

B. All work, equipment, and systems will be manufactured, provided, repaired, installed, and tested in accordance with the latest edition and all current amendments of the applicable publications and standards of the organizations listed below as of the date of the Contract Documents. When the Specification requirements exceed the requirements of these publications and standards the Specifications will govern:
1. State Building Code (SBC)
2. Building Department Inspectional Services
3. American Society for Testing and Materials (ASTM)
4. Underwriter's Laboratories, Inc. (UL)
5. Insulated Cable Engineers Association (ICEA)
6. National Electrical Manufacturers Association (NEMA)
7. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
8. American National Standards Institute, Inc. (ANSI)
9. National Fire Protection Association (NFPA)
10. Local Electric Code
11. Department of Public Safety (DPS)
13. Department of Labor USA. Safety and Health Regulations for Construction (OSHA)
14. Energy Codes
15. National Electrical Contractors Association (NECA)
17. Federal Communications Commission (FCC)
18. Utilities Serving Project.
19. Fire Department.
22. Any and all Federal, State and Local Standards, Codes and Authorities having Jurisdiction.
23. In addition, all phases of the Structured Cabling System installation will adhere to applicable Local Area Network (LAN) Specifications of the Institute of Electrical and Electronics Engineers (IEEE), Electronics Industry Association/Telecommunications Industry Association (TIA/EIA), American National Standards Institute (ANSI), and Building Industry Consulting Service International (BICSI). The entire system and all components will be NRTL certified to appropriate TIA/EIA performance rating Category. Latest TIA Standards 455, 492.CAAAB, 492.AAAC, 492.AAAD, 568, and (SP-4195-B and SP-4195-B-1), 569, 570, 606, 607 and 758 (latest revisions), TIA/EIA TSB 67, TSB 72, TSB 75, TSB 95 and other standards as applicable.

C. The Installer will have available at the job site at all times one copy of the latest edition of the Electrical Code, TIA and BICSI Standards applicable to the work as specified within this document.
D. The above requirements will not in any way limit responsibility or requirements to comply with all other codes, standards and laws.

E. Material, equipment, enclosures, and systems will be designed for use as required to suit the conditions, exterior or interior operation, dust tight, water tight, explosion-proof, or other special types.

2.03 UTP PIN/PAIR TERMINATION ASSIGNMENT

A. The UTP cabling systems will have TIA/EIA T568B pin/pair termination assignment. All conductors provided will be properly and consistently terminated at both ends throughout the entire systems. Maintain proper untwist of pairs and removal of jacket per TIA and BICSI.

2.04 SYSTEM PERFORMANCE

A. Horizontal four pair Category 6A copper cabling system shall be capable of supporting 10G Base-T applications for a total distance of 100 meters with equipment cords.

B. System shall provide “future proof” channel performance and guaranteed margins as noted in this document and is guaranteed to exceed TIA-568 Category specifications for Insertion Loss, NEXT, PSNEXT, ACR, PSACR, ELFEXT, PSELFEXT and Return Losses 500 MHz for 6A. The system is also guaranteed 10 dB PSACR headroom for 6A cabling.

2.05 SYSTEM PERFORMANCE

A. CAT6A Unshielded (U/UTP, or UTP) Systems
   1. Horizontal UTP Category 6A 23AWG copper cabling system shall be guaranteed to exceed all TIA-568 link and channel performance requirements and be capable of supporting 10G Base-T (802.3an) and ISO/IEC 11801 Class EA applications for a total distance of 100 meters with equipment cords. System is guaranteed to meet all Cat 6A requirements for short links and channels down to a 10 foot link (5 meter channel) with a guaranteed 4 dB margin of Alien Crosstalk. Field testing is not required for Alien Crosstalk clearance.  
   2. Basis of Design is Berk-Tek Leviton Technologies CX6850 Cat6A Premium UTP System  
   3. CAT6A Performance Parameters, headroom over TIA-568 standard:

<table>
<thead>
<tr>
<th>Insertion Loss</th>
<th>NEXT</th>
<th>PSNEXT</th>
<th>ACR-F (ELFEXT)</th>
<th>PSACR-F (PSELFEXT)</th>
<th>Return Loss</th>
<th>ACR-N</th>
<th>PSACR-N</th>
<th>PSANEXT</th>
<th>PSACR-F</th>
</tr>
</thead>
<tbody>
<tr>
<td>3%</td>
<td>5 dB</td>
<td>6 dB</td>
<td>10 dB</td>
<td>10 dB</td>
<td>4 dB</td>
<td>7 dB</td>
<td>7 dB</td>
<td>5 dB</td>
<td>11 dB</td>
</tr>
</tbody>
</table>

2.06 SOURCE QUALITY CONTROL

A. All materials shall be purchased from Distributors authorized by system Manufacturers to sell new and unused components.

2.07 CATEGORY JACKS

A. Communications Faceplate ports shall contain Category jacks which are matched to cable. Jacks shall be terminated to the Horizontal Cabling and inserted into the Communications Faceplate.
B. Connection Reliability
   1. Use connectors with 50-µm gold-plated tines (as specified by TIA standards), as well as designs that distance the connection point between the connector tines and plug from the arcing damage.
   2. Connectors should also meet contact resistance requirements found in the IEC 60512-99-001 standard covering connectors for electronic equipment.

C. CATEGORY 6A JACKS:
   1. Provide modular type Category 6 information outlets for 23/24AWG copper cable. These Category 6A (CAT6) connectors shall be individual snap-in style, and exceed compliance with TIA-568 specifications. The connectors shall comply with the following:
      a. Be 8-position/8 conductor (8P8C, RJ45-style) modular jacks.
      b. Utilize a universal Keystone-style insertion footprint as the manufacturer’s main “flagship” line of products.
      c. Comply with FCC Part 68; UL listed and CSA Certified.
      d. Termination of all connectors shall be rear 110-type insulation displacement connectors (IDC) with solder-plated phosphor bronze contacts.
      e. IDC posts shall employ a mechanism to allow for terminations without a complete untwist of each pair of conductors.
      f. The connector shall provide a ledge directly adjacent to the 110-style termination against which the wires can be directly terminated and cut in one action by the installation crafts-person.
      g. Connector wiring label shall provide installation color codes for both T568A and T568B wiring schemes on separate labels.
      h. Jacks shall employ “Retention Force Technology” or similar functionality involving polymer springs above tines for support and longevity of unimpeded physical conductor contacts.
   2. Approved Products:
      a. Leviton eXtreme CAT6A QuickPort Module # 61110-R*6

Where * = one of 13 colors. See drawings or check with Owner for application.

2.08 UTP CABLE

A. NETWORK DATA CABLES

   1. Provide 4-pair, 100-Ohm balanced unshielded twisted pair (UTP) Cables for each data outlet designated.
   2. All UTP cables passing through air handling space shall be PLENUM-rated (CMP). Cables not passing through air handling spaces may be PVC (CMR) jacketed. Some buildings will require the use of Plenum cable. The contractor is solely responsible for verifying the construction requirements and installing the correct cable. Failure to provide CMP cable in Plenum required spaces will result in the contractor removing and replacing the cable at their own expense.
   3. Cable jacketing:
      a. Color Coding standard for patch cables and jacks:
      b. Voice - white cable and jacks
      c. Data - blue cable and jacks
      d. Wireless Access Points - green cable and jacks
      e. Security, video - yellow cable and jacks
      f. Emergency Speakers - orange cable and jacks
4. Cable shall be independently verified for flammability by UL and listed under file number E138034 and shall comply with NEC article 800, NFPA 70, and [CMP (NFPA 262, UL 910) or CMR (ANSI/UL 1666, IEC 332-1)].
5. Copper clad aluminum cables are not permitted. Installation of such will be cause for the necessity of removing the cabling and the installation of copper cables at the contractor’s expense.
   a. Any costs associated with project delays caused by the installation of these cables and the removal and installation of acceptable cables will be borne by the contractor.

   B. CAT6A UTP cable shall conform to the following requirements:
      1. CAT6A Unshielded twisted-pair cable (U/UTP, or UTP)
      2. 100-Ohm, 23 AWG, CAT 6A 4-pair balanced unshielded twisted pair solid annealed copper
      3. Cable shall be characterized to 750 MHz and UL/ETL Listed by the Manufacturer printed on the cable jacket and package, as well as ETL Verified to TIA-568 Category 6A and ISO/IEC 11801 Class E_A requirements for channel, link and component performance to support IEEE 10GBASE-T (802.3an) networks
      4. Maximum Cable Outer Diameter: 0.275”.
      5. Documentation available from an independent third-party testing agency that verifies through random sampling that cable components perform at or above the levels contained on their product specifications, not simply at or above the standard.
      6. Guaranteed cable balance improves overall performance and reduces emissions which results in error-free performance up to 10 Gigabit Ethernet with full duplex transmission
      7. Provided on spools to reduce risk of kinking cable upon deployment
      8. Cable shall be Plenum-rated (CMP) for any location where plenum cable is required.
     10. Meet or exceed Channel margin guarantees as stated above under System Performance
     11. Approved Products:
         a. Berk-Tek LANmark XTP, CAT6A CMP, 1000’ reel
         b. Berk-Tek LANmark XTP, CAT6A CMR, 1000’ reel

2.09 OUTLET MOUNTING

   A. Wall-plates
      1. Wall plates (or “faceplates”) provide information outlets to the work area. Contractor shall provide and install single gang faceplate kits to allow up to six data or voice jacks as required for all work area outlets, workstation base feeds, and unused telecom backboxes and furniture openings. Faceplates shall:
         a. Utilize a Quickport (“keystone”-style) footprint to match the approved connectivity manufacturer, and be made by the same manufacturer as the connectors.
         b. Match colors and materials of the power wiring device plates.
         c. Support any connectivity media type, including fiber and copper applications.
         d. Have write-on designation labels for circuit identification together with a clear plastic cover.
         e. Be available in single-gang and double-gang configurations.
         f. Have surface-mount boxes and standoff rings available for both single and double gang faceplates.
         g. Have single-port matching color blank inserts available in packs of 10.
         h. Shall be stainless steel when installed above accessible ceiling.
         i. Approved Products:
1) Leviton QuickPort Single-Gang, Plain, # 41080-#xP
2) Leviton QuickPort Single-Gang with ID Windows, # 42080-#xS
3) Leviton QuickPort Blank Inserts, pack of 10, # 41084-BxB
4) Leviton QuickPort Stainless Steel wall phone plate, # 4108W-0SP
5) Leviton Furniture Faceplate, 4-port, 49910-Ex4
   Where:
   # = number of ports: 1, 2, 3, 4, 6
   x = color: White (W), Ivory (I), Light Almond (T), Gray (G), Black (E)

B. SURFACE-MOUNT BLOCKS (SMB)
1. Surface-Mount Blocks (SMBs) are used to protect terminated CAT6A cables at the
   endpoints where they are not contained within walls or furniture. Example locations may
   be Wireless Access Points (WAPs), Group Work Areas fed by conduits run down columns,
   security cameras, or other network-enabled device locations.
2. Ceiling, WAP, Camera and other non-wall-mount locations will use a 2-port plastic SMB.
3. Small Surface-Mount Boxes shall exhibit the following characteristics:
4. Outlet housings for WAPs and other devices shall be a high-density, low profile design
   with (2) or (4) field-configurable ports, snap-lock cover, and cable knockouts on back.
5. Housing cover shall have raceway knockouts for top and bottom entry. Base shall include
   Tie-wrap anchor points at all cable entrances.
6. The housing shall be mountable with screws, tape or a single magnet.
7. The cover shall provide the option of securing it to the base with a screw that is hidden
   under the outlet identification window.
8. Shall be constructed of a Plenum-rated, high-impact self-extinguishing plastic rated UL
   94V-0, and be UL Listed and compliant with FCC Part 68 and TIA-568 specifications.
9. Approved Products:
   a. Leviton QuickPort 2-port Surface-mount Housing, White, #41089-2WP

2.10 CABLE SUPPORTS

A. J-HOOKS
1. Support all cable above ceiling on dedicated cable support hardware a minimum of 6”
   above accessible ceilings.
2. Provide cable saddles and J-hooks where cable tray or wire basket is not available. These
   must be supported on their own ceiling wires, threaded rod, or affixed to building structure
   by use of beam clamps (on metal beams) or wood screws (on wood beams). Affixing
   communication cable supports to existing ceiling support wires is not allowed.
3. Approved Products:
   a. B-Line Cable Hook, BCHxx
   b. B-Line Cable Hook, Cable to Beam Fastener, BCHxx-C2
   c. B-Line Cable Hook, Cable to Fastener, 2”, BCHxx-C422
   d. B-Line Cable Hook, Cable to Rod Fastener, 2”, BCHxx-W2
   Where:
   xx = 21 (1.25”), 32 (2”), or 64 (4”)

A. JACK/OUTLET BRACKETS
1. Above-ceiling cable termination locations shall be either wall-mounted or suspended from
   structure above the drop ceiling. Cables or terminations shall not rest on ceiling grid or
   equipment above ceiling grid.
2. For Wireless Access Points and other above-ceiling-mounted communications devices, cables shall land in an above-ceiling bracket which is affixed to dedicated cable support hardware.

3. Two category-rated jacks may be installed in each above-ceiling bracket. Each above-ceiling bracket will hold a 2-port Surface-Mount Box or 1-U MOS SMB for multimedia applications.

4. For wall-mounted device locations (above or below ceiling), devices needing to be mounted directly to a backbox will utilize the in-wall mounting bracket to secure the jack inside the backbox.

5. One category-rated jack can be installed in each in-wall backbox jack mounting bracket. For devices requiring (2) category-rated jacks, (2) in-wall brackets must be used.

6. Approved Products:
   a. Leviton QuickPort In-Ceiling Bracket, rod/wire hanger, 49223-CBC
   b. Leviton QuickPort In-Ceiling Bracket, accepts beam and screw mounts, 49223-CB0
   c. Leviton QuickPort In-Wall Bracket, 49223-BA5 (pack of 5)

2.11 APPROVED PRODUCTS

A. Approved Copper Connectivity Manufacturer Basis of Design
   1. Leviton Network Solutions

2.12 COPPER CONNECTIVITY

A. Category 6A Field Installable Modular Plug:
   1. The universal plug shall meet or exceed all performance requirements for Category 6A as described in ANSI/TIA-568.2-D, as well as Class EA requirements as described in ISO/IEC 11801-1.
   2. The plug shall comply with all National Electrical Codes, be compliant with ANSI/TIA-1096-A, and be UL listed.
   3. The plug shall meet all requirements of IEC 60603-7 (including IEC 60512-5-2) and IEC 60512-99-001(including IEC 60512-9-3) standards.
   4. The plug shall be compliant with UL 2043 for use in air handling spaces
   5. The plug shall be encased in a 360° die-cast housing to protect it from potential EMI/RFI.
   6. The plug shall not require a specialized termination tool.
   7. The plug wiring shall accommodate T568 A/B wiring schemes.
   8. The plug shall accommodate 26-22 AWG solid or stranded conductors.
   9. The plug may be used to terminate to horizontal cable when connecting to Ethernet devices placed in fixed locations as recognized in ANSI/TIA-568.2-D Annex F- Modular Plug Terminated Link (MPTL), ANSI/TIA-862-B Annex C- Direct Connections, and ISO 11801-6 Type B generic cabling.
   10. The connector module shall support the following POE standards
       a. IEEE 802.3at (Type 1) Power over Ethernet (PoE) applications up to 15.4 watts
       b. IEEE 802.3at (Type 2) Power over Ethernet (PoE+) applications up to 30 watts,
       c. IEEE Draft 802.3bt draft (Type 3) Power over Ethernet (PoE+) applications up to 60 watts
       d. IEEE Draft 802.3bt draft (Type 4) Power over Ethernet (PoE+) applications up to 100 watts
       e. Cisco Universal Power Over Ethernet (UPOE) applications up to 60 watts
       f. Power over HDBaseT (POH) applications up to 100 watts
   11. Manufacturer: Leviton Cat 6A Universal Tool-Free Plug
PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to section 27 00 00

B. All installation shall be done in conformance with TIA-568 standards, BICSI methods, industry standards and manufacturer's installation guidelines. 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. 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. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

C. Cabling between communications rooms and workstation locations are to be installed as individual “home runs”. No intermediate punch down blocks or splices may be installed or utilized between the communications rooms and the information outlets at the workstation location.

D. All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable. There shall never be more than .5 inches of unsheathed Category 5e or 6 UTP cable at either the wiring closet or the workstation termination locations.

E. All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair equipment's efficient use of their full capacity.

F. EMT or Conduit for pathways shall have no more than two 90 degree bends and no continuous section over 100'. Each conduit opening will be fitted with a nylon bushing to prevent damage to cables.
   1. Add hinged pull boxes to meet this requirements

G. 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. Owner must approve all exceptions.

H. Wireless Access Point Cable Requirements
   1. The Contractor shall:
      a. Install horizontal cable from dedicated wireless patch panel(s) in telecommunications room terminated with a modular jack on the WAP location (wired to project standard).
      b. All WAP locations and cables shall be accessible by use of a 6’ ladder.

I. Coordinate with other trades on whether there is a presence of variable frequency drive motors (VFD) being used above ceilings or at any location in the building, and if so, where their locations are.
   1. Route cabling away from VFD motors, maintaining a minimum of 6 feet from the motors.
J. Special Circuits
   1. The Contractor shall coordinate with the Owner on the cable termination plan for special circuits (cables to wireless access point locations, IP security cameras, emergency analog telephone lines (elevators, fire alarms, etc.), service provider special circuits, security circuits, etc.).
      a. IP security cameras shall be terminated with an 8P8C modular jack at the device end.
      b. WAP jack placed in standard box and plate above ceiling.
      c. Security Camera jacks shall be the surface mount ‘biscuit’ type. Place biscuit jack in 5 square box at locations or use in-box bracket as specified in project documents and/or as indicated on drawings.
      d. Location and termination field description
         1) Room location
         2) Rack-mount or wall mount
         3) Termination field type
   2. 110-type blocks
      a. Unique identifiers
         1) Segregation and position on equipment rack
         2) Port color-coding
         3) Unique labeling
   3. The Contractor shall provide a copy of the finalized plan in writing to the Owner’s representative for review and authorization to proceed.

K. All cabling placed above drop ceilings must be supported by cable tray, conduit, or J-Hooks.
   1. 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.
   2. Attaching cable to pipes or other mechanical items is not permitted.
   3. Communication cables shall be routed so as to provide a minimum of 18 inches spacing whenever possible from light fixtures, sources of heat and EMI sources.
   4. Cabling shall not be attached to ceiling grid wires. Multiple cables are to be dressed every 5 feet to 7 feet.
   5. Maximum cable sag between cable hooks is 3”-6”.

L. Provide shall provide a 3-foot service loop above the access ceiling or cable trays unless specified otherwise. All service loops shall be a minimum of 18 inches in diameter and be accessible for maintenance.
   1. Coordinate loop placement and orientation with the technology consultant. This allows for future changes or expansion without installing new cables.

M. Install cabling in cable trays and J-hooks by function and type of circuit.
   1. Loosely lay cable in trays, segregating cable types. Do not use Velcro or cable ties to bundle cables.
   2. Install cables that are likely to induce current in UTP cables (such as speaker wiring) in a segregated manner, such as bridal rings on the side of a tray, or separate J-Hook support.

N. Maximum allowable temperature rise above ambient temperature is 55 degrees F.
   1. Reduce cable bundle sizes and separate bundles to mitigate cable bundle temperature rise to a max of 55 delta from ambient.
   2. Maximum allowable cable bundle internal temperature is 130 degrees F. Provide mitigation if allowable temperatures are exceeded.
3. When bundling cables place non-PoE cables at the center of bundles and PoE cables on the exterior or outer layers of the bundles.

O. Identification:
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. Labeling convention to be coordinated with Owner.
6. Label data patch panels and voice blocks in the communications rooms to match those on the corresponding voice and data outlets. The font shall be at least .125-inch in height.
7. 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 with the Owner for all access point identification information.
8. All labels shall correspond to as-built drawings and to final test reports.
9. Coordinate with Owner for specifications on labeling of all hardware, cabling, and related equipment prior to any testing.
10. Label each distribution rack, block and other terminating equipment unit and field within that unit within 4 inches from the block or patch panel termination. Keep labels in a neat and orderly lineup.
11. Label each connector and each discrete unit of cable-terminating and connecting hardware within connector fields, in wiring closets and equipment rooms. 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.
12. 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.
13. Provide electronic copy of final comprehensive schedules for project in software and format selected by Owner.
14. Refer to the following drawing for faceplate labeling:
15. All cable labels shall:
   a. Be marked at each end, on the sheath indicating the Telecommunications Room and jack number to which the cable is wired.
   b. Backbone cables shall be marked at each endpoint and at all intermediate pull/access points or junction boxes. Label shall indicate origination and destination Telecommunication Rooms, sheath ID and strand or pair range.
   c. Meet the legibility, defacement, exposure and adhesion requirements of UL 969.
   d. Be pre-printed or laser printed type.
   e. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.
   f. Where insert type labels are used, provide clear plastic covers to go over label.
   g. The Contractor shall confirm specific labeling requirements with the Owner or Owner’s Representative prior to cable installation or termination.

P. 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.

3.02 CLEANING

A. All surfaces, cabling, and hardware shall be kept clean and free of dust and debris.

B. Clean as needed and protect as required to maintain this requirement.

3.03 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.

3.04 FIELD QUALITY CONTROL

REFER TO SECTION 27 00 00

END OF SECTION
SECTION 27 1600

COMMUNICATIONS CONNECTING CORDS, DEVICES AND ADAPTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for connecting cords, devices and adaptors, supplementing requirements found in the related sections.

B. Related Sections
   1. 270000: Communications
   2. 270526: Grounding and Bonding of Communication Systems
   3. 270810: Optical Fiber Testing and Measurement
   4. 270820: Copper Testing
   5. 271100: Communications Equipment Room Fittings
   6. 271300: Communications Backbone Cabling
   7. 271500: Communications Horizontal Cabling

1.2 WORK INCLUDED

A. The Work of this Section shall consist of the labor, materials and equipment required for furnishing and installing telecommunications patch cables and equipment cords as part of a complete and functional telecommunications system.

B. All items specified or included in this section shall be furnished and installed by Telecommunications Contractor, wired and connected by Telecommunications Contractor and tested by Telecommunications Contractor, unless noted otherwise. “Contractor” as used herein shall mean Telecommunications Contractor or Telecommunications Contractor’s sub-contractor.

C. Communications Patch Cords, Station Cords, and Cross-Connect Wire
   1. Data cable assemblies for the horizontal cross-connect and the workstation shall match horizontal, patch panel, and jack Category.
   2. Data cable assemblies shall be factory-assembled by the manufacturer of the cabling system.
   3. Provide data backbone factory-terminated fiber optic cable assemblies (Duplex LC to LC duplex) using duplex XG 850nm laser-optimized 50/125μm and Single-mode cable cross-connect assemblies in equipment rooms.
   4. Provide patch cord quantities on shop drawings.

1.3 COORDINATION

A. Furnish and install the following:
   1. Patch and Equipment cords, for both copper and fiber.

B. Electrical Contractor shall furnish and install the following:
   1. Floor boxes, box covers, straps.
   2. Boxes above ceilings and box covers.

C. Unless noted, the following items will be the responsibility of the Owner:
1. All electronics and active data networking equipment, etc.
2. Telephones, fax machines and modems, etc.
3. PC’s, printers, video display terminals, flat panel displays, etc.

D. Contact the Owner’s network and computer equipment personnel for specific instructions before starting Work.

PART 2 - PRODUCTS

2.1 COPPER PATCH & EQUIPMENT CORDS

A. Patch cables and equipment cords shall be factory pre-connectorized, TIA/EIA compliant matching horizontal cable specifications, 4 pair UTP, 8-position modular jack, and stranded conductors. Patch cables and equipment cords shall be able to withstand at least a minimum of 200 jack mating cycles without any transmission degradation.

B. Provide all cords the same Category rating as cable, jacks and patch panels installed.

C. Provide patch cable lengths as coordinated with Owner. For bidding purposes assume 50% for 2M, and 25% for 1M, & 3M lengths.

D. Patch Cables For Equipment Rooms:
   1. Provide one UTP patch cable for each horizontal cable terminated on patch panels.
   2. Coordinate patch cable lengths and color with the Owner prior to ordering.
   3. Provide fifteen (15%) spare patch cables for each cable provided.

E. Provide equipment cords as follows:
   1. Provide one 10-foot (3 m) Category equipment cord for each data connector installed in data Work Area Outlets.
   2. Coordinate equipment cord lengths and color with the Owner prior to ordering. Minimum length: 10’.
   3. Provide fifteen (15%) spare equipment cords for each cable provided.
   4. Cords are to be new and factory terminated, delivered in original unopened packages.

F. Connection Reliability
   1. Use connectors with 50 μm gold-plated tines (as specified by TIA standards), as well as designs that distance the connection point between the connector tines and plug from the arcing damage.
   2. Connectors should also meet contact resistance requirements found in the IEC 60512-99-001 standard covering connectors for electronic equipment.

G. Manufacturer – Match approved manufacturer’s solution

2.2 FIBER OPTIC PATCH CORDS

A. Provide Fiber Optic Patch Cords to the existing telecommunications system as required for newly added data network cables. Verify existing conditions and requirements from District IT prior to purchase of patch cords.

B. Patch cables and equipment cords shall be factory pre-connectorized, TIA/EIA compliant.

C. Manufacturer: CommScope, or approved equal.
1. Provide one duplex fiber patch cable per two terminated fibers.
2. Connectors:
3. Lengths: 2 meters. Verify with Owner prior to purchase

D. Confirm connector types with Owner prior to purchase.
   1. Provide the following multi-mode Core Style/Polish Type:
      a. [50/125 laser optimized cords to match installed backbone and riser fiber ]
   2. Provide the following Single-mode Core Style/Polish Type:
      a. [UPC Polish]
      b. [APC Polish]
   3. Provide the following Cable Type:
      a. Duplex Plenum
   4. Provide the following Hybrid Connector Combinations:
      a. [SC to LC]
   5. Provide the following Standard and Pigtail Connector Combinations:
      a. [LC to LC]
   6. Provide the following Mode Type:
      a. Single-mode
      b. Multi-mode
   7. Provide the following Cable Lengths Quantity mix TBD:
      a. [(1m) = 3.3’]
      b. [(2m) = 6.6’]
      c. [(3m) = 9.8’]

PART 3 - EXECUTION

3.1 ADDITIONAL INFORMATION

A. Refer to Section 27 00 00 for submittal and other general requirements

3.2 INSTALLATION

A. Patch cords shall be delivered to the Owner in factory sealed packages.
   1. Coordinate on delivery timing with GC and Owner to ensure any circuits required for
      permit or occupancy certificates will be active and connected on time.

B. Install all patch cords in accordance with the Owners I.T. Department or the person in charge
   of the telecommunications infrastructure.
   1. After discussion with Owner, provide matrix of patching from port to switch port.

C. Bend radius of cables shall be maintained as recommended by the manufacturer and per
   BICSI standards.

END OF SECTION
SECTION 28 00 00

BASIC SECURITY REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes general administrative and procedural requirements for Division 28 and is intended to supplement, not supersede, the requirements specified in Division 1.

B. The requirements described herein include the following:
   1. References
   2. Definitions
   3. System Description
   4. Submittals
   5. Quality Assurance
   6. Project Management and Coordination Services
   7. Product Delivery, Storage, and Handling
   8. Warranty
   9. Maintenance

C. Products furnished and installed under another section:
   1. 120V power
   2. Conduit and junction boxes
   3. Door hardware
   4. Network Connections

D. Related Sections:
   1. Consult other Sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation.
   2. Section 28 05 13 – Security System Cabling
   3. Section 28 05 53 – Security System Labeling
   4. Section 28 08 00 – Security System Acceptance Testing
   5. Section 28 13 00 – Access Control and Alarm Monitoring System
   6. Section 28 16 00 – Intrusion Detection System
   7. Section 28 23 00 – Video Surveillance System
   8. Earthwork: Include trenching, backfilling, boring and soil compaction as required for the installation of underground conduit, in-grade pull boxes, vaults, and bollard foundations.
   9. Selective Demolition: Nondestructive removal of materials and equipment for reuse or salvage as indicated. Also dismantling electrical materials and equipment made obsolete by these installations.
10. Concrete Work: Include forming, steel bar reinforcing, cast-in-place concrete, finishing and grouting as required for underground conduit encasement, pedestal foundations, and curbs (also includes saw-cutting of existing slabs and grouting of conduits in saw-cut).

11. Miscellaneous Metal Work: Include fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, equipment enclosures, cameras, and similar devices.

12. Miscellaneous Lumber and Framing Work: Include wood grounds, nailers, blocking, fasteners, and anchorage for support of security materials and equipment.

13. Moisture Protection and Smoke Barrier Penetrations: Include membrane clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors, ceiling slabs and foundation walls. Tape and make vapor tight penetrations through vapor barriers at slabs on grade.

14. Locking Hardware: Include interface to electronic hardware and door controllers on security related doors.

15. Access Panels and Doors: Required in walls, ceilings, and floors to provide access to security devices and equipment.

16. Painting: Include surface preparation, priming and finish coating as required for security cabinets, exposed conduit, pull and junction boxes, and devices where indicated as field painted in this Division. Refer to Division 9, Painting.

17. Elevators: Include interface to elevator floor and hall call on security related elevators.

1.02 REFERENCES

A. General

1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Consider such codes and/or standards a part of this Specification as though fully repeated herein.

2. 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.

3. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid unless otherwise specifically stated.

B. Codes: Perform Work executed under this Section in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:

1. California Code of Regulations (CCR):
   a. Title 8, “Industrial Relations”
      1) Chapter 3.22, “California Occupational Safety And Health Regulations (CAL/OSHA)”
   b. Title 24, “California Building Standards Code”
      2) Part 2, Volumes 1 and 2, “California Building Code” (CBC)
3) Part 3, “California Electrical Code” (CEC)
4) Part 11, “California Green Building Standards Code” (CALGecn)

2. National Fire Protection Agency (NFPA)
   a. NFPA 70, “National Electrical Code” (NEC)
   b. NFPA 75, “Protection Of Information Technology Equipment”

3. National Fire Protection Agency (NFPA)
   a. NFPA 70, “National Electrical Code” (NEC)
   b. NFPA 75, “Protection of Information Technology Equipment”

4. International Code Council

5. National, State, Local and other binding building and fire codes

   a. Part 15, Radio Frequency Devices

C. Standards: Perform Work and furnish materials and equipment under Division 137xx in accordance with the latest editions of the following standards as applicable:

   a. UL 294: Access Control System Units
   b. UL 1076: Proprietary Burglar Alarm Units and Systems
   c. UL 2044 Commercial Closed-Circuit Television Equipment

1.03 DEFINITIONS

A. The Definitions of Division 1 apply to the 28xxxx sections

B. In addition to those Definitions of Division 1, the following list of terms as used in this specification defined as follows:

1. “Owner”: Contra Costa Community College District

2. “Engineer”: TEECOM Design Group

3. “Furnish”: To purchase, procure, acquire, and deliver complete with related accessories.

4. “Install”: To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Complete installation and make ready for regular operation.

5. “Provide”: To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation.

6. “Connect”: To install required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.

7. “As directed”: As directed or instructed by the Owner, or their authorized representative.
8. “Cabling”: A combination of cables, wire, cords, and connecting hardware (e.g., cables, conductor terminations, connectors, outlets, patch panels, blocks, and labeling).

9. “System”: The access control, video surveillance, and intrusion detection systems


11. “SJB”: Security Junction Box

12. “ACAMS”: Access Control & Alarm Monitoring System

13. “VSS”: Video Surveillance System

14. “IDS”: Intrusion Detection System

1.04 SYSTEM DESCRIPTION

A. Overview

1. The Owner intends to renovate a multi-level building at Diablo Valley College.

2. Security at the new facility will consist of video surveillance, access control and alarm monitoring, and intrusion detection systems.

3. The System will connect to the Owner’s existing Software House CCure 9000 headend located at the District Office over the Owner’s local/wide area network.

4. Provide a high level of coordination services to ensure the proper installation and functioning of the security system.

5. Coordinate the installation of the security system with other trades. This may include review of other’s subcontractor’s shop drawings, attendance at meetings, providing samples for mockup, and preparation & distribution of written documentation.

6. Refer to Division 1 for detail building description.

B. Existing Conditions

1. Perform a functional test of the existing security devices and provide a written list to the Owner and Engineer of deficiencies prior to the commencement of work. Security work not identified assumed as functional and contractor will repair at no additional cost to the Owner.

C. Base Bid Work

1. Access Control and Alarm Monitoring System (ACAMS)
   a. The Owner requires an access control system to automate opening and closing of the building, restrict access after hours by cardholder privileges, and monitor specific spaces for intrusion.
   b. The ACAMS consists of card readers, control panels, power supplies, workstations, alarm monitoring devices, and interfaces to other security equipment.
   c. Refer to Section 28 13 00 for detailed description of system.

2. Intrusion Detection System (IDS)
The IDS consists of keypads, control panels, duress buttons, alarm monitoring devices, and interfaces to other security equipment.

The IDS will communicate with a remote, third-party central station for alarm monitoring and contact Police Services during day-time operation and dispatch of the local Police Department after hours.

Refer to Section 28 16 00 for detailed description of system.

3. **Video Surveillance System (VSS)**
   a. The Owner requires a video surveillance to provide a photographic record of access control transactions and alarm events, some real-time monitoring of the facility, and integration with the access control and alarm monitoring system.
   b. The VSS consists of a combination of analog and IP cameras, power supplies, IP encoders, and network video recorders.
   c. Refer to Section 28 23 00 for detailed description of system.

4. The System includes integration with the Fire/Life-Safety system to provide the following:
   a. Automatically release locks upon fire alarm activation for doors within the path of egress
   b. Disconnect power to magnetic door holders to automatically close doors after business hours

1.05 **SUBMITTALS**

A. Submit required submittals to the General Contractor in the quantities and formats as required under the general contract. In the absence of requirements, provide as described in the following with reference to quantity and format.

B. **Contractor Qualifications**
   1. Resumes of the Project Manager, General Foreman, and Lead Technician(s) indicating role, years of experience, product certifications and training, listing of similar projects the individual performed the role proposed for this project along with client contact information for each.
   2. Certification letters stating the Contractor is an authorized reseller, installer, and extended warranty provider for the following systems:
      a. Software House CCure 9000
      b. Salient Systems

C. **Product Data**
   1. Obtain written approval from the Engineer for the product data submittal prior to the release of materials and equipment purchase order and prior to installation.
   2. **Quantity:** Submit product data submittals as described in Division 1.
   3. **Format:**
      a. **Minimum Format:** Submit each product data submittal in an 8-1/2 x 11 inch folder. Product data submittal shall be in a 3-ring binder (or similar). If in a 3-ring binder, insert the submittal information the transparent front cover and spine pockets.
      b. Clearly label the cover and spine of each submittal with the following information:
         1) Client Name
2) Project Name and Address
3) Project Submittal Number
4) Submittal Name (e.g., “Product Data Submittal for Video Surveillance System”)
5) Specification Section Number (e.g., “Section 28 23 00”)
6) Date of Submittal Format: <month> <day>, <year> (e.g., “January 1, 2010”)
7) Contractor Name

c. Include a Table of Contents at the beginning of the submittal that lists materials by article and paragraph number (e.g., “2.02-A Network Video Recorders”).
d. Include tabbed separators for improved navigation through the submittal.

4. Content:
a. Cover Letter: Product data submittals shall include a cover letter stating that the submittal is in full compliance with the requirements of the Contract Documents. Sign (and stamped, if applicable) cover letter and list items and data submitted. Have the person who prepared the submittal sign the document as well. Failure to comply with this requirement shall constitute grounds for rejection of submittal.

b. Product Information: Product Data submittal shall consist of manufacturer’s technical data, product literature, "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary). This data shall clearly describe the product’s characteristics, physical and dimensional information, electrical performance data, materials used in fabrication, material color & finish, and other relevant information such as test data, typical usage examples, independent test agency information, and storage requirements. Clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories, which are included and those which are excluded. At a minimum, include products listed in the Division 28 specifications. Include relevant products that will be installed, which are not listed in the specifications.

c. Re-submittals: Provide a cover letter with the re-submittal that lists the action taken and revisions made to each product submittal in response to Submittal Review Comments. No review shall take place for any re-submittal packages that is not accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the re-submittal package.

D. Shop Drawings
1. Obtain written approval from the Engineer for the shop-drawings submittal prior to the release of materials and equipment purchase order and prior to installation.

2. Quantity and Media: Submit shop-drawings as described in Division 1.

3. Format:
a. Produce shop drawings using AutoCAD, or other computer design application that can save files to AutoCAD-compatible files.

b. Use the same size drawing sheet as the drawings of the Contract Documents.

c. Text: minimum of 3/32” high when plotted at full size.

d. Screen background information.

e. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.

f. Scaling:
4. Content:
   a. Submit shop drawings that represent proposed installation of security system.
   b. Floor Plans: Scale floor plans at 1/8"=1'-0". Floor plans shall show:
      1) Locations and identifiers of security devices.
      2) Size, quantity, location and proposed routes of security cabling.
      3) Size, quantity, location, and routes of pathways (such as cable trays, cable basket, conduits, cable hangers, and other cable support devices).
   c. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices.
   d. Schedules: Provide schedules for devices and control panels that show each point ID with a description of the connected devices.
   e. Block Diagram/Riser Diagram: Show the devices, conduit, wire types, and sizes between them, including cabling interties between termination hardware.
   f. Proposed mounting details

E. As-Built Drawings

1. Quantity and Media: Submit as-built drawings as described in Division 1 in both hard copy and electronic formats.

2. Format:
   a. Produce as-built drawings using AutoCAD, or other computer design application that can save files to AutoCAD-compatible files.
   b. Use the sheet size as the drawings of the Contract Documents, and use the project title block.
   c. Text: minimum of 3/32" high when plotted at full size.
   d. Use symbols identical to the symbols shown on the Drawings.
   e. Screen background information.
   f. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.

3. Content:
   a. Submit as-built drawings that fully represent actual installed conditions and that incorporate modifications made during the course of construction.
   b. Floor Plans: Scale floor plans at 1/8"=1'-0". Floor plans shall show:
      1) Locations and identifiers of security devices.
      2) Size, quantity, location and proposed routes of security cabling.
      3) Size, quantity, location, and routes of pathways (such as cable trays, cable basket, conduits, cable hangers, and other cable support devices).
   c. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices.
   d. Schedules: Provide schedules for devices and control panels that show each point ID with a description of the connected devices.
   e. Block Diagram/Riser Diagram: Show the devices, conduit, wire types, and sizes between them, including cabling interties between termination hardware.
   f. Custom mounting details
F. Operation and Maintenance (O&M) Manuals

1. Quantity: Submit quantity of O&M Manuals as described in Division 1 in both hard copy and electronic formats.

2. Format:
   a. Submit each O&M Manual in a white, 3-ring binder with front cover and spine clear pockets for insertion of the project information.
   b. Clearly label the cover of each O&M Manual with the following information:
      1) Client Name
      2) Project Name and Address
      3) Manual Name (e.g., “Operation and Maintenance Manual for Telecommunications Cabling System”)
      4) Date of Submittal Format: <month> <day>, <year> (e.g., “January 1, 2010”)
      5) Contractor Name
   c. Include a Table of Contents at the beginning that lists the contents.
   d. Include tabbed separators for improved navigation through the manual.

3. Content:
   a. 11”x17” prints of as-built drawings, as described above
   b. Manufacturer's original catalog information sheets for each component provided under applicable Section (typically, this is similar to the accepted product data submittal)
   c. Warranty certificate from the manufacturer and the Contractor
   d. Manufacturer's instructions for system or component use
   e. Instructions and requirements for maintenance and warranty issues

4. Contents shall include requirements and methods for maintaining installed products.

1.06 QUALITY ASSURANCE

A. General

1. Provide new and unused materials, equipment, and parts comprising the units specified herein of current manufacturer and of highest grade.

2. Only use products and applications listed in this Division on the project

B. Substitutions

1. Conform to the general requirements and procedure outlined in Division 1 in the Request For Substitution.

2. Where products are noted as "or equal", a product of equivalent design, construction, and performance is considered. Include in the Product Data submittal: catalog cuts, product information, and pertinent test data required to substantiate that the product is in fact equivalent to that specified.

3. Only one substitution allowed for each product specified. Do not provide substituted material, processes, or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor.

4. The burden of proof rest with the Contractor that the substituted product is equivalent to the specified product. When the Engineer accepts a substitution in writing, it is with the
understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Approved substitutions do not relieve the Contractor of responsibilities for the proper execution of the Work, or from provisions of the Specifications.

5. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the Contract Documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when “or equal” follows the manufacturers' names or model number(s).

6. Whenever material, process or equipment is specified in accordance with a Federal specification, an ASTM standard, an ANSI specification, UL rating or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, submit support test data to substantiate compliance at no additional cost.

7. Pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, subcontractor's or other Contractor's work.

C. Contractor Qualifications
1. A current, active, and valid and C7 or C10 California State Contractors License
2. Minimum five years experience in installation and service of access control, video surveillance, and intrusion detection systems.
3. Minimum five completed projects similar to scope and cost.
4. Evidence of technicians qualified for the work in the form of current manufacturer’s training certification

D. Materials
1. Materials, support hardware, equipment, parts comprising units, etc., shall be new, unused, without defects and of current manufacturer, materials
2. Use specified products and applications, unless otherwise submitted and approved in writing.

E. Regulatory Requirements
1. Work and materials shall conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and shall conform to the regulations of the State Fire Marshal, OSHA and the codes of the governing local municipalities. Work under Division 28 shall confirm to the most stringent of the applicable codes.
2. Provide the quality identified within these Specifications and Drawings when codes, standards, regulations, etc. allow Work of lesser quality or extent. The Contract Documents address the minimum requirements for construction.

F. Drawings
1. Follow the general layout shown on the Drawings except where other work may conflict with the Drawings.
2. Drawings for the Work within this Division are essentially diagrammatic within the constraints of the symbology applied.

3. The Drawings do not fully represent the entire installation for the security system. Drawings indicate the general route for the cables and the location of outlets. The Drawings might not expressly show every conduit, sleeve, hanger, etc., but a complete system is required.

4. Complete the details necessary for point-to-point design. This allows the Contractor to achieve desired results applying their own procedures and methods. Submit shop drawings for review prior to installation.

1.07 PROJECT MANAGEMENT AND COORDINATION SERVICES

A. Project Management and Coordination Services

1. Provide a project manager for the duration of the project to coordinate this Work with other trades. Coordination services, procedures and documentation responsibility include, but are not limited to, the items listed in this section.

2. Review of Shop Drawings Prepared by Other Subcontractors:
   a. Obtain copies of shop drawings for equipment provided by others that require telecommunication service connections or interface with Work.
   b. Perform a thorough review of the shop drawings to confirm compliance with the service requirements contained in the Division 28 contract documents. Document discrepancies or deviations as follows:
      1) Prepare memo summarizing the discrepancy
      2) Submit a copy of the specific shop drawing, indicating via cloud, the discrepancy
   c. Prepare and maintain a shop drawing review log indicating the following information:
      1) Shop drawing number and brief description of the system/material
      2) Date of the review
      3) Name of the individual performing the review
      4) Indication if follow-up coordination is required

3. Request for Information (RFI)
   a. Thoroughly review the contract documents prior to the preparation and submission of an RFI. If an RFI is submitted, attach 8 1/2" x 11" copies of relevant documents to clarify the issue.
   b. Submit RFIs with your recommended solution.
   c. Prepare and maintain an RFI log using a Microsoft Excel spreadsheet indicating the following information:
      1) RFI number and brief summary of the issue.
      2) Date of issuance and receipt of response.

4. Scheduling of Work
   a. Prepare work schedules for each floor or building indicating the following information:
      1) Cable Installation
      2) SEC Build Out
      3) Device Installation
4) Programming
5) Testing
6) Other tasks included under the alternate work section of these specifications

B. Role of the Engineer

1. During the construction phase of the project, the Engineer will work with the Contractor to provide interpretation and clarification of project contract documents, reply to (and 'process') relevant Requests for Information (RFIs), and act as an interface between the Contractor and the Owner.

2. The Owner has retained the Engineer's services to observe the Work for general compliance with the Contract Documents and to ensure that the installation meets the design intent of the system.

3. In general, the Engineer will participate during the construction phase as follows:
   a. Review product data and shop drawings submittals for general compliance with the contract drawings and specifications.
   b. Review changes as they arise, and confirm that the proposed solutions maintain the intended functionality of the system.
   c. Interpret field problems for Owner, and translate between Owner and Construction Team.
   d. Review the testing procedures to confirm compliance with industry-accepted practices.

C. Use of CAD Files

1. Should the Contractor need the Engineer's CAD files to produce shop drawings and/or as-built drawings, the Engineer requires the Contractor sign a CAD files release agreement.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery

1. Do not deliver security system components to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable.

2. Replace equipment damaged during shipping and return to manufacturer at no cost to the Owner.

B. Storage

1. Store materials in a clean, dry, ventilated space free from temperature extremes.

2. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.

3. Provide heat where required to prevent condensation or temperature related damage.

C. Handling

1. Handle in accordance with manufacturer's written instructions.

2. Prevent internal component damage, breakage, denting and scoring. Do not install damaged equipment. Replace damaged equipment and return equipment to manufacturer.
1.09 WARRANTY

A. Provide the Security System as described in this specification with a one-year parts and service warranty at no additional cost to the Owner.

B. Include in the warranty package, at a minimum, the following:
   1. Software support agreement for the ACAMS and VSS
   2. Software upgrades and patches
   3. Labor to install software upgrades and patches necessary to maintain the latest version
   4. Emergency service on regular working hour basis
   5. Service by factory trained and employed service representatives of system manufacturer

C. Maintain regular service facilities and provide a qualified technician familiar with this work at the site within four (4) hours of receipt of a notice of malfunction including weekends and holidays. Provide material, devices equipment and personnel necessary for repairs. Install approved temporary, alternate equipment if required by the Owner, complete and operational within twenty four (24) hours after notification of a malfunction, at no additional cost.

D. Conduct warranty repairs and service at the job site unless in violation of manufacturer's warranty; in the latter event, provide substitute systems, equipment and/or devices, acceptable to the Owner, for the duration of such off-site repairs. Transport warranty substitute and/or test systems, equipment, devices, material, parts and personnel to and from the job site at no additional cost.

1.10 MAINTENANCE

A. Extra Materials
   1. Deliver extra materials to a secured location determined by the Owner.
   2. Provide a complete Bill of Materials listing quantities, part numbers, and descriptions for each device for the Owner to sign indicating receipt of equipment.
   3. Provide new and unused spare parts in their original packing materials upon delivery.

B. Maintenance Service
   1. For the first year of service, conduct quarterly system performance review meetings to review system operation problems and/or defects that occurred during the preceding 3 months. During these performance review meetings, perform the following:
      a. Visual checks and operational tests of the central processor, local processors, monitors, keyboards, system printers, peripheral equipment, ACAMS equipment, power supplies, and electrical and mechanical controls
      b. Clean system equipment, including interior and exterior surfaces
      c. Perform diagnostics on equipment
      d. Check and calibrate each device
      e. Run system software and correct diagnosed problems
      f. Resolve previous outstanding problems
   2. Provide software and firmware updates issued free of charge by the manufacturer.
PART 2 - PRODUCTS

2.01 GENERAL
A. Material and equipment specified herein have been selected as the basis of acceptable quality and performance and have been coordinated to function as components of the included systems. Where a particular material, device, equipment or system is specified directly, the current manufacturer's specification for same is a part of these specifications, as if completely elaborated herein.
B. Remove manufacturer identification marks from visible equipment.
C. Use standard, regularly manufactured, materials and equipment for this and/or other similar systems, and not custom designed especially for this project. Provide systems and components thoroughly tested and proven in actual use. Provide subsystems of one manufacturer.

2.02 TAMPER RESISTANT HARDWARE
A. Provide pinned-allen type hardware for exposed hardware in public spaces.
   1. Provide hardware used in specialty metal surfaces that posses a similar finish color.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Conditions: Verify existing conditions, which have been previously provided under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
B. Pathways: Verify that pathways and supporting devices, which have been previously provided under other sections, are properly installed, and that temporary supports and devices have been removed.
C. Field Measurements: Verify dimensions of pathways, including length of pathways. For example, “True Tape” the conduits to verify cable distances.

3.02 FIELD QUALITY CONTROL
A. Staffing: Provide a qualified foreman who is in charge of the Work and who is present at the job site at times Work is being performed. Perform the Work using skilled technicians under the direction of the foreman. Supervise the work force executing the Work. Perform the installation within the restraints of the construction schedule. Do not change the supervisor during the project without prior written approval from the Owner.
B. Inspection: Perform inspection after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion released for inspection. Document completion, and inspection as required.

3.03 INSTALLATION
A. Perform this work in accordance with acknowledged industry and professional standards and practices and the procedures specified herein.
B. Provide a complete, operating system. Include devices specified including basic components and accessories, interconnecting wiring and other equipment and installation devices necessary for a complete system as specified.

C. Manufacturer's Instructions:
1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.
2. Maintain jobsite file of Material Safety Data Sheets (MSDS) for each product delivered to jobsite.

D. Boxes, Panels, and Enclosures
1. Install boxes, panels, and enclosures square and plumb.
2. Set "flush mounted" units with the face of the cover, bezel or escutcheon in the same plane as the surrounding finished surface.
3. Mount boxes, panels and trim so that there are no gaps, cracks or obvious lines between the trim and the adjacent finished surface and ready them to receive final finish, as applicable.
4. Install insulating terminations in signal circuit boxes, panels, wireways or enclosures.

E. Painting
1. Custom paint devices as indicated on the drawings.

3.04 REPAIR/RESTORATION
A. Replace or repair work completed by others that you deface or destroy, at not cost to the Owner.
B. Punch List:
1. Inspect installed work in conjunction with the General Contractor and develop a punch list for items needing correction.
2. Provide punch list to Engineer for review prior to performing punch walk with the Engineer.

C. Re-Installation:
1. Make changes to the system such that defects in workmanship are correct and cables and the associated termination hardware passes the minimum test requirements.
2. Repair defects prior to system acceptance.

D. Painting: Repaint surfaces altered during installation of the security system to match previous conditions.

3.05 CLEANING
A. Remove temporary coverings and protection of adjacent work areas. Remove unused products, debris, spills, or other excess materials. Remove installation equipment.
B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.
C. Repair or replace damaged installed products.
D. Legally dispose of debris.
E. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

END OF SECTION
SECTION 28 00 01

ELECTRONIC SAFETY BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Work included in 28 00 01, Electronic Safety Basic Requirements applies to Division 28, Electronic Safety work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of electronic safety systems for proposed project.

B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.

C. Definitions:
   1. Provide: To furnish and install, complete and ready for intended use.
   2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
   3. Install: Includes unloading, unpacking, assembling, erecting, installing, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
   4. Or Equal: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent," substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
   5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities having jurisdiction, including local fire marshal, Owner's insurance underwriter, Owner's representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.2 RELATED SECTIONS

A. Contents of Section apply to Division 28, Electronic Safety Contract Documents.

B. Related Work:
   1. Additional conditions apply to this Division including, but not limited to:
      a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
      b. Drawings
      c. Addenda
      d. Owner/Architect Agreement
      e. Owner/Contractor Agreement
      f. Codes, Standards, Public Ordinances and Permits

C. Contents of Division 26, Electrical apply to this Section.
1.3 REFERENCES AND STANDARDS

A. References and Standards per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 28, Electronic Safety Sections and those listed in this Section.

B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/for:
   1. State of California:
      a. CBC - California Building Code
      b. CEC - California Electrical Code
      c. CEC T24 - California Energy Code Title 24
      d. CFC - California Fire Code
      e. CMC - California Mechanical Code
      f. CPC - California Plumbing Code
      g. CSFM - California State Fire Marshal

C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
   1. ABA - Architectural Barriers Act
   2. ADA - Americans with Disabilities Act
   3. ANSI - American National Standards Institute
   4. ASCE - American Society of Civil Engineers
   5. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
   6. ASHRAE Guideline 0, the Commissioning Process
   7. ASME - American Society of Mechanical Engineers
   8. ASTM - ASTM International
   9. CFR - Code of Federal Regulations
   10. EPA - Environmental Protection Agency
   11. ETL - Electrical Testing Laboratories
   12. FM - FM Global
   13. ISO - International Organization for Standardization
   14. NEC - National Electric Code
   15. NEMA - National Electrical Manufacturers Association
   16. NFPA - National Fire Protection Association
   17. OSHA - Occupational Safety and Health Administration
   18. SMACNA - Sheet Metal and Air Conditioning Contractors’ National Association
   19. UL - Underwriters Laboratories Inc.

D. See Division 28, Electronic Safety individual Sections for additional references.

E. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract.

F. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
G. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

1.4 SUBMITTALS

A. See Division 01, General Requirements for Submittal Procedures.

B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.

C. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.

D. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one zip file per specification division containing a separate file for each Specification Section. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.

E. Product Data: Provide manufacturer’s descriptive literature for products specified in Division 28, Electronic Safety Sections.

F. Identify/mark each submittal in detail. Note what difference, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the specifications and drawings.

   1. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.

   2. Include technical data, installation instructions and dimensioned drawings for products, equipment and devices installed, furnished or provided. Reference individual Division 28, Electronic Safety specification Sections for specific items required in product data submittal outside of these requirements.

   3. See Division 28, Electronic Safety individual Sections for additional submittal requirements outside of these requirements.

G. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of additional reviews at Engineer’s hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.

H. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer’s comments. Identify Engineer’s comments and provide an
individual response to each of the Engineer’s comments. Cloud changes in the submittals and further identify changes which are in response to Engineer’s comments.

I. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.

J. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 28, Electronic Safety Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical and Division 28, Electronic Safety submittals.

K. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.

L. Substitutions and Variation from Basis of Design:
   1. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
   2. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor are required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals." For any product marked "or equal," a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
   3. Where manufacturer equipment or model numbers are indicated with no exceptions, substitutions will be rejected.

M. Shop Drawings:
   1. Provide coordinated shop drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Reference individual Division 28, Electronic Safety specification Sections for additional requirements for shop drawings outside of these requirements.
   2. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.

N. Samples: Provide samples when requested by individual Sections.

O. Resubmission Requirements:
   1. Make any corrections or change in submittals when required by Architect/Engineer review comments. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a
cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.

2. Resubmit for review until review indicates no exception taken or "make corrections noted."

3. When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.

P. Operation and Maintenance Manuals, Owners Instructions:
1. Reference individual Division 28, Electronic Safety Specification Sections for additional requirements for operations and maintenance manuals.

2. Submit, at one time, electronic files (PDF format) on CD/DVD of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
   a. Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
   b. Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes and quantities relevant to each piece of equipment.
   c. Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub-assemblies.
   d. Include Warranty per Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Sections.
   e. Include product certificates of warranties and guarantees.
   f. Include copy of start-up and test reports specific to each piece of equipment.
   g. Include commissioning reports.
   h. Engineer will return incomplete documentation without review.
   i. Engineer will provide one set of review comments in Submittal Review format. Arrange for additional reviews; Bear costs for additional reviews at Engineer's hourly rates.

3. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 28 00 01, Electronic Safety Basic Requirements Article titled "Demonstration."

4. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranty, specified elsewhere or indicated on Drawings.

Q. Record Drawings:
1. Maintain at site at least one set of drawings for recording "as-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document.
and include buried elements and location of concealed items. Include items changed by addenda, field orders, supplemental instructions, and constructed conditions.

2. Record Drawings are to include equipment locations, calculations, and schedules that accurately reflect "as constructed or installed" for project.

3. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.

4. See Division 28, Electronic Safety individual Sections for additional items to include in Record Drawings.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Work and materials to conform to all local, State, Federal and other applicable laws and regulations.

B. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (e.g. cable tray, panels, etc.) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

C. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.

D. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.

E. Provide products that are UL listed.

1.6 WARRANTY

A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.

B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.7 COORDINATION DOCUMENTS

A. Prior to construction, prepare and submit coordinated layout drawings (composite drawings), to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, plumbing, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other
trades (including plumbing, HVAC, fire protection, electrical, ceiling suspension, and ceiling tile systems, etc.), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence. Unless otherwise required by Division 00, Procurement and Contracting Requirements and/or Division 01, General Requirements, Division 28, Electronic Safety to combine information furnished by other trades onto master coordination documents.

B. Prepare Drawings as follows:
   1. Coordination models/drawings may be created using Revit 3D modeled elements or a 3D CAD software. The modeled elements to be graphically represented within the model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the model elements. Model elements must have the ability to be spatially coordinated with other modeled elements using either Revit, Autodesk Navisworks or Autodesk A360.
   2. Drawings in CAD Format. CAD format release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.
   3. Review and revise, as necessary, section cuts in Contract Drawings after verification of field conditions.
   4. Indicate fittings, hangers, access panels, and elevation of bottom of cable tray above finished floor.
   5. Drawings to indicate proposed ceiling grid and lighting layout as shown on electrical drawings and architectural reflected ceiling drawings and HVAC equipment, ductwork.
   6. Incorporate Addenda items and change orders.
   7. Provide additional coordination as requested by other trades.

C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

D. Verify in field exact size, location, and clearances of existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.

E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide like items from one manufacturer, including but not limited to panels, devices and equipment unless otherwise specified in individual Division 28, Electronic Safety Sections.
2.2 **MATERIALS**

A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or FM approved or have adequate approval or be acceptable by state, county, and city authorities.

B. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.

C. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.

D. Hazardous Materials:
   1. Comply with local, State of California, and Federal regulations relating to hazardous materials.
   2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
   3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

**PART 3 - EXECUTION**

3.1 **ACCESSIBILITY AND INSTALLATION**

A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.

B. Install equipment having components requiring access (i.e., devices, equipment, electrical boxes, panels, etc.) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.

C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.

D. Earthwork:
   1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
      a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork divisions. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

E. Firestopping:
1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
   a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around conduit, raceway and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer’s installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

F. Plenums: In plenums, provide plenum rated materials that meet the requirements to be installed in plenums.

3.2 SEISMIC CONTROL

A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 28 Electronic Safety Sections.

B. Provide means to prohibit excessive motion of safety equipment during earthquake.

3.3 REVIEW AND OBSERVATION

A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.

B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
   1. Underground conduit and wire installation prior to backfilling.
   2. Prior to covering walls when electronic safety systems installation is started.
   3. Prior to ceiling cover/installation.
   4. When main systems, or portions of, are being tested and ready for inspection by AHJ.

C. Final Punch: Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 CONTINUITY OF SERVICE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements in Division 01, General Requirements, comply with individual Division 28, Electronic Safety Sections and the following:
1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.

2. Prior to changing over to new system, verify that every item is thoroughly prepared. Install new wiring to point of connection.

3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.

4. Organize work to minimize duration of power interruption.

3.5 CUTTING AND PATCHING

A. Confirm Cutting and Patching Requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:

1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).

2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.

3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.

4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, repair, refinish and leave in condition matching existing prior to commencement of work.

5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.6 EQUIPMENT SELECTION AND SERVICEABILITY

A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.7 DELIVERY, STORAGE AND HANDLING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with the individual Division 28, Electronic Safety Sections and the following:

1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust.
2. Protect equipment and pipe to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
3. Protect devices, panels and similar items until in service.
4. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.

3.8 DEMONSTRATION

A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.

B. Upon completion of work and adjustment of equipment, test systems, demonstrate to Owner's Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Staff as specified in Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.

C. Manufacturer's Field Services: Furnish services of a qualified factory certified instructor at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.9 CLEANING

A. Confirm cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28 Sections.

B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.

B. Install equipment in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to building structure. Maintain manufacturer's recommended clearances.

C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

D. Provide miscellaneous supports required for installation of equipment, conduit and wiring.
3.11 PAINTING

A. Confirm Painting requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:

1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e. hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
2. In electrical and mechanical room, on roof or other exposed areas, equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
3. See individual equipment Specifications for other painting.
4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
5. Conduit: Clean, primer coat and paint interior conduit exposed in finished areas with two coats paint suitable for metallic surfaces. Color selected by Architect.

3.12 DEMOLITION

A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In the absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:

1. Scope:
   a. It is the intent of these documents to provide necessary information and adjustments to electronic safety system required to meet code, and accommodate installation of new work.
   b. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve underground utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
   c. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access, access to different areas. Owner will cooperate to best of their ability to assist in coordinated schedule, but will remain final authority as to time of work permitted.
2. Examination:
   a. Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to locate and preserve utilities. Replace damaged items with new material to match existing.
   b. Verify that abandoned wiring and equipment serve only abandoned facilities.
   c. Demolition drawings are based on casual field observation and existing record documents.
      1) Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish work.
      2) Verify location and number of electronic safety system devices, panels, etc. in field.
   d. Report discrepancies to Architect before disturbing existing installation.
3. Promptly notify Owner if systems are found which are not shown on Drawings.
4. Execution:
   a. Remove existing electronic safety equipment, devices and associated wiring from
calls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or
demolition unless shown as retained or relocated on Drawings.
   b. Provide temporary wiring and connections to maintain electrical continuity of
existing systems during construction. Remove or relocate electrical boxes, conduit,
wiring and equipment as encountered in removed or remodeled areas in existing
construction affected by this work.
   c. Remove and restore wiring which serves usable existing outlets clear of
construction or demolition.
   d. If existing junction boxes will be made inaccessible, or if abandoned outlets serve
as feed through boxes for other existing electrical equipment which is being
retained, provide new conduit and wire to bypass abandoned outlets.
   e. If existing conduits pass through partitions or ceiling which are being removed or
remodeled, provide new conduit and wire to reroute clear of construction or
demolition and maintain service to existing load.
   f. Extend circuiting and devices in existing walls to be furred out.
   g. Remove abandoned wiring to source of supply.
   h. Remove exposed abandoned conduit, including abandoned conduit above
accessible ceiling finishes. Cut conduit flush with walls and floors, and patch
surfaces.
   i. Disconnect and remove electrical devices and equipment serving utilization
equipment that has been removed.
   j. Maintain access to existing electrical installations which remain active. Modify
installation or provide access panel as appropriate.
   k. Existing electronic safety system components are indicated on demolition plans.
Verify exact location and number of existing devices and components in field.
Only partial existing systems shown. Locations of items shown on Drawings as
existing are partially based on Record and other Drawings which may contain
errors. Verify accuracy of information shown prior to bidding and provide such
labor and material as is necessary to accomplish intent of Contract Documents.
   l. Remove abandoned wiring to leave site clean.
   m. If existing electrical equipment contains PCBs (Polychlorinated Biphenyl), replace
with new non-PCB equipment. Dispose of material containing PCBs as required
by federal and local regulations.
   n. Repair adjacent construction and finishes damaged during demolition work.
   o. Maintain access to existing electrical installations which remain active. Modify
installation or provide access panel as appropriate.
5. Existing Fire Alarm System: Maintain existing system in service during construction.
   Disable system only to make switchovers and connections.
   a. Notify Owner before partially or completely disabling system.
   b. Notify local fire service.
   c. Make notifications at least five working days in advance.
   d. Make temporary connections to maintain service in areas adjacent to work area.
3.13 ACCEPTANCE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
   1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer’s installation instructions, particularly in reference to following:
      a. Cleaning
      b. Operation and Maintenance Manuals
      c. Training of Operating Personnel
      d. Record Drawings
      e. Warranty and Guaranty Certificates
      f. Start-up/test Documents and Commissioning Reports

3.14 FIELD QUALITY CONTROL

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
   1. Tests:
      a. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in Closeout Documents.
      b. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.15 LETTER OF CONFORMANCE

A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement in letter that electronic safety systems were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in operating and maintenance manuals.

END OF SECTION
SECTION 28 05 13
SECURITY SYSTEM CABLELING

PART 1 - GENERAL

1.01 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working security system installation, as described in these specifications.

B. Section Includes:
   1. Wire and cable
   2. Compression Seal BNC Connectors

C. Related Sections:
   1. Consult other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
   2. Section 28 00 00 – Basic Security Requirements: includes general project requirements, submittal formats, installation, and warranty requirements.
   4. Section 26 05 33 – Raceways: includes pathway types in different areas of the project.

1.02 SUBMITTALS

A. Product Data: Submit product information, including:
   1. Cable Description and Use
   2. Jacket Rating
   3. Outside Diameter (of the overall wire or cable)
   4. Manufacturer and Part Number

PART 2 - PRODUCTS

2.01 WIRE AND CABLE

A. General
   1. Provide required wire and cable sized to allow for voltage drop on long runs and effectively shielded as required to allow the routing of 12 & 24V power and video signal cable in the same conduit without interference or signal noise.
2. Cable installed outdoors or in underground conduit must contain a PVC or Polyethylene jacket to prevent water intrusion and compliant with the TIA-455-82B water infiltration test.

3. Cables installed indoors to contain a plenum rated jacket (type CMP).

B. Manufacturers:
1. West Penn
2. Belden
3. Or Equal

C. Access Control & Alarm Monitoring System
1. Plenum Jacketed Cable
   a. #18/2 AWG unshielded: West Penn #25224B, door contact cable
   b. #18/4 AWG unshielded: West Penn #25244B, REX and alarm device cable
   c. #18/6 AWG shielded (overall): West Penn #253186B, card reader cable
   d. #16/2 AWG unshielded: West Penn #25225B, lock power cable
   e. #14/2 AWG unshielded: West Penn #25226B, lock power cable from local power booster to exit device
   f. #24/4 AWG shielded (overall): West Penn #D4854, RS-485 communications cable

D. Intrusion Detection System
1. Plenum Jacketed Cable
   a. #22/2 AWG unshielded: West Penn #25221B, door contact cable
   b. #22/4 AWG unshielded: West Penn #25241B, keypad and alarm device cable
   c. #18/2 AWG unshielded: West Penn #25224B, control panel power cable

E. Video Surveillance System
1. Cabling for IP cameras provided by Telecommunications contractor. Refer to Section 27 15 13 – Communications Horizontal Twisted Pair Cabling.

2.02 MISCELLANEOUS COMPONENTS

A. Cable Ties
1. General
   a. Provide Velco-style cable ties on security cabling within telecommunications spaces and covered wireways.
   b. Dress and bind cabling with cable ties every 24” minimum.
   c. Width: 0.75 inches
   d. Color: Black

2. Manufacturer:
a. Panduit #HLS-15-R-0 Black, 15 feet roll, cut to length
b. Or Equal

PART 3 - EXECUTION

3.01 INSTALLATION

A. Label cables in accordance with Section 28 05 53 – Security System Labeling.

B. Horizontal Cable Installation and Routing

1. Provide wire and cable with a continuous, splice-free sheath for the entire length of run between designated connections or terminations. Splices not permitted.

2. Place cables within designated pathways, such as cable tray, basketway, cable hangers, etc. Do no fasten (such as with cable ties) or attach cables to other building infrastructure (such as ducts, pipes, conduits, etc), other systems (such as ceiling support wires, wall studs, etc), or to the outside of conduits, cable trays, or other non-approved pathway systems.

3. Place and suspend cables and conductors during installation and termination in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination at no additional cost.

4. Route cables at 90-degree angles, allowing for bending radius, along corridors for ease of access.

5. Do not exceed manufacturer’s limits for pulling tension.

6. Do not use cable-pulling compounds for indoor installations.

7. Route cables under building infrastructure (such as ducts, pipes, conduits, etc) so the installation results in easy accessibility to the cables in the future. Do not route cables over building infrastructure.

8. Dress and secure coaxial cables to preclude stress and/or deformation.

9. Install shielded wiring or route in separate raceways as recommended by the manufacturer’s current requirements.

10. Place cables 6", minimum, away from power sources to reduce interference from EMI.

11. Do not run signal wire and cable in parallel to power (120VAC).

12. Make connections to screw-type barrier blocks with insulated crimp-type spade lugs. Size lugs properly to assure high electrical integrity, i.e., low resistance connections.

13. Follow manufacturers recommended guidelines for installation.

14. When exiting the primary pathway (such as basketway or cable tray) to the work area, exit via the top of the pathway. Secure the cables to the pathway using an approved cable tie.

C. Cable Routing and Dressing within Telecommunication Rooms
1. Place cables within the overhead cable support and, when routing vertically, fasten the cables onto wall-mounted vertical cable support every 24 inches on-center using cable ties.

2. Only use Velcro type cable ties within the IDF.

3. Neatly bundle (dress cable longitudinally) and support security cables within overhead cable runways.

4. Dress and bind cabling with cable ties every 12” minimum.

5. Provide 4 feet, minimum, sheathed cable slack – length not to exceed permanent link maximum length requirement. Place the slack within the screw cover gutter wireways.

3.02 CABLE SUPPORT

A. Horizontal Support

1. Concrete and Metal construction (Above Ceiling)
   a. Provide separate and dedicated cable support system for security cable runs. Anchor cable support system to structural ceiling. Support and tie cables at a maximum of 5-foot intervals.

2. Wood Construction (above ceiling and no ceiling)
   a. Support cable utilizing appropriately sized drive rings or "D" rings.
   b. Fasten rings to structural ceiling.
   c. Install drive rings at approximately 5 foot intervals.
   d. Route cable through drive rings and cable tie at 10 foot intervals, or every other drive.

B. Vertical Support

1. Riser Systems
   a. Route cable through conduit in vertical riser systems.
   b. Terminate conduit at each stacked closet in a lockable junction box. Refer to Section 28 00 00 – Basic Security Requirements for minimum sizing of junction boxes and equipment enclosures.
   c. Fastened entire cable group to the inside of junction box at every other floor or approximately every 24 feet.
   d. Fasten cable in Junction box utilizing cable ties equipped with eyelets designed to accept screws for fastening or approved equivalent method.

2. Vertical cable on floor space not in riser system
   a. Route cable from below suspended ceiling devices to above ceiling when possible.
      1) Provide conduit and firestoppping for cable routed in fire rated wall assemblies.
      2) Provide conduit for cable routed from below ceiling devices to above ceiling on concrete tilt up style walls.
   b. Cable routed vertically from devices with no suspended ceiling.
1) Provide conduit stub from device junction box to 14 feet above finished floor minimum.

END OF SECTION
SECTION 28 05 53
SECURITY SYSTEM LABELING

PART 1 - GENERAL

1.01 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working security system installation, as described in these specifications.

B. Section Includes:
   1. Labeling of wire, cable, security devices, enclosures, and raceways.

C. Related Sections:
   1. Consult other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
   2. Section 28 00 00 – Basic Security Requirements: includes general project requirements, submittal formats, warranty, and installation requirements.

1.02 SUBMITTALS

A. Product Data: Submit the following:
   1. Product information for components specified herein.
   2. List of equipment (wire, cable, devices, enclosures, and raceways) and the corresponding text for the label.

PART 2 - PRODUCTS

2.01 NAMEPLATES

A. Engraved, plastic laminated nameplates, signs, and instruction plates. Engrave stock melamine plastic laminate 1/16 inch minimum thickness for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Use white letters for engraved nameplates and punch for mechanical fasteners.

2.02 LABELS

A. Wire and Cable Labels:
   1. General
      a. Self-laminating adhesive laser labels.
      c. Cable size: 0.16 – 0.32” OD
      d. Color: white with black lettering
2. Manufacturer:
   a. Panduit #R100X125V1T, #R100X150V1T, and R100X225V1T wire marking labels
   b. Brady #WML-211-295 and #WML-311-292 wire marking labels
   c. Or Equal

B. Device Labels:
   1. Self-laminating, type on tape, adhesive labels. Use Helvetica 12 pt text

PART 3 - EXECUTION

3.01 INSTALLATION

A. General Requirements
   1. Label the security system components. The components include, but are not limited to, the following:
      a. Equipment Enclosures
      b. Conduits
      c. Security Devices
      d. Batteries
      e. Wires and Cables
      f. Equipment Racks
      g. Terminal Blocks
      h. Relays
      i. Patch panels, and the termination positions within the patch panels.
   2. Labels to coincide with device IDs used on the record drawings.
   3. Degrease and clean surfaces to receive nameplates and labels
   4. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using machine screws.

B. Equipment Cabinets
   1. Label SEC enclosures associated with the security system with a nameplate.
   2. Mount label on exterior of door, centered horizontally, and positioned one-third of the door height vertically from the top.
   3. Example: Line 1: “SEC-01” (1/2 inch high letters)
               Line 2: “Security Equipment Cabinet” (1/4 inch high letters)

C. Conduits
   1. Write the destination for every conduit entering a junction box, SEC, and CEC enclosure, or wireway using a black permanent ink marker next to the conduit inside the box.
   2. Example: “To SEC-01”
D. Security Devices
1. Label devices associated with the security system with a permanent machine generated, laminated, label. Use 12 point Helvetica text with a clear background. Use white or black lettering depending upon the color of the device.
2. Label each device in a concealed location with the system point number and address.

E. Batteries
1. Label power supply batteries with the month and year they were installed.
2. Example: “April 2012”

F. Wire and Cable
1. Identify wire and cable clearly with permanent machine-generated labels wrapped about the full circumference within one (1) inch of each connection.
2. Indicate the cable ID designated on the associated field or shop drawings or run sheet, as applies.
3. Assign wire or cable designations consistently throughout a given system; i.e., each wire or cable to carry the same labeled designation over its entire run, regardless of intermediate terminations.
4. Provide labels where wire and cable first enter and exit from conduit, junction or distribution boxes; locate labels within six (6) inches of the point of exit.
5. Positional labels so they are clearly visible without the need to remove wire management or other obstructions.
6. Label cables at both ends of a run and within pull and junction boxes using machine generated wrap-around labels.

3.02 CABLE LABEL FORMAT

A. From Panel to Field Device
1. Line 1: Device Type and Device Number
2. Line 2: Panel ID – Port Number
3. Example: CR 001
   PANEL 2 – CR5
4. Standard Device Types
   a. CR = Card Reader
   b. K = Camera
   c. ET = Entry Telephone
   d. R = Relay Output
   e. A = Alarm Point
5. Standard Port #s
   a. CR = Reader
b. \( M = \) Monitored Input  
c. \( R = \) Relay Output

B. From Door Junction Box to Card Reader
   1. Line 1: Device Type and Device Number  
   2. Line 2: Panel ID – Port Number  
   3. Example: \( CR\ 001\ )  
      PANEL 4 – CR3

C. Miscellaneous Examples:
   1. From Door Junction Box to Door Contact  
      a. \( CR001\ )  
      b. DC  
   2. From Door Junction Box to Rex Alarm  
      a. \( CR001\ )  
      b. REX ALM  
   3. From Panel to Rex  
      a. \( CR001\ )  
      b. REX PWR  
      c. 12 VDC  
   4. From Panel to Lock  
      a. \( CR001\ )  
      b. LCK PWR  
      c. 24 VDC

D. Communications Cable
   1. Line 1: Communication Type and Direction  
   2. Line 2: Panel ID  
   3. Example: \( RS-485\ TO\ )  
      PANEL 2  
   4. Typical Communication Types  
      a. RS-485  
      b. RS-232  
      c. RS-422

END OF SECTION
SECTION 28 08 00
SECURITY SYSTEM ACCEPTANCE TESTING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, and transportation required to thoroughly test the completed security system installation as described in these specifications.

B. Base Bid Work

1. Full testing of a completed security system which includes:
   a. Develop, submit, and obtain Engineer’s approval of security system Pre-functional and Functional testing forms.
   b. Complete 100% Pre-functional test of the security system. Submit Pre-functional testing documentation reflecting that all security devices, cabling, locking hardware, power, interfaces to other systems, IT switches, computer/servers and other components required for a completely functional security system are provided per project documents.
   c. Complete 100% Functional test of the security system. Submit Functional testing documentation reflecting that all security equipment, components, interfaces, and programming are functioning correctly per project documents. Upon receiving approval of functional testing documentation, schedule final acceptance testing activities to be witnessed by Engineer and/or Owner.
   d. Demonstrate 100% security system functionality to the Engineer and/or Owner. Document testing activities and submit with final As-Built drawing.

C. Related Sections:

1. Section 28 00 00 – Basic Security Requirements
2. Section 28 05 13 – Security System Cabling
3. Section 28 05 53 – Security System Labeling
4. Section 28 08 00 – Security System Acceptance Testing
5. Section 28 13 00 – Access Control and Alarm Monitoring System
6. Section 28 16 00 – Intrusion Detection System
7. Section 28 23 00 – Video Surveillance System

1.02 SUMMARY OF SYSTEM COMMISSIONING ACTIVITIES

A. Overview

1. The purpose of system commissioning is to ensure the security system operates properly when it is needed most. Security systems are very complex from both an equipment and programming standpoint, and thorough testing is necessary to ensure correct operation.
2. Perform testing activities after-hours or on weekends when the system is “quiet” and the building is generally unoccupied. This will minimize the amount of irrelevant activity in the system activity reports that will be used as a record of the pre and final test results.

B. Pre-Functional Test

1. Perform a 100% pre-functional test of system aspects to verify correct operation prior to scheduling the final test. The pre-test will help to make the final test run smoothly when demonstrating the system’s operation to the Owner and Engineer.

2. Document the results of the pre-test using the approved test forms and submit a copy to the Engineer along with the system activity reports.

C. Functional Test

1. Perform a 100% functional test of system aspects to verify correct operation prior to scheduling the final test. The functional test will help to make the final test run smoothly when demonstrating the system’s operation to the Owner and Engineer.

2. Document the results of the pre-test using approved test forms and submit a copy to the Engineer along with the system activity reports prior to final acceptance test.

D. Final Acceptance Test

1. Perform a final test of the system in the presence of the Engineer and/or Owner to demonstrate correct operation of the security system.

1.03 SUBMITTALS

A. Operation and Maintenance Manuals: Submit the following for review and comment at the completion of the project:

1. Functional Design Manual: Includes a detailed explanation of the operation of the system.

2. Hardware Manual which includes:
   a. Pictorial parts list and part numbers
   b. Pictorial and schematic electrical drawings of wiring systems, including devices, control panels, instrumentation and annunciators
   c. Telephone numbers for the authorized parts and service distributors
   d. Include service bulletins

3. Software Manual which includes:
   a. Use of system and applications software
   b. Initialization, start-up, and shut down procedures
   c. Alarm Reports

4. Operator’s Manual which fully explains procedures and instructions for the operation of the system and includes:
   a. Computers and peripherals
   b. System start up and shut down procedures
   c. Use of system, command, and applications software
   d. Recovery and restart procedures
   e. Graphic alarm presentation
   f. Use of report generator and generation of reports
5. Maintenance Manual which includes:
   a. Instructions for routine maintenance listed for each component, and a multi-page summary of component’s routine maintenance requirements.
   b. Detailed instructions for repair of the security system.
   c. A summary of the software licenses, including license numbers, quantity of clients, summary of the software options provided and database capabilities.
   d. A summary of the TCP/IP address used and which system component they are associated with. Include the gateway address, subnet mask, DNS server, and host name information.

6. Test Results Manual, which includes the document results of tests, required under this Specification, organized by System, Floor, and Door.

7. Record Drawings Manual which includes 11”x17” prints of record drawings as described below.

B. Record Drawings: Submit the following for review and comment at the completion of the project:

1. Drawings to fully represent installed conditions including actual locations of devices, actual cable and terminal block numbering, and correct wire sizing as well as routing. Record changes in the work during the course of construction on blue or black line prints.

2. Include drawings submitted as part of the Shop Drawing package, plus additional information required to accurately document installed conditions.

3. Include the following additional information:
   a. Device addresses & IP address information.
   b. Settings for each camera (lens specs, mm setting, auto shutter setting, and other available camera settings, etc.)

4. Final acceptance will not be made until the Engineer approves the record drawings.

1.04 QUALITY ASSURANCE

A. Provide a project manager to coordinate the security system commissioning work with other trades.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 SCHEDULING

A. Coordinate security acceptance testing with the General Contractor, and provide specific information on pre-test and final-testing activities to be entered into the overall project construction schedule.
3.02 TESTING REQUIREMENTS

A. Site Tests

1. Perform a 100% pretest of the system prior to final testing by the Engineer. Provide the Engineer with a minimum of a 5 day notice prior to scheduling testing.

2. At the conclusion of the work on a floor, test the system on that floor to verify proper operation and reporting of devices.

3. Work with the door hardware supplier to resolve electric hardware failures and door alignment/closure problems.

4. At the completion of the work, test the entire system to verify proper operation. At a minimum, include these tests:
   a. Building Perimeter Test: Test doors, cameras, and devices related to securing the perimeter of the building.
   b. MDF/IDF Test: Test devices related to securing the MDF and IDF rooms. Inspect system panels, power supplies, and other related security equipment located in these areas.
   c. Access Control System Test: Test the software for correct programming and setup. Test control and alarm communication through both campus and District security workstations. Verify correct integration with the IDS and Video Surveillance Systems.
   d. CCTV Recording System Test: Test the recording system for correct programming, alarm recording, and event retrieval. Verify correct integration with the ACAMS and IDS system for alarm call-up. Test and verify CCTV system viewable from workstations.
   e. Intrusion Detection System Test: Test the alarm dialer and duress stations for correct programming and operation. Verify correct arming/disarming functions from each keypad and alarm partitioning. Verify integration with ACAMS and Video Surveillance Systems.
   f. CCTV Camera Test: Review cameras for proper coverage, video quality, physical installation, etc.
   g. Other Readers/Door Test: Test remaining card readers, scheduled unlock doors, and exit-only doors not included in the above tests.
   h. Glass Break Test: Test the glass break detectors for correct operation.
   i. Motion Detector Test: Test the motion detectors for correct operation and coverage.
   j. Battery and UPS Load Test: Disconnect AC power to security system equipment to verify battery operation functions and system remains fully operational.

B. Test Preparation
1. Provide device identification numbers that differ from or were not included on the original contract drawing set.

2. Provide a complete systems point list.

3. Provide paper and toner for the printer so that an event log can be printed out and attached to the test reports as verification of test sequence and systems response.

4. During testing, provide a minimum of three technicians familiar with the installation to assist with the test. Stage the technicians as follows: one at the host, one at the device being tested, and one runner responsible to furnishing tools, step ladders, etc.

5. Provide radios for use by the Engineer and Owner during testing.

6. Provide pre-programmed access cards for use during testing. Provide one card for each access level.

**3.03 TEST PROCEDURES**

A. Refer to the test forms for testing procedures for each type of device/system.

**3.04 DOCUMENTATION**

A. Provide a full-sized blueline drawing containing a detailed wiring diagram (layout of equipment/elevation, complete parts list, and a complete wiring diagram for each ACU & I/O Board) for each SEC. Fold the diagram and place it inside a clear plastic pocket affixed to the inside door of the SEC.

B. Provide a service log on the inside door of each SEC. Include columns for the following information: date of service, description of work performed, service technician(s), service company in the service log. Place the service log inside a separate clear plastic pocket affixed to the inside door of the SEC.

**3.05 DEMONSTRATION**

A. On completion of the acceptance test, instruct the owner's representatives, at a time convenient to them, in the operation and testing of the system.

B. Utilize the database for the project during training to give the users a project specific example to learn from.

C. Provide a minimum of 12 hours of on-site training by a factory trained representatives. Maintain a sign in sheet with names and dates of persons trained and forwarded to owner upon completion of training.

D. Provide for two Owner's representatives to attend factory certification training (off-site) for both the following systems:

1. Access Control System
2. Video Surveillance System

END OF SECTION
SECTION 28 13 00

ACCESS CONTROL & ALARM MONITORING SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working Access Control & Alarm Monitoring system installation, as described in these specifications.

B. Section Includes:
   1. ACAMS control panels, input/output modules, and card readers
   2. ACAMS power supplies
   3. Alarm initiating devices, including: magnetic switch contacts, and request-to-exit sensors.
   4. Interface to electric door hardware and ADA door operators
   5. Interface to security subsystems to allow bi-directional communication with one another

C. Products Installed But Not Supplied Under This Section:
   1. Electric feed-through power transfer hinges
   2. Electrified locking hardware cable and termination to transfer hinge and security system

D. Products Furnished and Installed Under another Section:
   1. 120V power
   2. Conduit, junction boxes
   3. ADA door operators and push buttons
   4. Fire/life-safety system interface relays
   5. Electromagnetic door holders
   6. Network connectivity for ACAMS devices via Owner’s local/wide area network

E. Related Sections:
   1. Consult other Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
   2. Section 08 71 00 – Door Hardware: for wireless card reader with integrated locking hardware product requirements.
   3. Section 28 00 00 – Basic Security Requirements: for submittal formats, warranty, general product requirements, and installation requirements.
4. Section 28 05 13 – Security System Cabling: for cable requirements related to the ACAMS.

5. Section 28 05 53 – Security System Labeling: for device labeling requirements.


7. Section 28 16 00 – Intrusion Detection: for interface requirement to the ACAMS.

8. Section 28 23 00 – Video Surveillance System: for interface requirement with the ACAMS.

1.02 SYSTEM DESCRIPTION

A. Overview

1. The ACAMS is a distributed network of control panels connected to and programmed from an existing host server and client workstations, one located at the District Office and the others at each respective campus.

2. The ACAMS is utilized for electronically controlling access to students, delivery personnel, and staff entrances to the building(s).

3. The ACAMS consists of an existing Software House CCURE 9000 server located at the District Office in Martinez, existing client workstations, control panels, card readers, battery powered wireless card readers with integrated locking hardware, wireless interface modules and alarm initiating devices. The host server communicates with the field panels via the Owner’s local/wide area network.

4. Card reader doors must tie into the existing District-wide host server. Develop schedules to automate the opening and closing of the building(s), including unlocking doors, bypassing alarms, and enabling ADA actuation devices.

5. Card readers used in classrooms and/or additional locations as identified by the college must include emergency lockdown capability for shelter in place. The lockdown capability will:
   a. Disable the exterior reader and only allow excess via mechanical key only.
   b. Notify Police Services via the access control system and/or the intrusion detection system of emergency lockdown alarm event.

6. The ACAMS also provides secondary alarm monitoring and alarm partition control of the IDS control panels through software integration.

B. Access Control & Alarm Monitoring System

1. Provide ACAMS interface software license for IDS control panels and program to enable bidirectional alarm communication for alarm notification and partition arm/disarm control.

2. Provide ACAMS interface software to VSS network video recorders to enable alarm event recording and automatic call up of associated cameras upon alarm activation (forced door, door held open, etc.).
3. Provide ACAMS control panels located in the telecommunication rooms as indicated on project drawings. Coordinate exact location of control panels with local IT department. Panels support up to 16 card readers with locking control outputs and multiple general-purpose input/output modules for automation.

4. Provide proximity wireless card readers with integrated locking hardware. Wireless readers are battery powered.

5. Provide wireless interface modules. Field determine the quantity and exact locations of the wireless interface modules for full coverage of wireless card readers.

6. Provide wireless survey kit to verify wireless interface module placement.

7. Provide input and output modules in a lockable enclosure to support the project specific security system requirements.

8. Provide multi-technology card readers with optical tampers on doors deemed critical to the security of assets subject to a high possibility of theft, sensitive information, or other areas of critical nature and doors with operational requirements such as building entrances, as noted on the project drawings.

9. Provide alarm contacts and request-to-exit motion detectors for card reader controlled doors. Include output from ACAMS to indicate alarm contact status to IDS.

10. Provide alarm contacts for non-card reader controller perimeter doors as indicated on project drawings.

11. Provide local audible alarms at monitored emergency exit-only doors and special card reader doors as indicated on project drawings. Local audible alarms to sound upon alarm activation (forced door, door held open, etc). Provide monitoring of the keyswitch and remote reset through the ACAMS.

12. Utilize IDS integration to monitor motion detector and duress alarms through the ACAMS workstation.

13. Provide interface to ADA automatic/power assist door operator and corresponding actuator push plates or optical motion detection actuators.
   a. When door locked, exterior push plate/optical sensor is disabled
   b. When door unlocked, even momentarily, push plate/optical sensor is enable.
   c. Interior push plate/optical sensor unlocks door and triggers automatic door operator at all times.

14. Provide 12/24VDC ACAMS device and lock power supplies as indicated on project drawings with enclosure tamper switches.

15. Provide battery backup of system components and power supplies.

C. Tamper Monitoring

1. Provide additional monitor input points for monitoring the following:
   a. Tamper switches located within each security equipment enclosure and wireway (use unsupervised inputs for this purpose).
b. Supervision of power supplies and batteries (use unsupervised inputs for this purpose).

c. Tamper switches located within each door junction box.

1.03 SUBMITTALS

A. Contractor Qualifications: Submit certification letters for the manufacturer of the ACAMS.

B. Product Data: Submit product information for components specified herein.

C. Shop Drawings:
   1. Device placement on floor plans
   2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:
      a. ACAMS control panel
      b. ACAMS card reader and input/output modules
      c. ACAMS power supplies
      d. Card Readers
      e. Wireless Card Reader interface modules
      f. Alarm contacts and request-to-exit sensors
      g. Local audible alarms
      h. Interface to electrified door hardware
      i. Interface to ADA auto operators and actuators
      j. Hardwired interfaces to IDS
      k. Cable conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)
   3. Schedules: Provide schedules for ACAMS control panels that show each point ID with a description of the connected devices.
   4. Block Diagram/Riser Diagram: Show the ACAMS components, conduit, wire types, and sizes between them, including cabling intertities between termination hardware.
   5. Custom mounting details

1.04 EXTRA MATERIALS

A. Provide 10% spare parts of total installed the following: (Round up to the next complete device)
   1. Card Readers
   2. Fuses (Place five (5) of each type of fuse inside each SEC and power supply housing).
   3. Relays

PART 2 - PRODUCTS
2.01 MANUFACTURERS

A. Access Control & Alarm Monitoring System
   1. Software House CCURE 9000 to match campus standards

2.02 ACAMS CONTROLLERS

A. General
   1. An intelligent controller with integrated battery backup, database, and communication ports that supports 16 card readers.
   2. Supports multiple communication channels to which a variety of devices can connect.
   3. Supports hardware modules used for additional memory and/or for future feature enhancements.
   4. Functions provided include:
      a. Central control for attached devices and addressable modules
      b. Makes decisions for access
      c. Responds to monitor activity
      d. Receives input to control its decision making
      e. Reports activity to other devices

B. Features
   1. Supports HID proximity, MIFARE, and DESFire card reader formats
   2. Supports flash upgrades for firmware updates
   3. Utilizes an onboard Ethernet NIC for TCP/IP communication, supporting IPv4 and IPv6
   4. Global input/output and anti-passback functionality
   5. Capable of utilizing keypad commands to activate/deactivate events

C. Supports RS-485 or RS-422 connectivity to addressable modules:
   1. Input Module: Supports 8 Class A supervised input points
   2. Output Module: Supports 8 Form C dry contact relays
   3. Reader Interface Module: Supports 2 or 4 card readers with associated alarm contacts, request-to-exit devices, and lock outputs

D. Manufacturer
   1. Software House # iSTAR ULTRA 64MB control panel
      a. Accessories
         1) Software House # I8 input module
         2) Software House # R8 output module
         3) Software House # RM-4E reader interface module
         4) Allegion PIM400-485; Panel Interface Module
2.03 EQUIPMENT ENCLOSURES

A. General
   1. Provide enclosures with butt hinged and lockable door containing a lock kit (keyed alike with other security enclosures on the project).
   2. Provide perforated back panel for mounting control boards, relays, and terminal strips with enclosure.
   3. Provide slotted wiring duct for routing security cabling within enclosure.
   4. One tamper switch for each enclosure

B. Security Equipment Cabinets
   1. Type: NEMA type 1 enclosure
   2. Size: 36” x 24” x 6” minimum
   3. Finish: ANSI 61 gray polyester powder paint finish inside and out
   4. Manufacturer:
      a. Cooper B-Line # 36246-1PP with back panel and lock kit
      b. Hoffman #A36N24M with #A36N24MPP back panel and #A612AR lock kit
      c. Or Equal

C. Security Junction Boxes
   1. Type: NEMA type 1 enclosure
   2. Size: 12” x 12” x 6” minimum
   3. Finish: ANSI 61 gray polyester powder paint finish inside and out
   4. Manufacturer:
      a. Cooper B-Line # 12126-1PP with back panel and lock kit
      b. Hoffman # A12N126 with #A12N12PP back panel and # A612AR lock kit
      c. Or Equal

D. Slotted Wiring Duct
   1. Type: Lead-free PVC with narrow finger design
   2. Size: 1” x 1” minimum
   3. Color: Light gray
   4. Manufacturer:
      a. Panduit # Type-F narrow slot wiring duct
      b. Iboco # T1-1010 wiring duct
      c. Or Equal

2.04 WIREWAYS
A. General:
1. Provide screw cover wireway sections with open top assembly as shown on Security drawings.
2. Provide closure plates to secure end of wireway sections.

B. Screw Cover Gutter Wireways
1. Type: NEMA type 1 enclosure
2. Size: 4” x 4” x 48” minimum
3. Finish: ANSI 61 gray polyester powder paint finish inside and out
4. Manufacturer:
   a. Copper B-Line # 4448-G-NK lay-in painted wireway without knockouts
   b. Hoffman # F44T148GVP lay-in painted wireway without knockouts
   c. Or Equal
5. Accessories:
   a. Cooper B-Line # 44-E-NK closure plate without knockouts
   b. Hoffman # A44GCNPNK closure plate without knockouts
   c. Or Equal

2.05 TERMINAL BLOCKS
A. General
1. Provide terminal blocks inside SEC for demarcation of elevator traveler and security cabling.
2. Provide DIN rails and other mounting accessories for a complete installation.

B. Modular Terminal Strips
1. Push-in style bridging system that utilizes the IDC termination method
2. Feed through style, single level
3. Modular design
4. Capable of mounting on standard 35mm DIN rails
5. Manufacturer:
   a. Phoenix Contact # QTC-1,5 terminal block
   b. Weidmuller
   c. Or Equal
6. Accessories:
   a. Phoenix Contact # NS-35/7,5 DIN rail
   b. Weidmuller
   c. Or Equal

2.06 CARD READERS
a. Card Readers under Increment 1 are furnished under door hardware as a part of the retrofit to existing spaces. Refer to division 08 for Integrated Card reader door hardware

2.07 ACCESS CARDS
A. General
   1. Utilizes a graphics quality surface that supports direct-to-card printing.
   2. Capable of being produced with holograms, ultra-violet fluorescent inks, or other anti-counterfeiting features.

B. Manufacturer
   1. HID ISOProx II proximity card, Corporate 1000 Program; verify card format with College in writing prior to ordering.

2.08 SECURITY SYSTEM PRINTERS
A. Badging System Printer
   1. Features
      a. Print Method: Dye-sublimation, resin thermal transfer
      b. Resolution: Up to 300 dpi
      c. Colors: Up to 16.7 million, 256 shades per pixel
      d. Accept card thickness from 0.020 inches to 0.060 inches
      e. Capable of utilizing custom watermarks for additional security
      f. Includes Ethernet NIC option
   2. Manufacturer
      a. HID # DTC550 card printer
      b. Zebra # P430i card printer
      c. Magicard # Tango 2e card printer
      d. Or Equal

2.09 MAGNETIC CONTACT SWITCHES
A. Wood, Steel, and Hollow Metal Doors
   1. General
      a. Mounting: Recessed
      b. Contacts: Single Pole, Single Throw
      c. Gap Distance: 0.5” maximum
   2. Manufacturer
      a. GE Security # 1078C 3/4” alarm contact switch
      b. GRI
      c. Or Equal

B. Local Audible Alarmed Doors
1. General
   a. Mounting: Recessed
   b. Contacts: Single Pole, Double Throw
   c. Gap Distance: 0.5” maximum

2. Manufacturer
   a. GE Security #1076C 3/4” alarm contact switch
   b. GRI
   c. Or Equal

2.10 REQUEST-TO-EXIT MOTION SENSORS

A. General
   1. Power: 12 or 24VDC, 35mA
   2. Relay Output: 2 form “C” contacts
   3. Adjustable relay latch time
   4. Programmable retrigger or non-retrigger mode
   5. Programmable Fail Safe or Fail Secure Modes
   6. Radio Frequency Interference (RFI) Immunity range from 26 to 1,000 MHz at 50 v/m

B. Manufacturer
   1. Bosch #DS160 with TP160 trim plate
   2. Honeywell #IS320WH with IS310WHTP trim plate
   3. Or Equal

2.11 LOCAL AUDIBLE ALARMS

A. General
   1. Panel operating voltage selectable 12 or 24VDC at 150mA.
   2. Keystwitch operation using rim cylinder provided by Owner to match existing standard.
   3. Utilizes 80 Db horn.
   4. Input points for door switch, alarm shunt, door status, tamper switch, and key switch override.
   5. Output points for door propped alarm, intrusion alarm, door status, tamper switch, and key switch override.
   6. Timers for access period, warning period, and auto reset.
   7. Tamper switch to detect the removal of the unit from the electrical back box.

B. Manufacturer
   1. Designed Security #4200 local alarm sounder
2. Or Equal

2.12 ACAMS POWER SUPPLIES

A. General
   1. Provides a 120VAC to 12 and 24VDC output, fully supervised power supply to power ACAMS field devices.
   2. Utilizes 16 fused Class 2 rated power limited outputs.
   3. Short circuit and thermal overload protection.
   4. Integrated charger for sealed lead acid or gel type batteries.
   5. Capable of providing a 10 amp supply current.
   6. Supports a fire alarm disconnect to relay that individually selects any or all of the 16 outputs.
   7. Enclosure with integrated tamper switch

B. Manufacturer
   1. Altronix # MAXIM75 power supply
   2. Or Equal

2.13 BATTERIES

A. General:
   1. Voltage: 12.00
   2. Amps: 12.00
   3. Chemistry: SLA or VRLA valve regulated
   4. Termination: Spade protected terminals

B. Manufacturer:
   1. Yuasa #RE12-12 sealed lead acid 12V 12Ah battery
   2. Interstate Batteries #SLA1105 sealed lead acid 12V 12Ah battery
   3. Or Equal

PART 3 - EXECUTION

3.01 INSTALLATION

A. ACAMS Control Panels
   1. Place power supply and associated hardware in same location.
   2. Install supervisory and end-of-line (EOL) resistors as required. Refer to Section 28 00 00 – Basic Security Requirements for EOL supervision requirements.
   3. Connect power supply tamper switches to ACAMS for SEC hub monitoring.
B. Wireless Interface Module
   1. Field determine best location for wireless card reader interface module. Locate module above accessible ceiling, whenever possible to avoid damage to units.
   2. Connect wireless interface module to ACAMS panel using the RS-485 data bus.

C. Remote Reader Modules
   1. Locate remote reader module in accessible ceiling space unless otherwise noted on the project drawings.
   2. Power remove reader modules from power supply located at centralized security hub.

D. Four-State End-of-Line (EOL) Supervision
   1. Provide designated resistors at device end of line per manufacturer’s EOL recommendation to provide four-state supervision of security device and cabling.
   2. Provide EOL supervision for alarm contacts, local alarm sounders, motion detectors, help/durress buttons, and other designated security devices connected to the ACAMS and IDS.
   3. Provide the following states of supervision:
      a. Contact closed = Secure
      b. Contact open = Alarm
      c. Short circuit = Line fault
      d. Open circuit = Line fault

E. Card Readers
   1. Wire the card reader’s multi-color LED to indicate the following status of the door.
      a. Red status indicates the door is secure (locked).
      b. Green status indicates the door is unsecured (unlocked).
      c. Yellow status indicates the card reader is not functioning (off-line/trouble), is processing a read request, or has denied access.
   2. Utilize configuration card to enable optical tamper.
   3. Wire the card reader’s optical tamper to spare input on the ACAMS reader module and jumper ground wire from door contact to provide a Normally Closed circuit.
   4. The card reader to produce an audible beep tone to indicate to the user:
      a. The card was read and/or access was denied.
      b. Door is being held open and needs to be closed.

F. Door Hardware
   1. Route power to electrically controlled locks on life-safety doors through fire alarm output to automatically unlock the door upon activation of Fire/Life-Safety system. Connect fire alarm output to the disconnect relay on the associated 24VDC lock power supply.
2. Setup and conduct a door hardware coordination meeting.

3. Coordinate the installation and termination of the security cable with the installation of the electric door hardware and transfer hinge.

4. Provide cable and terminate wires to delayed egress devices for monitoring activation of delayed egress by the ACAMS system.

G. Door Contacts
   1. Install on protected (secured) side of door.
   2. Install 6” from leading edge at top of door.

H. Request-To Exit Motion Detectors
   1. Mount motion detector on the secured (protected) side of door.
   2. Install motion detector so that detection pattern is not obstructed by Exit Signs, light fixtures and other objects that would interfere with proper operation.
   3. Adjust relay hold time and pattern to properly detect valid exit and allow shunting of door contact.
   4. Adjust detection sensitivity to pulse.
   5. Mask detector lens to provide a confined detection area limited to the door handle or pushbar.
   6. Run wire inside structural tube steel frame into back of conduit for cage locations.

I. Local Alarm Sounders
   1. Mount local alarm sounder as indicated on project drawings.
   2. Install local, square, and plumb. Set flush-mounted units so that the face of the cover, bezel, or escutcheon matches the surrounding finished surface.
   3. Mount so that there are no gaps, cracks, or obvious lines between the trim and the adjacent finished surface.

3.02 PROGRAMMING

A. Prior to the completion of construction, schedule and hold a meeting with the Owner to determine the programming criteria. Discuss the following:

   1. Door and device names
   2. Access card levels and door groupings
   3. Alarm priority levels
   4. Alarm integration with IDS including arming and disarming protocol through the ACAMS card readers (for example valid card disarms alarm partition while presenting card two times arms alarm partition)
   5. Schedules and time codes
   6. Holidays and holiday types (priorities)
7. Action/responses from individual input points
8. Standard and custom (expanded) reports
9. Defining alarm messages and standard response messages applicable to site
10. Routing of alarm points to selected pagers
11. Routing of alarm points to operator’s workstations, printers, and history files
12. Coordinate implementation of graphics with Owner. Develop sample graphic complete with icons and text. Alarms to appear on building floor plans depicting the nature and location of alarms. Review and revise graphic layout as required by Owner.
13. System data base backup to external hard-drives

B. Document the results of the meeting and perform necessary programming to achieve the Owner’s requests.

C. System Operation, Alarm and Reporting Function: Program door control panel tamper switches to immediately reported as a separate “tamper” point to the system resulting in an alarm condition displayed in both text and graphic form on the applicable workstation(s) and an alarm message transmitted to the appropriate pager(s).

D. Receive CAD drawing files of floor plans and perform the following relative to system graphics:
1. Delete non-applicable drawing layers and details to arrive at simple floor plans of the building as built.
2. Convert drawings to a graphic file format compatible with the Owner’s access control and alarm monitoring system.
3. Load drawing files into the system.
4. Apply new and predefined icons and other points on each graphic to indicate point and control status.
5. Link graphic images to reader, monitor and control points.

E. Program routing of monitor and control points. Route activations and restore messages to one or more of the following locations as directed by the Owner’s Representative:
1. One or more system workstations;
2. One or more system printers;
3. One or more alphanumeric pagers;
4. History files in addition to the above;
5. History files only.

F. Program the system such that reliance on a remote host for routine building operations, such as scheduled door commands and conditional events, are minimized to the greatest extent possible and decisions are made at the local building controller.
G. Program the system in a manner that minimizes the amount of time required for the users to make updates and maintain the system on a daily basis especially updates that impact card holder record updates. Nested programs, such as reader groupings used in access codes shall be used to the greatest extent possible such that single actions are required to update an entire card data population. If there is a question regarding the appropriate approach to programming, given the flexibility of most systems, contact the Engineer prior to any initial programming.

H. Complete other programming as required for system operation.

I. Program and setup the system such that no additional programming other than entering new access cards is required. Include setup of available features of the software.

J. Use the point names provided on the system point schedule.

K. Perform 2 full system back-ups at completion of initial programming and deliver one copy to owner with letter of Transmittal explaining information included in back-up and brief description of recovery procedures. Label the second CD-ROM and store onsite. Perform back-ups on a regular basis through the remainder of the project.

L. Customize menus with the assistance of the factory to “gray-out” features not used on project (such as elevator control).

M. Perform field software changes after the initial programming session to "fine tune" operating parameters and sequence of operations based on revised operating requirements.

3.03 TESTING

A. Commission ACAMS in accordance with Section 28 08 00.

END OF SECTION
SECTION 28 16 00

INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction, and special or occasional services required to make a complete working intrusion detection system installation as described in these specifications.

B. Section includes:
   1. Intrusion Detection System, including digital communicator, keypad, and alarm devices.
   2. Door contacts, glass break detectors, motion sensors
   3. Duress alarm stations
   4. Interfaces and connections between intrusion detection subsystems to allow communication with one another

C. Products furnished and installed under another section:
   1. 120V power
   2. Network connectivity for IDS Panel via Owner’s local/wide area network
   3. Phone line

D. Related sections:
   1. Section 28 00 00 – Basic Security Requirements: for submittal format, warranty, general product requirements, and installation requirements
   2. Section 28 13 00 – ACAMS: for interface requirement to the intrusion detection system
   3. Section 28 05 13 – Security System Cabling: for cable requirements related to the IDS
   4. Section 28 05 53 – Security System Labeling: for device labeling requirements
   5. Section 28 08 00 – Security System Acceptance Testing: for testing requirements

1.02 SYSTEM DESCRIPTION

A. Overview

   1. The IDS is comprised of multiple areas that can be armed and disarmed independently of each other
   2. The IDS is utilized for after hours monitoring of the building(s), interior partitions and alarm zones. The IDS will also be utilized for 24-hour monitoring
of specific areas which include but are not limited to duress buttons, glass breaks, etc.

3. Activation of the IDS dials a remote, third party central station to first contact Police Services on campus during campus hours or dispatch the local Police Department after hours.

4. The IDS integrate with the ACAMS through software to send alarm information for secondary monitoring with the ACAMS and hardwired input points for remote monitoring of ACAMS door alarm contact status.

B. Intrusion Detection System

1. Provide an IDS control panel with integrated UL listed digital communicator shown on the project drawings. Panels support up to 8 areas and 64 zones by use of addressable input/output point modules.

2. Provide LCD command keypads as indicated on project drawings. Keypads allow for system arming and disarming by authorized users.

3. Provide wireless back up alarm communicator.

4. Provide under counter duress buttons as indicated on project drawings. Program duress alarm inputs as 24 hours zones.

5. Provide alarm contacts on perimeter doors and operable windows as indicated on project drawings.

6. Provide local audible alarms on doors indicated on project drawings.

7. Provide double pole, double throw alarm contacts on doors with local alarm sounders. Wire one contact to alarm sounder and wire the other contact to the IDS.

8. Provide 12VDC auxiliary power supply to support the field devices indicated on project drawings.

9. Provide battery backup of IDS components and power supplies for a minimum of 24 hours in the event of a power failure or emergency.

C. Interface with ACAMS

1. Connect ACAMS alarm outputs to the IDS control panel. Provide expansion modules as necessary to support the security devices shown on the project drawings.

2. Integrate IDS with ACAMS for alarm monitoring and alarm partition arming/disarming through ACAMS workstation(s).

D. Tamper Monitoring

1. Provide additional monitor input points for monitoring the following:
   a. Tamper switches located within each security equipment enclosure and wireway (use unsupervised inputs for this purpose).
   b. Supervision of power supplies and batteries (use unsupervised inputs for this purpose).
1.03 SUBMITTALS

A. Product Data: Submit product information for the intrusion detection systems, including:
   1. IDS control panel
   2. Keypads
   3. Cellular backup communicator
   4. Duress buttons
   5. Alarm contacts
   6. Local audible alarms
   7. Power supplies
   8. Calculations for backup batteries

B. Shop Drawings: Submit shop drawings containing the following:
   1. Device placement on floor plans
   2. Point-to-Point Wiring Diagrams: Include wiring, points of connect, and interconnecting devices between the following:
      a. IDS control panel
      b. IDS expansion modules and relays
      c. Keypads
      d. Alarm contacts
      e. Local audible alarms
      f. Power supplies
      g. Cable conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)
   3. Schedules: Provide schedules for the IDS control panel that show each alarm zone, applicable area or partition, and a description of the connected device.
   4. Custom mounting details

1.04 EXTRA MATERIALS

A. Provide 10%, of the total installed, spare parts for the following: (Round up to the next complete device)
   1. Duress buttons
   2. Alarm contacts

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Intrusion Detection System
   1. DSC to match campus standard
2.02 IDS CONTROL PANELS

A. General

1. Integrated UL listed digital communicator with phone line monitor (loop or ground start).
2. Supports up to 64 alarm zones and 8 programmable areas or partitions.
3. Capable of utilizing multiple telephone numbers, primary and duplicate paths with main and alternate destinations.
4. Capable of utilizing a dual phone line switcher to monitor 2 phone lines.
5. Capable of sending daily automatic test and status reports.
7. Supports RS-232 connectivity to third party devices for automation.

B. Manufacturer

1. DSC PowerSeries #PC1864 8-64 zone control panel
   a. Accessories
      1) DSC #PC5200 Power Supply Module
      2) DSC #PC5204 Power Supply Module
   b. Expansion modules
      1) DSC #PC5100 Addressable Xone Expander
      2) DSC #PC5108 8-Hardwire Xone Expander
      3) DSC #PC 5208 Programmable Output Module
      4) DSC #IT-100 Integration Module
      5) Lantronix #UDS1100 w/ #500-163-R cable adapter
      6) DSC #TL250GS Internet Alarm Communicator
   c. Wireless back-up communication device
      1) DSC #GS3060; Universal Wireless Alarm Communicator

2.03 IDS KEYPADS

A. General

1. 32-character display
2. Keys light on entry or key press
3. Back lighted multi-key touch pad
4. User controlled brightness and loudness

B. Provide the ability to display for each detection point:

1. Alarm
2. Trouble
3. Supervisory
4. Faulted
5. Custom text

C. System wide displays include:
   1. Local system test
   2. Sensor reset
   3. Event log

D. Manufacturer
   1. DSC #PK5500 64-Zone LCD Full-Message Keypad

2.04 DURESS BUTTONS

A. General
   1. Actuating lever, housing, and cover plate made of ABS fire-retardant plastic
   2. Latching circuit with integrated LED
   3. Contact: Normally Open or Normally Closed electrical loop, SPDT
   4. Operating Voltage: 12VDC

B. Manufacturer:
   1. GE Security # 3040 panic switch
   2. Or Equal

2.05 MOTION SENSORS

A. General
   1. Type: Passive infrared (PIR) detector with Fresnel type lens
   2. Operating Voltage: 10-14VDC
   3. Range: 35’ x 35’ minimum
   4. Integrated tamper switch

B. Manufacturer
   1. Wall mount
      a. Bosch # ISM-BLP1 blue line PIR detector
      b. Or Equal
   2. Ceiling Mount
      a. Bosch # DS938Z panoramic PIR detector
      b. Or Equal
2.06 MAGNETIC CONTACT SWITCHES

A. Wood, Steel, and Hollow Metal Doors
   1. Mounting: Recessed
   2. Contacts: Single Pole, Single Throw
   3. Gap Distance: 1.0” maximum
   4. Manufacturer:
      a. GE Security # 1078 1” alarm contact switch
      b. Or Equal

B. Local Audible Alarmed Doors
   1. Mounting: Recessed
   2. Contacts: Double Pole, Double Throw
   3. Gap Distance: 0.5” maximum
   4. Manufacturer:
      a. GE Security # 1076D alarm contact switch
      b. Or Equal

C. Overhead Roll-Up Doors
   1. Mounting: Surface
   2. Contacts: Single Pole, Single Throw
   3. Gap Distance: 3.0” maximum
   4. Wiring: Armor Cable, 12” minimum
   5. Manufacturer:
      a. GE Security # 2205 floor mounted contact switch with 3’ armored cable lead
      b. Or Equal

2.07 LOCAL AUDIBLE ALARMS

A. General
   1. Panel operating voltage selectable 12 or 24VDC at 150mA.
   2. Keyswitch operation using rim cylinder provided by Owner to match existing standard.
   3. Utilizes 80Db horn.
   4. Input points for door switch, alarm shunt, door status, tamper switch, and key switch override.
   5. Output points for door propped alarm, intrusion alarm, door status, tamper switch, and key switch override.
   6. Timers for access period, warning period, and auto reset.
7. Tamper switch to detect the removal of the unit from the electrical back box.

B. Manufacturer
   1. Designed Security # 4200 local alarm sounder
   2. Or Equal

2.08 IDS POWER SUPPLIES

A. General
   1. Provides a 120VAC to 12/24VDC output, fully supervised power supply to
      power IDS field devices.
   2. Utilizes 16 PTC Class 2 rated power limited outputs.
   3. Short circuit and thermal overload protection.
   4. Integrated charger for sealed lead acid or gel type batteries.
   5. Capable of providing 6 amp supply current.

B. Manufacturer
   1. Altronix # AL600ULXPD16CB multi-output power supply/charger
   2. Or Equal

PART 3 - EXECUTION

3.01 INSTALLATION

A. General
   1. Follow manufacturers recommended guidelines for installation.

B. Components
   1. IDS Control Panel
      a. Utilize dedicated power supplies to power control panel and associated
         expansion boards. Do not use plug-in transformers.
      b. Place power supply and associated hardware in same location.
      c. Install supervisory and end-of-line resistors on alarm initiating devices.
      d. Coordinate installation of phone jack and network connection in IDS
         control panel enclosure for communications to the contracted central
         station and integration with the ACAMS.

   2. Keypads
      a. Mount keypads as indicated on project drawings.

   3. Duress Buttons
      a. Mount duress buttons under work desks as indicated on the project
         drawings.
      b. Coordinate with architect and casework contractor to field determine
         exact placement prior to installation.
4. Motion Sensors
   a. Mount motion detectors as indicated on project drawings. Verify current location to maximize coverage prior to installation.
   b. Install motion detector so that detection pattern is not obstructed by exit signs, light fixtures, and other objects that would interfere with proper operation.

5. Door Position Contacts
   a. Program input on IDS control panel to receive alarm output from ACAMS indicating card reader door forced or door held-open alarm.
   b. Install on protected (secured) side of door.
   c. Install 6” from leading edge at top of door.

3.02 PROGRAMMING

A. Prior to the completion of construction, schedule a meeting with the Owner to determine the following programming criteria:
   1. Zone or alarm point descriptions
   2. User authority levels to arm/disarm areas or alarm partitions
   3. Auto arm/disarm schedules
   4. Arm/disarm requirements through the ACAMS using specific credentials.
   5. Interface requirement with ACAMS
   6. Central station response from individual alarm points
   7. Central station password and call list information

B. Document the results of the meeting and perform necessary programming to achieve the Owner’s requests. Program and setup the system such that no additional programming other than entering new access codes is required.

3.03 TESTING

A. Commission the Intrusion Detection System in accordance with Section 28 08 00.

END OF SECTION
SECTION 13720
VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. General: Provide engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction, and special or occasional services as required to make a complete working video surveillance system installation, as described in this specification.

B. Section Includes:
   1. VSS Monitoring and Recording System
   2. VSS Fixed, Multi-sensor, and PTZ IP cameras, lens, mounts, and housing
   3. VSS Power supplies
   4. Integration with ACAMS
   5. Interfaces and connections between VSS subsystems to allow communication with one another

C. Products Supplied But Not Installed Under This Section:
   1. None

D. Products Installed But Not Supplied Under This Section:
   1. None

E. Products Specified But Not Installed Under This Section:
   1. None

F. Products Furnished and Installed Under another Section:
   1. 120V power
   2. Ethernet cable back to telecommunication for IP cameras
   3. PoE switches in the telecommunications rooms for VSS connectivity via LAN/WAN

G. Related Sections:
   1. Consult other Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
   2. Section 280000 Basic Security System Requirements: includes general project requirements, submittal formats, installation, and warranty requirements.
3. Section 281300 Access Control & Alarm Monitoring System: includes product information for video integration with the ACAMS.

4. Section 280513 Security System Cabling: includes product information for wire and cable needed to support the video surveillance system.

5. Section 280553 Security System Labeling: includes label types and formats for security devices.

6. Section 280800 Security Acceptance Testing: includes the integrating testing/commissioning requirements for the video surveillance system.

1.02 DEFINITIONS

A. The Definitions of Division 1 apply to the 28 XX XX sections.

B. In addition to those Definitions of Division 1, the following list of terms as used in this specification defined as follows:

1. “IP”: Internet Protocol
2. “NVR”: Network Video Recorder
3. “VMS”: Video Management System
4. “PTZ”: Pan-Tilt-Zoom
5. “NAS”: Network Attached Storage
6. “PoE”: Power-over-Ethernet
7. “VSS”: Video Surveillance System

1.03 SYSTEM DESCRIPTION

A. Overview

1. The VSS is a network of IP cameras connected to and managed through a video management and recording server software and viewed on client workstations. The recording servers are managed and provided by District / Campus IT on centrally located servers.

2. The VSS consists of interior and exterior fixed and PTZ IP cameras, networked video recorders, management software, and dedicated client video monitoring workstations.

3. Cameras will integrate with the ACAMS through software and TCP/IP communication for alarm events which initiate video recording and tag video with specific alarms.

B. VSS Camera System - Base Bid

1. Provide VSS software and licenses capable of video motion detection and integration capabilities with the ACAMS software for alarm interface.

2. Provide the appropriate number of video licenses for IP cameras connected to the VSS video management system.
3. Coordinate installation of VSS camera licenses on centrally located network video server(s) hardware provided by the Owner. Provide District / Campus IT the bandwidth and storage requirements for cameras included under the project scope to ensure appropriate resources are available.

4. Provide NVR client workstation software for monitoring and viewing capabilities in the Police Services Office. Load client software on existing workstation located in the security office.

5. Coordinate network connection between IP cameras and existing security workstation at the Police Services Office with the District’s IT department prior to installation.

6. Coordinate one static IP network connection for each camera and/or IP video encoder.

7. Provide IP fixed VSS cameras as indicated on the floor plans.

8. Provide IP multi-sensor VSS cameras as indicated on the floor plans.

9. Provide IP PTZ VSS site camera as indicated on the floor plans.

10. Provide day/night cameras in outdoor locations with low light levels. Coordinate field of view with exterior light sources to prevent poor image quality.

11. Provide VSS camera power supplies (if needed) for PTZ and exterior camera enclosures.

12. Provide software interface to the ACAMS for alarm call up of cameras and PTZ specific presets on predefined alarm events.

C. Tamper Monitoring

1. Provide additional monitor input points for monitoring the following:
   a. Tamper switches located within each security equipment enclosure and wire way
   b. Supervision of power supplies and batteries

1.04 SUBMITTALS

A. Contractor Qualifications: Submit certifications for the manufacturers of the video surveillance equipment.

B. Product Data: Submit product information for components specified herein.

C. Shop Drawings:
   1. Device placement on floor plans.
   2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:
      a. Video surveillance system, monitors, and recording equipment
      b. Devices connected to the system
      c. Miscellaneous control relays
d. Conductor (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)

3. Block Diagram/Riser Diagram: Show the video surveillance system components, conduit, wire types, and sizes between them, including cabling interties between termination hardware.

4. User interface graphics with icons and control buttons displayed.

5. Custom mounting details

1.05 EXTRA MATERIALS

A. Provide 10% spare parts of total installed the following: (Round up to the next complete device)

1. Fuses (Place five (5) of each type of fuse inside each power supply).

1.06 WARRANTY

A. Camera Systems

1. Provide a manufacturer’s warranty covering repair or replacement of defective parts for a period of one year from the date of shipment from the factory

2. Cameras and support devices

   a. Provide a manufacturer’s warranty covering repair or replacement of defective parts for a period of one year from the date of shipment from the factory.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Video Surveillance System

1. Network Video Recorder Software

   a. Salient Systems

2. IP Cameras

   a. Sony
   b. Axis Communications
   c. Arecont Vision
   d. Or Equal

3. Power Supplies

   a. Altronix
   b. Pelco
   c. Or Equal
2.02 CAMERA SYSTEMS

A. General
   1. Type: Color, solid-state CCD with DSP technology, unless otherwise noted
   2. Power: 24 VAC/VDC,
   3. Imager: 1/3 inch format, unless otherwise noted
   4. Lens Mount: Accept a "CS" mount auto or manual-iris lens
   5. Synch: Adjustable line lock for synchronizing camera to power line. No auxiliary sync cable required.
   6. Resolution: 640x480 minimum resolution (EIA RS-170), unless otherwise noted
   7. Minimum Light Level: 0.1 fc imager illumination at full video, unless otherwise noted
   8. Lens: Field determine, unless otherwise noted
   9. Video transmission through IP or analog signals through IP encoder

B. Fixed IP Interior Dome Cameras
   1. Complete prepackaged unit containing:
      a. Minimum 1280x720 megapixel resolution for fixed cameras, with progressive scan
      b. Resolution: 30 frames per second at all resolutions
      c. Video streaming: Simultaneous Motion JPEG and H.264
      d. Auto iris, varifocal lens of 2.5-6mm
      e. Security: IP address filtering and HTTPS encryption
      f. Power over Ethernet (IEEE 802.3af), Class 1
      g. Connectors:
         1) Ethernet 10/100 BaseT, RJ-45
         2) Terminal block for alarm inputs, output, and RS-485/422
         3) Power - Mini DC
      h. Dome housing
   2. Manufacturer:
      a. Axis #P33 Series network dome megapixel camera
      b. Sony #SNC-H140 network dome megapixel camera
      c. Arecont Vision #AV1355 network dome megapixel camera
      d. Or Equal
   3. Accessories:
      a. Axis In-Ceiling Mount #5502-361 or Surface Mounting Plate #5502-401
      b. Sony In-Ceiling Mount #YTICB45
      c. Arecont Vision Surface Mounting Plate #MD-EBA
      d. Or Equal
C. Exterior Fixed IP Mini-Dome Cameras

1. Complete prepackaged unit containing:
   a. Superior 1.3 megapixel image sensor quality with progressive scan
   b. Resolution: 12 frames per second at 1280x1024 and 30 frames per second at 640x480
   c. Video streaming: Simultaneous Motion JPEG and MPEG-4
   d. Auto iris, varifocal lens of 2.8-10mm
   e. Security: IP address filtering and HTTPS encryption
   f. Power over Ethernet (IEEE 802.3af), Class 1
   g. Connectors:
      1) Ethernet 10/100 BaseT, RJ-45
      2) Terminal block for alarm inputs, output, and RS-485/422
      3) Analog video, BNC composite output
      4) Audio line output, mini-jack
   h. Vandal resistant dome housing
   i. Manufacturer:
      1) Axis #P33 Series megapixel network mini-dome camera
      2) Or Equal
   j. Accessories:
      1) Axis #5502-321 Pendant kit
      2) Axis #5017-611 Wall Bracket
      3) Axis #5017-641 Corner Bracket
      4) Axis #5017-671 Pole Bracket

D. PTZ IP Dome Camera

1. Provide IP PTZ camera with appropriate mount to flush mount into roof soffit

2. Complete prepackaged unit containing:
   a. 1/4” high-resolution color CCD camera & motorized zoom auto-iris lens
   b. Resolution: Supports 1280x720 resolution at 30 frames per second
   c. Resolution: 30 frames per second at all resolutions
   d. High-speed pan and tilt that is stepper motor driven (belt-driven not acceptable).
   e. Integral receiver/driver
   f. Color
   g. Integral 18X min optical zoom lens for exterior locations
   h. Exterior cameras: wide dynamic range and auto day/night switching between color and B/W
   i. Motion JPEG and H.264 video compression
   j. Integrated heater and blower for exterior locations
   k. Power over Ethernet plus (IEEE 802.3at) compatible
1. Electronic Image Stabilizer

3. Provide seismic support of unit attached directly to roof soffit structure.

4. Manufacturer:
   a. Sony #SNCRH164
   b. Axis #P5534 Series
   c. Or Equal

5. Accessories:
   a. Sony #UNI#MB1 mounting bracket
   b. Axis #T91A Mounting Accessories
   c. Or Equal

E. Multi-sensor camera

1. Complete prepackaged unit containing:
   a. Minimum resolution: (4) 1920 x1080
   b. Video Compression format: H.264
   c. Power over Ethernet (IEEE 802.3af, Class 2)
   d. Frame Rate: 12.5 fps at H.264
   e. Sensor: Four 1/2.8” progressive scan RGB CMOS sensors
   f. Vandal Resistant Dome

2. Manufacturer, or equal:
   a. Axis P3707-PE

3. Accessories, or equal:
   a. AXIS T91D61 Wall Mount including weather shield

2.03 VIDEO MANAGEMENT SOFTWARE

A. NVR Video Management Software

1. Video surveillance software must have software integration with ACAMS. Hard-wired input/output alarms is not acceptable.

2. Include software licenses:
   a. Camera licenses to support devices shown on project drawings
   b. Client workstation licenses to support a minimum of 5 concurrent users
   c. Internet Explorer client browser license

3. Manufacturer:
   a. Salient Systems Complete View Enterprise (to match existing standard)

2.04 POWER SUPPLIES/BATTERY CHARGERS

A. VSS System Power Supplies
1. 120 VAC input to 24 VAC output, continuous current, fully supervised power supplies for power to cameras.
2. Provide a separate fused connection to power supply per camera.
3. Exterior PTZ Camera
   a. Pelco #WCS 1-4 NEMA4X/IP66 rated for outdoor use
   b. AXIS #5000-001 24VAC Outdoor power supply
   c. Altronix
   d. Or Equal

2.05 VSS LIGHTNING PROTECTORS

A. Power Line Protectors
   1. Provide on power lines serving exterior cameras.
   2. Manufacturer:
      a. PolyPhaser Corp #IS-SPTV
      b. DITEK
      c. Or Equal

B. PTZ Data Line Protectors
   1. Provide on data lines serving exterior IP cameras.
   2. Manufacturer:
      a. PolyPhaser Corp #NX4-60-IG
      b. DITEK
      c. Or Equal

2.06 IP VIDEO ENCODER

A. General
   1. Video Compression: Motion JPEG, MPEG-4 Part 2 (ISO/IEC 14496-3), Profiles: ASP and SP
   2. Resolution: 4CIF, 2CIFExp, 2CIF, QCI
   3. Frame Rate: Up to 30/25 per channel
   4. Pan/Tilt/Zoom control
   5. Alarm and event management
   6. Channels: 4 minimum

B. Blade Video Server
   1. Hot-swappable
   2. Built-in, universal power supply
   3. Security: IP address filtering and HTTPS encryption
4. Manufacturer:
   a. Axis #243Q blade video server
   b. Or equal

C. Video Server Rack Enclosure
   1. High density rack-mount solution
   2. Capable of storing a minimum of 3 interchangeable and hot-swappable blade video servers
   3. Manufacturer:
      a. Axis #291 1U video server rack
      b. Or equal

PART 3 - EXECUTION

3.01 INSTALLATION

A. VSS Cameras
   1. Provide outdoor housing and mounts for exterior cameras.
   2. Field determine exact placement of cameras to ensure complete coverage.
   3. Coordinate location with obstructions such as columns or exceedingly high shelving units to avoid concealment opportunity.
   4. Field determine fixed camera lens size to ensure complete coverage.
   5. Route watertight flex from junction box to camera housing from below on exterior cameras.
   6. Provide 25 foot cable loop at PTZ location for relocating unit if required post installation
   7. Coordinate Network Data Drop with Telecom contractor for each IP Camera.
   8. Coordinate camera IP address with District IT staff.

B. VSS Power supplies
   1. Do not combine with Access Control & Alarm Monitoring System power supplies.

C. Network Video Recorder Storage
   1. Coordinate installation of additional camera licenses and programming of cameras on owner provided network video server with District ITS

D. Surge Protection
   1. Provide surge protection for video, power, and control cable on exterior cameras.
   2. Provide protective device at the camera and encoder/recorder device.
3.02 PROGRAMMING

A. Coordinate a meeting with Owner’s IT representative to determine IP addresses and LAN/WAN utilization of IP cameras and NVRs.

B. Prior to the completion of construction schedule a meeting with the Owner and the Engineer to determine the programming criteria. Discuss the following:
   1. Camera naming
   2. PTZ Presets
   3. Schedules and recording parameters including quality and frame rate (including video motion detection)
   4. ACAMS alarm and event integration requirements for workstation pop-ups and recording.
   5. Video archiving schedule
   6. Live viewing requirements
   7. System data base backups

C. Document the results of the meeting and perform necessary programming to achieve the Owner’s requests.

D. Setup and program the system such that no additional programming required.

E. Use the camera naming convention agreed upon at in the programming meeting when programming point names into the system.

F. Perform a full system back-ups at completion of initial programming and deliver one copy to the Owner with a Letter of Transmittal explaining information included in back-up and brief description of recovery procedures.

G. Customize menus with the assistance of the factory to “gray-out” features not used on project (such as elevator control).

H. Perform field software changes after the initial programming session to "fine tune" operating parameters and sequence of operations based on revised operating requirements.

3.03 TESTING

A. Commission the video surveillance system in accordance with Section 280800.

END OF SECTION
SECTION 283100

FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Notification Appliance Circuit Panels
   3. Rate-of-Rise and Fixed Temperature Heat Detectors
   4. Photoelectric Type Detectors
   5. Duct-Mounted Smoke Detectors
   6. Relay Modules
   7. Control Modules
   8. Input Modules
   9. Fault Isolation Modules
   10. Combination Horn/Strobes
   11. Strobes
   12. Horns
   13. Miscellaneous Accessories

B. Scope: Provide modification and extension of the existing Siemens fire alarm system to accommodate remodel and addition.

C. In addition, provide design for the following as required in these Contract Documents: Fire Alarm System.

D. In addition, remove existing fire alarm system in remodel areas.

E. System Design:
   1. Design Criteria: Design systems utilizing equipment appliance and device layouts depicted in the contract documents.
   2. Design of Fire Alarm System:
      a. Provide design of the fire alarm system as required by code.
      b. Fire Alarm Sequence of Operation: Match Existing.
      c. Supervisory Sequence of Operation: Match Existing.
      d. Trouble Sequence of Operation: Match Existing.

1.2 RELATED SECTIONS

A. Contents of Division 28, Electronic Safety and Division 01, General Requirements apply to this Section.

B. Division 26, Electrical requirements apply to this section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Division 28, Electronic Safety and Division 01, General Requirements.
B. In addition, meet the following:

1.4 SUBMITTALS

A. Submittals as required by Division 28, Electronic Safety and Division 01, General Requirements.

B. In addition, provide:
   1. Shop drawings to include the following:
      a. Provide system designer NICET certification number or Engineer's signature and seal on shop drawings.
      b. Identification of system designer and evidence of qualification or certification of designer as required by AHJ.
      c. Floor plans indicating walls, doors, partitions, room descriptions, device/component locations.
      d. Ceiling height and ceiling construction details.
      e. A symbol legend with device catalog number, description, back box size and mounting requirements.
      f. Detailed riser diagram.
      g. Device address adjacent to each device symbol. Notification appliance circuit and number adjacent to each notification appliance symbol.
      h. Point to point wiring indicating the quantity and gauge of the conductors and size of conduit/raceway used.
      i. Wiring connection diagrams for control equipment, annunciators, power supplies, chargers, initiating devices, notification appliances, components being connected to the system and interfaces to associated equipment.
      j. Battery calculations for each battery backed fire alarm control unit.
      k. Voltage drop calculations for each notification appliance circuit, indicating individual appliance current draw, conductor run length and size.
      l. Complete sequence of operation.
   2. Prior to final acceptance, submit a letter confirming that inspections have been completed and system is installed and functioning in accordance with Specifications. Include manufacturer representative's certification of installation and letter of warranty.
   3. Operation and Maintenance Manuals. Provide manuals containing the following:
      a. Catalog Cut Sheets
      b. System Components, Initiating Devices and Notification Appliances' Installation Sheets
      c. Manufacturer's Installation, Operation and Maintenance Manual
      d. Program Data File Printout
      e. Program Data File on Electronic Storage Media
      f. Record Drawings
      g. Record Drawings on Electronic Storage Media
      h. One year warranty agreement including parts and labor. Warranty period begins upon date of completion.
      i. Record of Completion
      j. Test Reports
k. Instruction Chart

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Division 28, Electronic Safety and Division 01, General Requirements.

B. In addition, meet City of San Ramon, California requirements, ordinances and amendments.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Division 28, Electronic Safety and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Notification Appliance Circuit Panels:
   1. Same manufacturer as fire alarm control equipment.
   2. No substitutions permitted.

B. Manual Pull Stations:
   1. Same manufacturer as fire alarm control equipment.
   2. No substitutions permitted.

C. Rate-of-Rise and Fixed Temperature Heat Detectors:
   1. Same manufacturer as fire alarm control equipment.
   2. No substitutions permitted.

D. Photoelectric Type Detectors:
   1. Same manufacturer as fire alarm control equipment.
   2. No substitutions permitted.

E. Duct-Mounted Smoke Detectors:
   1. Same manufacturer as fire alarm control equipment.
   2. No substitutions permitted.

F. Relay Modules:
   1. Same manufacturer as fire alarm control equipment.
   2. No substitutions permitted.

G. Control Modules:
   1. Same manufacturer as fire alarm control equipment.
   2. No substitutions permitted.

H. Input Modules:
   1. Same manufacturer as fire alarm control equipment.
   2. No substitutions permitted.

I. Fault Isolation Modules:
1. Same manufacturer as fire alarm control equipment.
2. No substitutions permitted.

J. Combination Horn/Strobes:
1. Must be compatible with fire alarm control equipment and notification appliance circuit panels.
2. Same manufacturer as fire alarm control equipment.
3. Wheelock
4. No substitutions permitted.

K. Strobes:
1. Must be compatible with fire alarm control equipment and notification appliance circuit panels.
2. Same manufacturer as fire alarm control equipment.
3. Wheelock
4. No substitutions permitted.

L. Horns:
1. Must be compatible with fire alarm control equipment and notification appliance circuit panels.
2. Same manufacturer as fire alarm control equipment.
3. Wheelock
4. No substitutions permitted.

M. Miscellaneous Accessories:
1. Weatherproof/Surface Backboxes:
   a. Same manufacturer as fire alarm detection devices or notification appliances.
   b. Or equal.
2. Circuit Conductors:
   a. Allied Wire and Cable
   b. Belden
   c. CCI
   d. West Penn Wire
   e. Or equal.
3. Surge Protection:
   a. Ditek
   b. Transtector
   c. Or equal.
4. Batteries:
   a. Same manufacturer as fire alarm control equipment.
   b. Power-Sonic
   c. Werker
   d. Or equal.
5. Locks and Keys:
   a. Same manufacturer as fire alarm control equipment.
   b. Or equal.
N. Substitutions: For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with contract documents.

O. Equipment to be supplied by a certified manufacturer representative.

2.2 NOTIFICATION APPLIANCE CIRCUIT PANELS

A. Provide power supply(s), adequate to serve modules, remote Annunciators, addressable devices, notification appliances and other connected devices or appliances.

B. Loss of normal and emergency power automatically causes system to transfer to battery power. Indicate battery power operation by yellow lamp and audible annunciation at control panel and remote Annunciator panels. Upon return of 120VAC power, unit recharges batteries to full capacity and maintains battery on float charge. Provide trickle charge adequate capacity to maintain battery fully charged with automatic rate charge.

C. Provide batteries in locking cabinet manufactured for purpose.

2.3 MANUAL PULL STATIONS

A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.

B. Semi-flush, red finish, non-grasping operation; maximum pull strength as allowed per ADA criteria.

C. Stations do not allow closure without keyed reset.

2.4 RATE-OF-RISE AND FIXED TEMPERATURE HEAT DETECTORS

A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.

B. Responding to 15 degrees F temperature rise per minute and to 135 degrees F fixed temperature as required by space use.

C. Provide off-white, low-profile detectors.

2.5 PHOTOELECTRIC TYPE DETECTORS

A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.

B. Panel adjustable sensitivity, LED source, multiple cell, 360 degree smoke entry, visual latching operation indicator, insect screen, functional test switch, two-wire operation and vandal-resistant locking feature.
2.6 DUCT-MOUNTED SMOKE DETECTORS
   A. Photoelectric type. Duct sampling tubes extending width of duct, visual indication of detector actuation, direct housing mount. Detector powered from control panel, power on indicator light. Detector rated for air velocity, humidity and temperature of duct and environment where installed.

2.7 RELAY MODULES
   A. Signaling line circuit interface module that connects to other building systems for control of fire/life safety functions, e.g., air-handler shutdown, fire/smoke damper closure, elevator recall.
   B. Module powered from control panel.

2.8 CONTROL MODULES
   A. Signaling line circuit interface module that provides notification appliance circuits or system control outputs.
   B. Module powered from control panel.

2.9 INPUT MODULES
   A. Signaling line circuit interface module that provides initiating device circuits for connection to contact closure initiating devices.
   B. Module powered from control panel.

2.10 FAULT ISOLATION MODULES
   A. Signaling line circuit interface modules that provide isolation of wire-to-wire shorts on a signaling line circuit with automatic reconnection upon correction of short circuit.
   B. Provide module with status indicator LED.

2.11 COMBINATION HORN/STROBES
   A. Multi-candela, flush wall and ceiling mount, insect-proof.
   B. Provide horn/strobes that meet the latest requirements of NFPA 72, ANSI 117.1 and UL 1971. Candela rating 75 cd minimum unless otherwise indicated on Drawings.

2.12 STROBES
   A. Multi-candela, flush wall mount, insect-proof.
   B. Provide strobes that meet the latest requirements of NFPA 72, ANSI 117.1 and UL 1971. Candela rating 75 cd minimum unless otherwise indicated on Drawings.
2.13 **Horns**

A. Flush wall mount, insect-proof.

B. Provide horns that meet the latest requirements of NFPA 72.

2.14 **Miscellaneous Accessories**

A. Circuit Conductors: Copper or optical fiber; color code and label. Type FPL, FPLR and FPLP as required by NEC. Minimum signaling line circuit and initiating device circuit wire size: AWG18. Minimum notification appliance circuit wire size: AWG14, or as approved by Engineer. Fiber optic cable as required by manufacturer.

B. Surge Protection: In accordance with IEEE C62.41 B3 combination waveform and NFPA 70; except for optical fiber conductors.

C. Batteries: Sealed lead acid type. Provide additional cabinet, if required due to space limitations in control panels.

D. Locks and Keys:
   1. Deliver keys to Owner.
   2. Provide same standard lock and key for each key operated switch and lockable panel and cabinet; provide five keys of each type.

**PART 3 - EXECUTION**

3.1 **General Installation Requirements**

A. Obtain Architect's approval of locations of devices, appliances and annunciators before installation.

B. Circuits:
   1. Signaling Line Circuits (SLC): Class B
   2. Notification Appliance Circuits (NAC): Class B.

C. Spare Capacity:

D. Power Sources:
   1. Primary: Dedicated branch circuits of facility power distribution system.
   2. Secondary: Storage batteries.
   3. Capacity: Sufficient to operate fire alarm system under normal supervisory condition for 24 hours and operate alarm signals for five minutes at end of standby period.

E. Obtain approval of system design from AHJ prior to installation. Do not begin installation without approval from AHJ and submittal review comments from Engineer.
F. Install in accordance with applicable codes, NFPA 72, NFPA 70 and the Contract Documents.

G. In accordance with manufacturer's instructions, provide wiring, conduit and outlet boxes required for the erection of a complete system as described in these specifications, as shown on Drawings and as required by AHJ.

H. Conceal wiring, conduit, boxes and supports where installed in finished areas.

I. Provide raceway system for cabling concealed in walls and hard ceilings and in locations where cabling is exposed. Where exposed, provide surface raceway in finished areas and surface mounted EMT in non-finished areas.

J. Provide cabling and conduits system suitable for wet locations for below grade systems.

K. At junction boxes and termination points, provide identification tags on wires and cables.

L. Route wiring to avoid blocking access to equipment requiring service, access, or adjustment.

M. Existing Components:
   1. Existing Fire Alarm System: Maintain fully operational during construction in all areas except areas of remodel.
   2. Disable system only to make switchovers and connections.
      a. Notify Owner before partially or completely disabling system.
      b. Notify local fire service.
      c. Make notifications at least five working days in advance.
      d. Make temporary connections to maintain service in areas adjacent to work area.
   3. Provide fire watch in areas where the system is not functioning if required by the AHJ.
   4. Equipment Removal:
      a. Remove existing system after acceptance of new fire alarm system. Restore damaged surfaces.
      b. Package operational fire alarm and detection equipment that has been removed and deliver to Owner.
      c. Remove from site and legally dispose of remainder of existing material.
   5. On-Premises Supervising Station: Include, as part of this work, modifications necessary to existing supervising station to accommodate new fire alarm work.

N. Fire Safety Systems Interfaces:
   1. Provide conduit, wiring, boxes and terminations from fire alarm system to monitored components.
      a. Alarm Inputs: Provide connection in accordance with NFPA 72 for the following systems and components:
         1) Fire sprinkler water flow switches.
         2) Other alarm inputs.
      b. Supervisory Inputs: Provide connection in accordance with NFPA 72 for the following systems and components:
         1) Fire sprinkler water control valve tamper switches.
         2) Other supervisory inputs.
      c. Trouble Inputs: Provide connection in accordance with NFPA 72 for the following systems and components:
1) Other trouble inputs.

2. Fire Safety Functions: Provide power and control conduit, wiring, boxes and terminations to power devices and interface to fire alarm system.
   a. Doors:
      1) Provide smoke detectors and addressable control relays to release magnetic hold open devices and roll-down fire doors and door locks. Verify requirements and quantities prior to bidding.
      2) Smoke Barrier Door Magnetic Holders: Release upon activation of smoke detectors in smoke zone on either side of door.
      3) Electronic Locks or Electromagnetic Door Locks on Egress Doors: Unlock smoke zone egress doors upon activation of any alarm initiating device or suppression system in smoke zone.
      4) Overhead Coiling Fire Doors: Release upon activation of smoke detectors on either side of door.
   b. HVAC Systems:
      1) Fire/Smoke Dampers and Smoke Dampers:
         a) Provide required smoke detectors, relays, wiring and the like.
         b) Connect control and power wiring to dampers per manufacturer's instructions.
         c) Verify quantities, location and requirements of dampers with Division 23, HVAC Drawings and Specifications and mechanical system installer.
      2) Air Moving Systems:
         a) Provide duct-mounted smoke detectors on air systems with air flow rates exceeding 2000 CFM. Coordinate with Division 23, HVAC.
         b) Install duct-mounted smoke detector(s) on supply side of air system.
         c) Provide control wiring from addressable relay contacts to air handling equipment controller. Connect to controller so that when duct-mounted smoke detector is activated, the air handling equipment is shut down.
         d) Provide duct-mounted smoke detectors rated for air velocity, temperature and humidity of duct. Verify quantities, locations and requirements with Division 23, HVAC Drawings and mechanical system installer.
         e) Where duct-mounted smoke detectors are mounted in inaccessible building void spaces provide access hatch. Provide access hatch with fire rating equivalent to rating of wall, ceiling, or shaft being penetrated.

O. Inspection and Testing for Completion:
   1. System testing and commissioning to be performed by a certified manufacturer representative.
   2. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.
   3. Document audibility measurements and verify intelligibility for each space on record drawings.
   4. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction and adjustments.
   5. Provide tools, software and supplies required to accomplish inspection and testing.
6. Prepare for testing by ensuring that work is complete and correct; perform preliminary
tests as required to test system.
7. Correct defective work, adjust for proper operation and retest until entire system
complies with Contract Documents.
8. Notify Owner seven days prior to beginning completion inspections and tests.
9. Notify authorities having jurisdiction and comply with their requirements for scheduling
inspections and tests and for observation by their personnel.
10. Diagnostic Period: After successful completion of inspections and tests, operate system
in normal mode for at least 14 days without any system or equipment malfunctions.
   a. Record all system operations and malfunctions.
   b. If a malfunction occurs, start diagnostic period over after correction of
      malfunction.
   c. Owner will provide attendant operator personnel during diagnostic period;
schedule training to allow Owner personnel to perform normal duties.
   d. At end of successful diagnostic period, complete and submit NFPA 72 "Inspection
      and Testing Form."

P. Closeout:
   1. Closeout Demonstration:
      a. Demonstrate proper operation of functions to Owner.
      b. Be prepared to conduct any of the required tests.
      c. Have at least one copy of operation and maintenance data, copy of project record
         drawings, input/output matrix and operator instruction chart(s) available during
demonstration.
      d. Have authorized technical representative of control unit manufacturer present
during demonstration.
      e. Demonstration may be combined with inspection and testing required by AHJ.
         Notify AHJ in time to schedule demonstration.
      f. Repeat demonstration until successful.
   2. Substantial Completion of the project cannot be achieved until inspection and testing is
      successful and:
      a. Specified diagnostic period without malfunction has been completed.
      b. Approved operating and maintenance data has been delivered.
      c. Spare parts, extra materials and tools have been delivered.
      d. All aspects of operation have been demonstrated to Architect.
      e. Final acceptance of the fire alarm system has been given by authorities having
         jurisdiction.
      f. Occupancy permit has been granted.

3.2 NOTIFICATION APPLIANCE CIRCUIT PANELS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide notification appliance circuit panel power supplies with 120VAC dedicated circuit per
NFPA requirements.

D. Do not install cabinets or equipment below the battery cabinet. Do not locate battery and
charging system cabinets in ceiling space.
3.3 MANUAL PULL STATIONS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.4 RATE-OF-RISE AND FIXED TEMPERATURE HEAT DETECTORS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.5 PHOTOELECTRIC TYPE DETECTORS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.6 DUCT-MOUNTED SMOKE DETECTORS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

3.7 RELAY MODULES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.
3.8 CONTROL MODULES
   A. Reference 3.01, General Installation Requirements.
   B. Install per manufacturer's instructions and recommendations.
   C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

3.9 INPUT MODULES
   A. Reference 3.01, General Installation Requirements.
   B. Install per manufacturer's instructions and recommendations.
   C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

3.10 FAULT ISOLATION MODULES
   A. Reference 3.01, General Installation Requirements.
   B. Install per manufacturer's instructions and recommendations.
   C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.
   D. Provide Fault Isolator Modules for signaling line circuit per code requirements and manufacturer instructions.

3.11 COMBINATION HORN/STROBES
   A. Reference 3.01, General Installation Requirements.
   B. Install per manufacturer's instructions and recommendations.
   C. Provide machine printed labels on notification appliances with appliance circuit number and sequence. Labels to be visible from the floor without magnification.
   D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.12 STROBES
   A. Reference 3.01, General Installation Requirements.
   B. Install per manufacturer's instructions and recommendations.
   C. Provide machine printed labels on notification appliances with appliance circuit number and sequence. Labels to be visible from the floor without magnification.
D. Provide wire guards or protective covers where device is subject to abuse and where required by AHJ.

3.13 HORNs

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed labels on notification appliances with appliance circuit number and sequence. Labels to be visible from the floor without magnification.

D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.14 MISCELLANEOUS ACCESSORIES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Weatherproof/Surface Backboxes: Provide manufacturer's weatherproof backbox listed for use in areas where the device or appliance is subject to humidity in excess of listed rating. Provide manufacturer surface backboxes where devices cannot be installed recessed.

D. Circuit Conductors: Provide wiring to meet the requirements of national, state and local electrical codes. Provide color coded wiring as recommended and specified by the fire alarm and detection system manufacturer. Provide Type FPLR cable when in a riser application or FPLP cable when installed in plenums.

E. Surge Protection; Equipment Connected to Alternating Current Circuits: Maximum let through voltage of 350 V(ac), line-to-neutral and 350 V(ac), line-to-line; do not use fuses.

END OF SECTION
SECTION 31 11 00
CLEARING & GRUBBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes all work necessary to successfully complete demolition, clearing & grubbing to prepare site for the phasing and new construction, including the following:

1. Protecting existing trees and vegetation to remain.
2. Trimming tree limbs and roots.
3. Removing trees as designated.
4. Clearing vegetation, debris, trash and other materials within limits indicated.
5. Grubbing of vegetation within limits indicated.
7. Removing above-grade site improvements within limits indicated.
8. Disconnecting, capping or sealing, and abandoning site utilities in place.
9. Disconnecting, capping or sealing, and removing site utilities.
10. Disposing of objectionable material off site.
11. Clean line saw cutting of existing asphalt pavement, concrete sidewalks, concrete curb/gutter, etc., as specified herein.
13. Protection from injury or defacement of trees and other vegetation and objects to be preserved.
   a. Removal of surface debris and deleterious materials such as rubbish.
   b. Removal and stockpile of materials for landscaping use at approved location.
   c. Disposal of unwanted materials off site.

1.2 REGULATORY REQUIREMENTS

A. No burning shall be allowed.

B. Comply with the following California Code of Regulations:
   1. Title 8: CAL/OSHA, Chapter, Subchapter 4 – Construction Safety Orders
   2. Title 24: Part 2, California Building Code, Chapter 33, Protection of Pedestrian during Construction or Demolition.
3. Bay Area Air Quality Management District
4. Alameda County Water District, Standard Specification and Details.
5. County of Alameda County Public Works Department, Design Guidelines.

1.3 DEFINITIONS


B. CAL-OSHA: California Occupational Safety and Health Administration.

C. Topsoil: Natural or cultivated surface-soil layer 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 2-inches in diameter; and free of weeds, roots, and other deleterious materials.

D. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain District’s property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS


1.6 QUALITY ASSURANCE

A. Do not remove or prune trees without first securing a permit from the appropriate agency.

B. Prune to the standards of the International Society of Arborists and to ANSI 300.

1.7 PROJECT CONDITIONS

A. Except for materials indicated to be stockpiled or to remain the District’s property, cleared materials are the Contractor's property. Remove cleared materials from site and dispose of in lawful manner.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store where indicated on plans or where designated by the District. Avoid damaging materials designated for salvage.

C. Unidentified Materials;
   1. If unidentified materials are discovered, including hazardous materials that will
require additional removal other than is required by the Contract Documents, immediately report the discovery to the District.

2. If necessary, the District will arrange for any testing or analysis of the discovered materials and will provide instructions regarding the removal and disposal of the unidentified materials.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Backfill excavations resulting from demolition operations with on-site or import materials conforming to structural backfill defined in Section 31 23 33 Utility Trenching and Backfill.

   1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain during construction.

   1. Restore damaged improvements to their original condition, as acceptable to the Engineer and/or District. Prior to restoration the contractor shall notify Engineer and/or District of the damaged improvements.

3.2 TREE PROTECTION

A. Erect and maintain temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.

B. Do not store construction materials, debris, or excavated material within drip line of remaining trees.

C. Do not permit vehicles or equipment within drip line of remaining trees.

D. Do not excavate within drip line of remaining trees, unless otherwise indicated.

E. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation edge as possible.

   1. Cover exposed roots with burlap and water regularly.
2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3. Coat cut faces of roots more than 1-1/2-inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.

4. Cover exposed roots with wet burlap to prevent roots from drying out. Backfill with soil as soon as possible.

3.3 TREE PRUNING

A. Prune trees to balance the crown, and eliminate hazards. Perform main work to reduce sail effect through thinning, reducing end weights, shortening long heavy limbs, removing deadwood, weak limbs and sucker growth. Prune limbs back to an appropriate lateral branch.

B. Make final cuts at the outer edge of the branch collar in accordance with the arborist’s recommendations.

C. Perform pruning work in a safe and proper manner, adhering to CAL-OSHA and ANSI Standards.

3.4 ROOT PRUNING

A. Do not cut tree roots greater than 3-inch in diameter and less than 12-inches below ground level without approval of the District.

B. Cut tree roots cleanly, as far from the trunk as possible, and not underneath any area where walkways are to be constructed. Root pruning shall be to a depth of 18-inches.

C. Tree root prune using a Vermeer root-cutting machine. Obtain the District’s approval before using alternate equipment or techniques.

D. Complete tree root pruning prior to any excavation adjacent to the tree.

E. Do not expose tree roots to drying out. Cover root ends with soil or burlap and keep moist until the final backfill is completed.

3.5 TREE REMOVAL

A. Remove trees designated for removal prior to the construction of new improvements.

B. Perform tree removal work in a safe and proper manner, adhering to CAL-OSHA and ANSI Standards.

C. Remove or grind stumps to a minimum of 18-inches below finish subgrade. Remove surface roots to this depth within 24-inches of the tree trunk. Trees, plants and roots that are below proposed building footprint or slabs on grade shall be removed in its entirety.
3.6 RESTORATION

A. Restore damaged improvements to their original condition, as acceptable to the District.

B. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, as directed by the District.
   1. Employ a qualified arborist, licensed in jurisdiction where the Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
   2. Replace trees that cannot be repaired and restored to full-growth status, as determined by the District. Clear and grub existing areas only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations.

3.7 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed or abandoned.

B. Arrange to shut off indicated utilities with utility companies or verify that utilities have been shut off.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by District or others unless authorized in writing by the Owner, and then only after arranging to provide temporary utility services according to requirements indicated.

D. Coordinate utility interruptions with utility company affected.

E. Do not proceed with utility interruptions without the permission of the District and utility company affected. Notify District and utility company affected 14 working days prior to utility interruptions.

F. Excavate and remove underground utilities that are indicated to be removed.

G. Securely close ends of abandoned piping with tight fitting plug or wall of concrete minimum 6-inches thick. All abandoned piping shall be filled with a cementious material, such as controlled low strength material.

3.8 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.

B. Remove trash, debris, logs, concrete, masonry and other waste materials.

C. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
D. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18-inches below subgrade. Trees, plants and roots that are below proposed building footprint or slabs on grade shall be removed in its entirety.

E. Use only hand methods for grubbing within drip line of remaining trees.

3.9 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Remove trash, debris, weeds, roots, and other waste materials.

D. Stockpile topsoil materials designated to remain on site at a location approved by the District at a location away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust. Refer to the SWPPP as required.

E. Do not stockpile topsoil within drip line of remaining trees.

3.10 SITE IMPROVEMENTS

A. Remove existing above-and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, and gutters, as indicated. Where concrete slabs, curb, gutter and asphalt pavements are designated to be removed, remove bases and subbase to surface of underlying, undisturbed soil.

C. Unless the existing full-depth joints coincide with line of pavement demolition, neatly saw-cut to full depth the length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

D. Remove driveways, curbs, gutters and sidewalks by saw cutting to full depth. If saw cut falls within 30-inches of a construction joint, expansions joint, score mark or edge, remove material to joint, mark or edge.

3.11 BACKFILL

A. Place and compact material in excavations and depressions remaining after site clearing in conformance with Section 31 23 33.

3.12 DISPOSAL

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off the Owner’s property.
3.13 TEMPORARY FACILITIES

A. Provide the following temporary facilities to facilitate the demolition operations, as necessary.
   1. Temp Traffic Controls
   2. Protection of Persons and Property
   3. Protection of Utilities
   4. Noise and Dust Abatement.
   5. Clear and restore area to their original condition.
   6. Protect survey markers and monuments, existing improvements, and adjacent structures from removal and damage.

3.14 CONSTRUCTION WASTE MANAGEMENT

A. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the General Contractor’s Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

END OF SECTION
SECTION 31 2300
EXCAVATION AND FILL

PART 1 - GENERAL

1.1 SUMMARY
A. This Section describes the requirements for earthwork operation, as shown on the Drawings and specified:
   1. Excavation and/or embankment from existing ground to subgrade, including soil sterilant, for parking areas, walks, paths, and any other site improvements called for on the Plans.
      a. Aggregate base.
      b. Lime stabilization.
      c. Dispose off-site waste, excess or unsatisfactory material.

1.2 RELATED DOCUMENTS
A. Sacramento Standard Specification:
   1. Section 14, Earthwork
   2. Section 17, Aggregate Bases.
   3. Section 10, Lime Stabilization

1.3 RELATED SECTIONS
A. Section 31 11 00 – Clearing and Grubbing

1.4 REGULATORY REQUIREMENTS
A. State of California, Department of Transportation (CSS) – Latest Edition, Section 19.
   3. ASTM D1557-70 for testing in compaction.
B. Alameda District, Standard Specification and Details.
C. ASTM
   1. D 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
   2. D 1586, Method for Penetration Tests and Split-Barrel Sampling of Soils.
   3. D 2487, Classification of Soils for Engineering Purposes.
   5. D 4318. Test Method for Liquid Limit, Plastic Limit and Plasticity Index of
Soils.


E. CAL/OSHA, Title 8.

F. "Geotechnical Investigation for Proposed New Tutorial Library Building Diablo Valley College – San Ramon Campus 1790 Watermill Road San Ramon, CA” by RMA Group

1.5 DEFINITIONS

A. Borrow: Approved soil material imported from off-site for use as Structural Fill or Backfill.

B. Excavation: Removal of material encountered above subgrade elevations.

1. Authorized Over-Excavation: Excavation below subgrade elevations or beyond indicated horizontal dimensions as shown on plans or authorized by the District’s Representative.

2. Unauthorized Over-Excavation: Excavation below subgrade elevations or beyond indicated horizontal dimensions without authorization by the District’s Representative. Unauthorized excavation shall be without additional compensation.

C. Structural Backfill: Soil materials approved by the District’s Representative and used to fill excavations resulting from removal of existing below grade facilities, including trees.

D. Structural Fill: Soil materials approved by the District’s Representative and used to raise existing grades.

E. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material ¾-cubic yards or more in volume that when tested by an independent geotechnical testing agency, according to ASTM D 1586, exceeds a standard penetration resistance of 100 blows/2-inches.

F. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man made stationary features constructed above or below grade.

G. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base or topsoil materials.

H. Unsuitable Material: Any soil material that is not suitable for a specific use on the
Project. The District’s Representative will determine if a soil material is unsuitable.

I. Utilities: onsite underground pipes, conduits, ducts and cables.

1.6 SUBMITTALS


B. Submit material certificates signed by the material producer and the Contractor, certifying that that each material item complies with, or exceeds the specified requirements.

1.7 QUALITY ASSURANCE

A. Conform all work and materials to the recommendations or requirements the District’s Representative.

B. Conform all work to the appropriate portion(s) of Sacramento Standard Specifications,

C. Percentage of compaction specified shall be the minimum acceptable. The percentage represents the ratio of the dry density of the compacted material to the maximum dry density of the material as determined by the procedure set forth in ASTM D 1557.

D. Excavate and backfill existing areas only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations. Backfill as necessary to achieve rough grade elevations as indicated per plan.

E. Perform excavation, filling, compaction and related earthwork under the observation of the District’s Representative. Materials placed without approval of the District’s Representative will be presumed to be defective and, at the discretion of the District’s Representative, shall be removed and replaced at no cost to the District. Notify the District’s Representative at least 24-hours prior to commencement of earthwork and at least 48 hours prior to testing.

F. The District’s Representative will perform observations and tests required to enable him to form an opinion of the acceptability of the Project earthwork. Correct earthwork that, in the opinion of the District’s Representative, does not meet the requirements of these Technical Specifications.

G. Upon completion of the construction work, certify that all compacted fills and foundations are in place at the correct locations, and have been constructed in accordance with sound construction practice. In addition, certify that the materials used are of the types, quality and quantity required by these Technical Specifications. The Contractor shall be responsible for the stability of all fills and backfills constructed by his forces and shall replace portions that in the opinion of the District’s Representative have been displaced or are otherwise unsatisfactory due to the Contractor’s operations.
H. Do not mix or place cement treated base when the temperature is below is below 36 degrees F or when the ground is frozen.

I. Finish surface of material to be stabilized prior to lime treatment shall be as specified in Sacramento Standard Specifications and as required by these Technical Specifications.

J. Finish surface of the stabilized material after lime treatment shall be as specified in Sacramento Standard Specifications and as required by these Technical Specifications.

K. Identify and protect existing utilities.

L. Finish soil grade tolerance at completion of grading:
   1. Paved areas: +0.05
   2. Other areas: ±0.10 feet.

1.8 PROJECT CONDITIONS

A. Promptly notify the District and the District’s Representative of surface or subsurface conditions differing from those disclosed in conformance with Division 1 General Requirements.

B. Protect open excavations, trenches, and the like with fences, covers and railings to maintain safe pedestrian and vehicular traffic passage.

C. Prevent erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

D. Temporarily stockpile fill material in an orderly and safe manner and in a location approved by the District.

E. Provide dust and noise control in conformance with Division 1 General Requirements.

F. Environmental Requirements: When unfavorable weather conditions necessitate interrupting earthwork operation, areas shall be prepared by compaction of surface and grading to avoid collection of water. Provide adequate temporary drainage to prevent erosion. After interruption, compaction specified in last layer shall be re-established before resuming work.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from on-site excavations.

B. Obtain approval of on-site soil materials and borrow materials to be used for
structural fill or structural backfill from the District's Representative.

C. On-Site Structural Fill and Structural Backfill: Soil or soil-rock mixture from on site excavations, free from organic matter or other deleterious substances. On-site structural fill and backfill shall not contain rocks or rock fragments over 3 inches in greatest dimension.

D. Imported Structural Fill and Structural Backfill: Conform to the requirements of on-site structural fill. Material shall also be a non-expansive and predominantly granular soil or soil-rock mixture with plasticity index of 8 or less, has a liquid limit less than 25, and an R-Value of 25 or greater.

2.2 SOIL STERILANT

A. Commercial chemical for weed control, registered by EPA. Provide granular, liquid or wet-able powder form.

2.3 AGGREGATE BASE

   1. Class 2, 1-1/2-inch Maximum: Section 26-1.02A.
   2. Class 2, 3/4-inch Maximum: Section 26-1.02A.
   3. Class 3: Section 26-1.02B.

2.4 LIME STABILIZATION

A. Lime Treatment Material: Conform to Section 24-1.02 and 24-1.03 of Sacramento Standard Specifications and the Project Geotechnical Report.

PART 3 - EXECUTION

3.1 GENERAL

A. Conform to Section 14, Earthwork, Sacramento Standard Specifications as modified by the Contract Documents.

B. Placement and compaction of material by flooding, ponding, or jetting will not be permitted.

C. The use of explosives will not be permitted.

3.2 CONTROL OF WATER AND DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding the site and surrounding area. Provide dewatering equipment necessary to drain and keep excavations and site free from water.
B. Dewater during backfilling operation so that groundwater is maintained at least two feet below level of compaction effort.

C. Obtain the District’s Representative’s approval for proposed control of water and dewatering methods.

D. Protect subgrades from softening, undermining, washout and damage by rain or water accumulation.

E. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations.

F. Maintain dewatering system in place until dewatering is no longer required.

3.3 WET WEATHER CONDITIONS

A. Do not prepare subgrade, place or compact soil materials if above optimum moisture content.

B. If the District’s Representative allows work to continue during wet weather conditions, conform to supplemental recommendations provided by the District’s Representative.

3.4 EXCAVATION

A. Excavate earth and rock to lines and grades shown on drawings as prepared by a licensed professional engineer and to the net dimensions indicated on the Plans, required herein or as required to satisfactorily compact backfill.

B. Remove and dispose of large rocks, pieces of concrete and other obstructions encountered during excavation.

C. Where forming is required, excavate only as much material as necessary to permit placing and removing forms.

D. Provide supports, shoring and sheet piles required to support the sides of excavations or for protection of adjacent existing improvements.

3.5 REMOVAL OF EXISTING FILLS AND UNSUITABLE MATERIAL

A. Over-excavate areas of existing fills and other unsuitable material encountered during mass grading as directed by the District’s Representative.

B. Conform with Division 1 General Requirements.

3.6 GRADING

A. Uniformly grade the Project to meet existing conditions.

B. Finish ditches, gutters and swales to the sections, lines and grades indicated and to permit proper surface drainage.
C. Round tops and bottoms of slopes as indicated or to blend with existing contours.

3.7 SUBGRADE PREPARATION

A. Prepare subgrades under paved areas, curbs, gutters, walks, structures, other surface facilities and areas to receive structural fill. At least 6 inches of select material shall be placed beneath exterior flatwork and extend at least two feet beyond the slab edges.

B. Prepare subgrades for paved areas, curbs and gutters by plowing or scarifying surface at least 9 inches in one lift below final subgrade elevations and 1-foot beyond edge of pavement unless specified otherwise by the District’s Representative. Uniformly moisture condition to obtain optimum moisture contents. Break clods and condition surface by harrowing or dry rolling. Remove boulders, hard ribs and solid rock. Prepare earth uniform for full depth and width of subgrade.

1. Surface soil that has a moisture content of less than 22 percent (average, approximate plastic limit of the soil) should be excavated, moisture-conditioned to at least three percent above optimum moisture content, and compacted to between 88 and 93 percent relative compaction to reduce its expansion potential; maximum depth of required excavation for moisture conditioning is about two feet.

C. Protect utilities from damage during compaction of subgrades and until placement of final pavements or other surface facilities.

D. Obtain the District’s Representative’s approval of subgrades prior to placing pavement.

E. Subgrade preparation will not be required in areas where lime treatment is used.

3.8 PLACEMENT OF STRUCTURAL FILL

A. Obtain the District’s Representative’s approval of surface to receive structural fill prior to placement of structural fill material.

B. Place structural fill on prepared subgrade.

C. Spread structural fill material in uniform lifts not more than 8-inches in un-compacted thickness and compact.

D. Place structural fill material to suitable elevations above grade to provide for anticipated settlement and shrinkage.

E. Overbuild fill slopes, as required by the District’s Representative, to obtain required compaction. Remove excess material to lines and grades indicated.

F. Do not drop fill on structures. Do not backfill around, against or upon concrete or masonry structures until structure has attained sufficient strength to withstand loads imposed and the horizontal structural system had been installed.
3.9 TEMPORARY AND PERMANENT SLOPES
A. Temporary slopes less than 10 feet high should be inclined no steeper than 1.5:1 (horizontal to vertical).
B. Shallow, permanent, cut and fill slopes shall be constructed no steeper than 2:1 (horizontal to vertical).

3.10 AGGREGATE BASE
A. Watering, Spreading and Compacting: Section 17 of Sacramento Standard Specifications.

3.11 LIME STABILIZATION
A. Performing the stabilization shall conform to Section 10 of Sacramento Standard Specifications and the following:
1. Add lime in the amount specified by the District’s Representative.
2. Lime treat subgrade soils from back of curb to back of curb to a depth specified by the District’s Representative.
3. Mix in two mixing periods, both with the tines lowered to the same depth. Both mixing periods shall be monitored and verified by the District’s Representative. The second mixing shall occur at about 24 hours after the initial mixing.
4. Compact and grade the lime mixed subgrade immediately after the second mixing.
5. Compact the lime treated subgrade to 93 percent as determined by ASTM D1557.
6. After application of the curing seal, do not allow traffic on the lime treated material for a period of 7 days in lieu of the 3 days specified in Section 10 of Sacramento Standard Specifications.
7. Proof-roll the stabilized subgrade after compacting to confirm that a non-yielding surface has been achieved. Yielding areas, if any, shall be mitigated. Mitigation could consist of over-excavation, utilization of stabilization fabric, or chemical treatment. Each case shall be addressed individually in the field by the District’s Representative.

3.12 COMPACTION AND TESTING
A. Do not compact by ponding, flooding or jetting.
B. Compact soils at optimum water content. Aerate material if it is too wet. Add water to material if it is too dry. Thoroughly mix lifts before compaction to ensure uniform moisture distribution.
C. Perform compaction using rollers, pneumatic or vibratory compactors or other equipment and mechanical methods approved by the District’s Representative.
D. Compaction requirements:
   1. Compact structural fills less than 5-feet thick to 90 percent compaction.
   2. Compact structural fill 5-feet thick or greater to 95 percent compaction.
   3. Compact the upper 6 inches of subgrade soils beneath pavements, curbs and gutters to 95 percent compaction. Extend compaction 2-feet beyond pavement edges unless specified otherwise by the District’s Representative.
   4. Compact the upper 6-inches of subgrade soils under walks, structures and areas to receive structural fill to 90 percent compaction.

3.13 SOIL STERILIZATION

A. Apply soil sterilant to areas indicated, such as beneath asphalt concrete pavement, brick pavement, concreter pavement and at grade concrete slabs, including sidewalks, curbs and gutters. Also where indicated apply soil sterilant below expansion and control joints and at areas where pipes, ducts or other features penetrate slabs.

B. Apply soil sterilant uniformly and at the rates recommended by the manufacturer.

C. Apply soil sterilant to prepared subgrade, or after installation of aggregate base as recommended by the manufacturer.

3.14 DISPOSAL

A. Lawfully dispose of all unsuitable and excess or surplus material off-site at no cost to the District.

END OF SECTION
SECTION 31 23 33
TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Excavation, bedding, and backfill for underground storm drain, sanitary sewer, and water piping and associated structures.

1.2 SECTION EXCLUDES

A. Drainage fill material and placement around subdrains.

B. Trenching and backfill for other utilities such as underground HVAC piping, electrical conduit, telephone conduit, gas piping, cable TV conduit, etc.

1.3 RELATED SECTIONS

1. Section 31 23 00 – Excavation and Fill.
2. Section 33 10 00 – Water Utilities.
3. Section 33 30 00 – Sanitary Sewerage Utilities.
4. Section 33 40 00 – Storm Drainage Utilities.

1.4 RELATED DOCUMENTS

A. ASTM:
   1. C 33, Specification for Concrete Aggregates.
   7. D 2487, Classification of Soils for Engineering Purposes.

B. California Code of Regulation Title 24, Part 2, California Building Code:
   1. Chapter 11B – Accessibility to Public Buildings.
   2. Chapter 33 – Site Work, Demolition and Construction.

C. Caltrans Standard Specifications:
   1. Section 19, Earthwork.
   2. Section 26, Aggregate Bases.
3. Section 68, Subsurface Drains.
4. Section 88, Engineering Fabrics.

D. CAL/OSHA, Title 8.
E. "Geotechnical Investigation for Proposed New Tutorial Library Building Diablo Valley College – San Ramon Campus 1790 Watermill Road San Ramon, CA" by RMA Group

1.5 DEFINITIONS

A. AC: Asphalt Concrete.
C. Bedding: Material from bottom of trench to bottom of pipe.
D. CDF: Controlled Density Fill.
E. DIP: Ductile Iron Pipe.
F. Initial Backfill: Material from bottom of pipe to 12-inches above top of pipe.
G. PCC: Portland Cement Concrete.
H. RCP: Reinforced Concrete Pipe.
I. Springline of Pipe: Imaginary line on surface of pipe at a vertical distance of ½ the outside diameter measured from the top or bottom of the pipe.
J. Subsequent Backfill: Material from 12-inches above top of pipe to subgrade of surface material or subgrade of surface facility or to finish grade.
K. Trench Excavation: Removal of material encountered above subgrade elevations and within horizontal trench dimensions.
   1. Authorized Trench Over-Excavation: Excavation below trench subgrade elevations or beyond indicated horizontal trench dimensions as shown on plans.
   2. Unauthorized Trench Over-Excavation: Excavation below trench subgrade elevations or beyond indicated horizontal trench dimensions. Unauthorized excavation shall be without additional compensation.
L. Utility Structures:
   1. Storm drainage manholes, catch basins, drop inlets, curb inlets, vaults, etc.
   2. Sanitary sewer manholes, vaults, etc.
   3. Water vaults, etc.

1.6 SUBMITTALS

A. Follow submittal procedures outlined in Section 01 33 00 – Submittal Procedures.

B. Product Data:
   1. Grading and quality characteristics showing compliance with requirements for the Work.
   2. Certify that material meets requirements of the Project.

C. Samples:
   1. If required, provide 40-pound samples of all imported trench bedding and backfill material sealed in airtight containers, tagged with source locations and suppliers of each proposed material.
   2. Provide materials from same source throughout work. Change of source requires approval of the Owner.

1.7 QUALITY ASSURANCE
A. Conform all work to the appropriate portion(s) of the Caltrans Standard Specifications, Section 19.

B. Percentage of compaction specified shall be the minimum acceptable. The percentage represents the ratio of the dry density of the compacted material to the maximum dry density of the material as determined by the procedure set forth in ASTM D 1557.

C. Conform work to the requirements of the California Building Code.
   1. Section 1806A.11 – Pipe and Trenches.

1.8 PROJECT CONDITIONS

A. Promptly notify the Owner of surface or subsurface conditions differing from those disclosed in the construction documents. First notify the Owner verbally to permit verification and extent of condition and then in writing. No claim for conditions differing from those anticipated in the Contract Documents will be allowed unless Contractor has notified the Owner in writing of differing conditions prior to contractor starting work on affected items.

B. Protect open, trenches, and utility structure excavations with fences, covers and railings to maintain safe pedestrian and vehicular traffic passage.

C. Stockpile on-site and imported backfill material temporarily in an orderly and safe manner.

D. Provide dust and noise control in conformance with Section 02000, Supplemental General Requirements for Civil Improvements. Also see Division 1 General Requirements for Cleaning and Waste Management.

PART 2 - PRODUCTS

2.1 PIPE BEDDING AND INITIAL BACKFILL

A. ASTM D 2321, Class IA, IB or II.
   1. Clean and free of clay, silt or organic matter.

B. Permeable Material: Conform to Section 68-1.025 of Caltrans Standard Specifications, Class 2 permeable.

C. Class 2 Aggregate Base: Conform to Section 26 of Caltrans Standard Specifications, ¾-inch maximum. Material shall also be non-expansive and predominantly granular soil or soil-rock mixture “(percent of passing #200: 50 maximum, 5 minimum)” with plasticity index of 15 or less.


2.2 WARNING TAPE

A. See Section 33 10 00 – Water Utilities.

2.3 SUBSEQUENT BACKFILL
A. Conform to on-site or imported structural backfill in Section 31 23 00 – Excavation and Fill.

2.4 CONTROLLED DENSITY FILL (CDF) (IN TRENCHES)

A. Provide non-structural CDF, from bottom of trench to finish subgrade of subbase or base material, that can be excavated by hand and produce unconfined compressive 28-day strengths from 50-psi to a maximum of 150-psi. Provide aggregate no larger than 3/8-inch top size. The 3/8-inch aggregate shall not comprise more than 30% of the total aggregate content.

B. Cement: Conform to the standards as set forth in ASTM C-150, Type II Cement.

C. Fly Ash: Conform to the standards as set forth in ASTM C-618, for Class F pozzolan. Do not inhibit the entrainment of air with the fly ash.

D. Air Entraining Agent: Conform to the standards as set forth in ASTM C-260.

E. Aggregates need not meet the standards as set forth in ASTM C-33. Any aggregate, producing performances characteristics described herein will be accepted for consideration. The amount of material passing a #200 sieve shall not exceed 12% and no plastic fines shall be present.

F. Provide CDF that is a mixture of cement, Class F pozzolan, aggregate, air entraining agent and water. CDF shall be batched by a ready mixed concrete plant and delivered to the job site by means of transit mixing trucks.

G. The Contractor shall determine the actual mix proportions of the controlled density fill to meet job site conditions, minimum and maximum strengths, and unit weight. Entrained air content shall be a minimum of 4.0%. The actual entrained air content shall be established for each job with the materials and aggregates to be used to meet the placing and unit weight requirements. Entrained air content may be as high as 20% for fluidity requirements.

2.5 CONCRETE STRUCTURE BEDDING AND BACKFILL

A. Precast Structures: Same materials to the same heights as specified for pipe bedding and backfill.

B. Poured-in-Place Structures:
   1. Bedding: In general, bedding is not required, pour bases against undisturbed native earth in cut areas and against engineered fill compacted to 90% relative compaction in embankment areas.
   2. Side Backfill: On-site or imported structural fill meeting the requirements given in Section 31 23 00 – Excavation and Fill.

2.6 FILTER FABRIC

A. Filter Fabric:
   2. Mirafi 140N (Mirafi Inc., Charlotte, NC) (Tel. 800-438-1855) or equal.
PART 3 - EXECUTION

3.1 TRENCHING AND EXCAVATION

A. Existing PCC or AC Areas: Cut PCC or AC to full depth at a minimum distance of 12-inches beyond the edge of the trench.

B. Excavate by hand or machine. For gravity systems begin excavation at the outlet end and proceed upstream. Excavate sides of the trench parallel and equal distant from the centerline of the pipe. Hand trim excavation. Remove loose matter.

C. Excavation Depth for Bedding: Minimum of 4-inches below bottom, except that bedding is not required for nominal pipe diameters of 2-inches or less.

D. Excavation Width at Springline of Pipe:
   1. Up to a nominal pipe diameter of 24-inches: Minimum of twice the outside pipe diameter.
   2. Nominal pipe diameter of 30-inches through 36-inches: Minimum of the outside pipe diameter plus 2-feet.
   3. Nominal pipe diameter of 42-inches through 60-inches: Minimum of the outside pipe diameter plus 3-feet.

E. Over-Excavations: Backfill trenches that have been excavated below bedding design subgrade, with approved bedding material.

F. Comply with the Owner's limitations on the amount of trench that is opened or partially opened at any one time. Do not leave trenches open overnight without the approval of the Owner.

G. Where forming is required, excavate only as much material as necessary to permit placing and removal of forms.

H. Grade bottom of trench to provide uniform thickness of bedding material and to provide uniform bearing and support for pipe along entire length. Remove stones to avoid point bearing.

3.2 CONTROL OF WATER AND DEWATERING

A. Be solely responsible for dewatering trenches and excavations and subsequent control of ground and surface water. Provide and maintain such pumps or other equipment as may be necessary to control ground water.

B. Dewater during backfilling operation so that groundwater is maintained at least one foot below level of compaction effort.

C. Reroute surface water runoff away from open trenches and excavations. Do not allow water to accumulate in trenches and excavations.

D. Maintain dewatering system in place until dewatering is no longer required.

3.3 BRACING AND SHORING
A. Conform to California and Federal OSHA requirements.

B. Place and maintain such bracing and shoring as may be required to support the sides of the excavations for the proper protection of workmen; to facilitate the work; to prevent damage to the pipes and appurtenances being constructed; and to prevent damage to adjacent structures or facilities. Remove all bracing and shoring upon completion of the work.

C. Be solely responsible for all bracing and shoring and, if requested by the Owner, submit details and calculations to the Owner. The Owner may forward the submittal to the Consulting Engineer and/or the California Division of Industrial Safety for their review. The Contractor's submittal shall include the basic design, assumed soils conditions and estimation of forces to be resisted, together with plans and specifications of the materials and methods to be used, and shall be prepared by a civil engineer or structural engineer registered in California. No excavations in trench section or around structures shall precede a response to the submittal by the Owner.

D. Be solely responsible for installing and extracting the sheathing in a manner which will not disturb the line, grade, or backfill compaction or operation of the utility being installed or adjacent utilities and facilities.

3.4 PIPE BEDDING

A. Accurately shape bedding material to the line and grade called for on the Plans. Carefully place and compact bedding material to the elevation of the bottom of the pipe in layers not exceeding 8-inches in loose thickness. Compact bedding material at optimum water content to 95% relative compaction unless specified otherwise on the. Compact by pneumatic tampers or other mechanical means. Jetting or ponding of bedding material will not be permitted.

3.5 WARNING TAPE

A. Install in accordance with Section 33 10 00 – Water Utilities.

3.6 BACKFILLING

A. Bring initial backfill up simultaneously on both sides of the pipe, so as to prevent any displacement of the pipe from its true alignment. Carefully place and compact initial backfill material to an elevation of 12-inches above the top of the pipe in layers not exceeding 8-inches in loose thickness. Compact bedding material at optimum water content to 90% relative compaction unless specified otherwise on the. Compact by pneumatic tampers or other mechanical means. Jetting or ponding of initial backfill material will not be permitted.

B. Bring subsequent backfill to subgrade or finish grade as indicated. Carefully place and compact subsequent backfill material to the proper elevation in layers not exceeding 8-inches in loose thickness. Compact bedding material at optimum water content to 90% relative compaction, unless specified otherwise on the Plans. Compact by pneumatic
tampers or other mechanical means. Jetting or ponding of subsequent backfill material will not be permitted.

C. Do not use compaction equipment or methods that produce horizontal or vertical earth pressures that may cause excessive pipe displacement or damage the pipe.

3.7 CLEANUP

A. Upon completion of utility earthwork all lines, manholes catch basins, inlets, water meter boxes and other structures shall be thoroughly cleaned of dirt, rubbish, debris and obstructions of any kind to the satisfaction of the Owner.

B. See Section 01 74 00 – Refer to Division 1 General Requirements for Cleaning and Waste Management for further cleanup requirements.

END OF SECTION
SECTION 31 63 29

DRILLED CONCRETE PIERS

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 project Geotechnical Engineer is available and will be furnished 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.

C. Related Sections
   1. Section 03 10 00 – Concrete Forming and Accessories
   2. Section 03 20 00 – Concrete Reinforcing
   3. Section 03 30 00 – Cast-In-Place Concrete

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. Pier Diameter: Diameter of drilling bucket or auger bit or inside diameter of casing.

D. Pier Length: Total length of caisson from bottom of wall, grade beam or pier cap to bottom of hole as drilled.

E. Center of Piers: Intersection of two diameters, one taken parallel to the wall, grade beam, or column line direction, the other taken perpendicular to the first diameter.

F. Tremie method: Procedure for placing concrete under water using a watertight steel pipe or tube to place concrete without washing out cement fines.
1.3 STANDARDS

A. Comply with the provision of the following codes, specifications and standards except where more stringent requirements are shown or specified:

1. California Code of Regulations, Title 24, 2016 edition, also known as California Building Code (CBC), with Division of the State Architect (DSA) amendments

2. ACI 301 “Specifications for Structural Concrete for Buildings”

3. ACI 318 “Building Code Requirements for Reinforced Concrete”


5. American Society for Testing and Materials (ASTM)


1.4 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, services, equipment (including temporary casings and/or dewatering where required), and shall install all piers at the locations and depths shown on the drawings or as otherwise directed by the Geotechnical Engineer. Installation methods compatible with the design may be used if acceptable to the Geotechnical Engineer. Methods that are not compatible with the design shall be excluded from consideration.

B. The 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 Contractor shall furnish all materials and labor as required to perform the load tests as specified herein and on the drawings.

D. The 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 Drilling Contractor shall have a minimum of 3 years successful experience and a minimum of 3
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 District 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. Survey Work:

1. The 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.

C. Testing Laboratory Requirements: The 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 District 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 District.

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 District’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 SUBMITTALS

A. Concrete Mix Design: Submit concrete mix designs suitable for method of concrete placement for Engineer's and Owner's Testing Laboratory approval prior to pier installation.

B. Drilling Records: The Contractor and the 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 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. Bottom elevation.
4. Top elevation.
5. Pier length.
8. Reinforcing steel size and depth actually placed.
9. Drilling start and finish time.
10. Concreting start and finish time.
11. Variation from specified tolerances including surveyed location and plumbness.
12. Construction method (dry method, casing method, or slurry displacement method).
13. 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).
14. Elevation of top and bottom of any casing left in place.
15. Description of temporary or permanent casing (including purpose, diameter, wall thickness and length).
16. Description and elevation of any obstructions encountered and whether removal was obtained.
17. Description of pier bottom including amount and extent of loose material.
19. Any difficulties encountered in drilling or concreting operations.
20. Any deviations from specifications.

Reports prepared by the District's Geotechnical Engineer or authorized inspector shall be compiled and signed by a California licensed professional engineer. Reports prepared by the Contractor shall be compiled and signed by the drilling superintendent.
C. Shop Drawings:

1. Reinforcing Steel: Submit shop drawings for all drilled pier reinforcing steel per Section 032000.

D. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items.

E. Post Construction Survey: After completion of pier placement, the Contractor shall provide the Owner 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 remain fluid throughout the concrete placement time and during extraction of any temporary casing. Provide a minimum 6" slump concrete with retarder for temporarily cased piers at time of pulling casing.

2.2 REINFORCING STEEL

A. See "Concrete Reinforcing Steel" Section 03 20 00 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, if used, shall conform to ASTM A 283, Grade C or ASTM A 36.

B. Provide steel casing of sufficient strength to withstand handling stresses, concrete pressure, and surrounding earth and fluid pressures. Provide complete penetration welds of joints in casing per AWS D1.1.

2.4 GROUT

A. Grout used for pier hole base grouting and 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 of 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 90°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 District's Geotechnical Engineer.
2. Maintain sidewall stability during drilling. If sidewall instability is encountered that the District’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 District’s Geotechnical Engineer and District’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 free water from the bottom of the shaft.

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 District’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 Geotechnical Engineer. Overexcavated drilled piers will be measured and paid for in accordance with the original design or authorized design depth and diameter.
E. Excavated Material:
   1. Remove excavated material and dispose of it off site.

3.2 TEMPORARY STEEL CASINGS

A. Requirements:
   1. Provide temporary casing at locations as directed by the Geotechnical Engineer 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.
   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 District’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.

3.3 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 Class B lap splices 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. 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.

3.4 CONCRETE PLACEMENT

A. General:

1. Fill drilled piers with concrete immediately after inspection and approval by the Geotechnical Engineer. Complete the excavation and concrete placement in uncased excavations before the end of the workday unless the 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 may 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 District'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 pier diameter by earth pressure on the fresh concrete. The concrete in each
   pier 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 pupline so as to provide a
   continuous flow, without aggregate segregation, from bottom to top of pier. 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 pupline, 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 District'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 District's authorized inspector has reason to suspect that the concrete was breached
   by the tremie or pupline 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 District, 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.
3.5 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 1 1/2" in any direction, whichever is less.

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 elevations of drilled piers as shown in Drawings are estimated from soil bearing data and are minimum depths for bid purposes. The Geotechnical Engineer will determine actual final bottom elevation during excavation.

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. Anchorage Embedment Tolerance: Vertical and horizontal deviation from design location for individual anchorage components embedded in the pier shall not exceed ± 0.5 inches.

G. 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.

3.6 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. Observation Requirements: Each drilled pier shall be inspected by the authorized inspector and approved prior to placement of concrete.
3.7 APPROVAL BY THE GEOTECHNICAL ENGINEER

A. Approval by the District’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.

3.8 CONTRACT BASIS

A. Basis of Bids: Bids shall be based on number of drilled piers, design length from top elevation to bottom of shaft and diameter of shaft, 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 may vary to coincide with elevation where satisfactory bearing or friction strata 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.

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: cost per cu. yd.
2. Permanent steel casings, installed: cost per lin. ft.
3. Reinforcing steel and dowels, installed: cost per lb.
4. Concrete: cost per cu. yd.

END OF SECTION
SECTION 32 05 23

CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Materials for portland cement concrete.
B. Aggregate and aggregate grading for portland cement concrete.
C. Water for portland cement concrete.
D. Admixtures for portland cement concrete.
E. Proportioning for portland cement concrete.
F. Mixing and transporting portland cement concrete.
G. Formwork for cast in place portland cement concrete.
H. Embedded materials for portland cement concrete.
I. Steel reinforcement for portland cement concrete.
J. Placing and finishing portland cement concrete.
K. Curing portland cement concrete.
L. Protecting portland cement concrete.

1.2 RELATED SECTIONS

A. Section 31 23 00, Excavation and Fill.
B. Section 32 13 00, Rigid Paving.

1.3 RELATED DOCUMENTS

A. Geotechnical Reports

B. ASTM Standards
1. A 82, Cold Drawn Steel Wire for Concrete Reinforcement.
2. A 185, Steel Welded Wire Fabric, Plain for Concrete Reinforcement.
3. A 615, Deformed and Plain Billet Steel Bars, for Concrete Reinforcement.
7. C 618, Fly Ash and Raw or Calcined Natural Pozzolan for use as Natural Admixture in Portland Cement.

C. Caltrans Standard Specifications:
   1. Section 51: Concrete Structures.
   2. Section 73: Concrete Curbs and Sidewalks.

D. California Building Code:
   1. Chapter 11B – Accessibility To Public Buildings.
   2. Chapter 19A – Concrete.
   4. Section 1133B – General Accessibility for Entrances, Exits and Paths of Travel.

E. 1.4 DEFINITIONS

1.5 SUBMITTALS
A. Follow submittal procedures outlined in Section 01 33 00 – Submittal Procedures.
B. Design Mixes: Have all concrete mixes designed by a testing laboratory and approved by the Consulting Engineer. Conform all mixes to the applicable building code requirement, regardless of other minimum requirements listed herein or on the drawings. Submit mix designs for review before use. Show proportions and specific gravities of cement, fine and coarse aggregate, and water and gradation of combined aggregates.
C. Reinforcing Steel Shop-Drawings

1.6 QUALITY ASSURANCE
A. Concrete shall be subject to quality assurance in accordance with Section 90 of the Standard Specifications.
   1. Slump tests: Have available, at job site, equipment required to perform slump tests. Make one slump test for each cylinder sample, from same concrete batch. Allowable maximum slump shall be 4 inches for walls and 3 inches for slabs on grade and other work.

B. Certifications:
   1. Provide Owner's Representative at the time of delivery with certificates of compliance signed by both Contractor and Supplier containing the following statements:

   2. Materials contained comply with the requirements of the Contract Documents in all respects.

   3. Proportions and mixing comply with the design mix approved by the Consulting Engineer. Design mix shall have been field tested in accordance with the herein requirements of the Caltrans Standard Specifications and produces the required compressive strength under like conditions.

   4. Statement of type and amount of any admixtures.

   5. Provide Owner's Representative, at time of delivery, with certified delivery ticket stating volume of concrete delivered and time of mixing, or time of load-out in case of transit mixers.

C. Conform to the applicable provisions of Section 51, 73 and 90 of the Caltrans Standard Specification and these Technical Specifications.
   1. Conform construction of portland cement concrete surface improvements (including curbs, gutters, medians, valley gutters, walks) to the requirements of Section 73 of the Caltrans Standard Specifications unless otherwise required in these Technical Specifications or shown on the Plans.

   2. Construct "V" ditches in accordance with Section 72-4 of the Standard Specifications; except that finishing shall be in accordance with Standard Specification Section 73 instead of 53, or as otherwise required in these Technical Specifications or shown on the Plans.

   3. Conform other construction of portland cement concrete items to the requirements of Section 51 of the Caltrans Standard Specifications unless otherwise required in these Technical Specifications or shown on the Plans.

D. Conform to the requirements of the California Building Code section 1929A.2 for testing of reinforcing bars.

1.7 DESIGNATION

A. General: Whenever the 28-day compressive strength is designated herein or on the plans is greater than 3,600 psi, the concrete shall considered to be designated by compressive strength. The 28-day compressive strength shown herein or on the plans which are 3,600 psi or less are shown for design information only and are not considered a requirement for acceptance of the concrete. Whenever the concrete is designated by
class or as minor concrete herein or on the plans, the concrete shall contain the cement
per cubic meter shown in section 90-1.01 of the Caltrans Standard Specifications.

B. Unless specified otherwise herein or on the Plans, Portland Cement Concrete for this
Project shall be Class "2" as specified in Section 90-1.01 of the Caltrans Standard
Specifications.

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT

A. General: Type V or type II (modified) cement conforming to the requirements of ASTM C
150, with the following modifications:

1. Cement shall not contain more than 0.60% by weight of alkalies, calculated as the
percentage of Na₂O plus 0.658 times the percentage of K₂O when determined by
either 4 intensity flame photometry or by the atomic absorption method. The
instrument and procedure used shall be qualified as to precision and accuracy in
accordance with the requirements of ASTM C 114.

2. The autoclave expansion shall not exceed 0.50%.

3. Mortar containing the Portland Cement to be used and the sand, when tested in
accordance with Test Method No. Calif. 527, shall not expand in water more than
0.010% and shall have an air content less than .048%.

4. Allowable tri-calcium Aluminate (C₃A) by weight shall not exceed 5%. Allowable
tetracalcium alumino ferrite plus twice the tricalcium aluminate (C₄AF+2C₃A) by
weight shall not exceed 25%. The sulfate expansion test (ASTM C 452) may be
used in lieu of the above chemical requirements, provided the sulfate expansion
does not exceed 0.040% at 14 days (max.).

5. Contractor may substitute pozzolan for Portland Cement in amounts up to 15% of the
required mix unless high early strength concrete is specified. Pozzolan shall consist
of Class F Fly Ash meeting the requirements of ASTM C 618.

B. Cement for Surface Improvements: Provide a coloring equivalent to ¼ pound of
lampblack per cubic yard. Add to the concrete at the central mixing plant.
Liquiblack, as supplied by Concrete Corporation of Redwood City, California, may be
used in lieu of lampblack. One pint of liquiblack shall be considered equal to one pound
of lampblack.

2.2 AGGREGATE AND AGGREGATE GRADING

A. General: Conform to the requirements of Section 90-2.02, 2.02A and 2.02B of the
Caltrans Standard Specifications.

B. Aggregate Size and Gradation: Conform to the requirements of section 90-3 of the
Caltrans Standard Specifications for 25-mm (1-inch) maximum combined aggregate.

2.3 WATER
A. General: Conform to the requirements of section 90-2.03 of the Caltrans Standard Specifications, for mixing and curing portland cement concrete and for washing aggregates.

2.4 CLASSIFICATION OF PORTLAND CEMENT CONCRETE

A. Concrete for the following items shall be designated by the following classes per Section 90-1.01 of the Caltrans Standard Specifications:
   2. Curbs, Gutters, and Sidewalks: Minor Concrete.
   3. Cast in place Concrete Pipe: The concrete shall consist of a minimum of 564 pounds of Portland cement per cubic yard of concrete.
   4. Thrust Blocks: The concrete shall have a minimum compressive strength of 3,000 psi.
   5. Sign and Fence Footings: The concrete shall consist of a minimum of 376 pounds of Portland cement per cubic yard of concrete.

2.5 EXPANSION JOINT MATERIAL

A. Material for expansion joints in portland cement concrete improvements shall be premolded expansion joint fillers conforming to the requirements of ASTM Designation D 1751. Expansion joint material shall be shaped to fit the cross section of the concrete prior to being placed. Suppliers certificates showing conformance with this specification shall be delivered with each shipment of materials delivered to the job site. Unless noted otherwise herein or on the Plans expansion joint thickness shall be as follows:
   2. Concrete Slope Protection, Gutter Lining, Ditch Lining and Channel Lining: ½-inch.
   3. Structures: As indicated.

2.6 REINFORCEMENT AND DOWELS

A. Bar reinforcement for concrete improvements shall be deformed steel bars of the size or sizes called for on the plans conforming to the requirements of ASTM Designation A 615 for Grade 60 bars. Size and shape for bar reinforcement shall conform to the details shown or called for on the Plans. Substitution of wire mesh reinforcement for reinforcing bars will not be allowed.

B. Slip dowels, where noted or called for on the plans or detail drawings shall be smooth billet-steel bars as designated and conforming to the requirements of ASTM Designation A 615 for Grade 60 bars. Ends of bars inserted in new work shall be covered with a cardboard tube sealed with cork; no grease or oil shall be used.

C. Mesh for reinforcement for concrete improvements shall be cold drawn steel wire mesh of the size and spacing called for on the plans conforming to the requirements of ASTM
Designation A 82 for the material and ASTM Designation A 185 for the mesh. Size and extent of mesh reinforcement shall conform to the details shown or called for on the plans.

D. Tie wire for reinforcement shall be eighteen (18) gauge or heavier, black, annealed conforming to the requirements of ASTM Designation A 82.

E. Suppliers certificates showing conformance with this specification shall be delivered with each shipment of materials delivered to the job site.

2.7 COLOR AND PATTERN FOR DECORATIVE SURFACES

A. Colors for decorative surfacing shall be CHROMIX admixtures as manufactured by the L. M. Scofield Company, Schedule A-312.05 or approved equal. The specific color shall be as designated or called for on the Plans.

B. Patterns for decorative surfacing shall be standard "Bomanite" patterns as copyrighted by the Bomanite Corporation of Palo Alto, California or equal. The specific pattern shall be as designated or called for on the Plans.

2.8 ACCESSORY MATERIALS

A. Conform water stops and other items required to be embedded in of Portland Cement Concrete structures to the applicable requirements of Section 51 of the Caltrans Standard Specifications unless otherwise specifically noted or called for on the Plans or detail drawings.

B. Curing Compounds:
   1. Regular Portland Cement Concrete: "Non-Pigmented Curing Compound - chlorinated Rubber Base-Clear" conforming to the requirements contained in Section 90-7.01B, of the Caltrans Standard Specifications.
   2. Color Conditioned Decorative Portland Cement Concrete: LITHOCHROME color wax as manufactured by the L. M. Scofield Company or approved equal.

2.9 FORMS

A. Conform to the requirements of Section 51-1.05 of the Caltrans Standard Specifications.

2.10 PRECAST CONCRETE STRUCTURES

A. Conform to the following Sections of Caltrans Standard Specifications:
   1. 51-1.02, Minor Structures.
   2. 70-1.02C, Flared End Sections.
   3. 70-1.02H, Precast Concrete Structures.

2.11 PORTLAND CEMENT CONCRETE VEHICULAR PAVEMENT

A. General: See Section 32 13 00 – Rigid Paving.
PART 3 - EXECUTION

3.1 STRUCTURAL EXCAVATION

A. Structural excavation may be either by hand, or by machine and shall be neat to the line and dimension shown or called for on the plans. Excavation shall be sufficient width to provide adequate space for working therein, and comply with CAL-OSHA requirements.

B. Where an excavation has been constructed below the design grade, refill the excavation to the bottom of the excavation grade with approved material and compact in place to 95% of the maximum dry density.

C. Remove surplus excavation material remaining upon completion of the work from the job site, or condition it to optimum moisture content and compact it as fill or backfill on the site.

3.2 BRACING AND SHORING

A. Conform to California and Federal OSHA requirements.

B. Place and maintain such bracing and shoring as may be required to support the sides of the excavations for the proper protection of workmen; to facilitate the work; to prevent damage to the facility being constructed; and to prevent damage to adjacent structures or facilities. Remove all bracing and shoring upon completion of the work.

C. Be solely responsible for all bracing and shoring and, if requested by the Owner’s Representative, submit details and calculations to the Owner’s Representative. The Owner’s Representative may forward the submittal to the Consulting Engineer and/or the California Division of Industrial Safety for their review. The Contractor’s submittal shall include the basic design, assumed soils conditions and estimation of forces to be resisted, together with plans and specifications of the materials and methods to be used, and shall be prepared by a civil engineer or structural engineer registered in California. No excavations related to the proposed facility shall precede a response to the submittal by the Owner’s Representative.

D. Be solely responsible for installing and extracting the sheathing in a manner which will not disturb the position or operation of the facility being constructed or adjacent utilities and facilities.

3.3 PLACING CONCRETE FORMS

A. Form concrete improvements with a smooth and true upper edge. Side of the form with a smooth finish shall be placed next to concrete. Construct forms rigid enough to withstand the pressure of the fresh concrete to be placed without any distortion.

B. Thoroughly clean all forms prior to placement and coat forms with an approved form oil in sufficient quantity to prevent adherence of concrete prior to placing concrete.

C. Carefully set forms to the alignment and grade established and conform to the required dimensions. Rigidly hold forms in place by stakes set at satisfactory intervals. Provide sufficient clamps, spreaders and braces to insure the rigidity of the forms.
D. Provide forms for back and face of curbs, lip of gutters and edge of walks, valley gutters or other surface slabs that are equal to the full depth of the concrete as shown, noted or called for on the Plans. On curves and curb returns provide composite forms made from benders or thin planks of sufficient ply to ensure rigidity of the form.

3.4 PLACING STEEL REINFORCEMENT

A. Bars shall be free of mortar, oil, dirt, excessive mill scale and scabby rust and other coatings of any character that would destroy or reduce the bond. All bending shall be done cold, to the shapes shown on the plans. The length of lapped splices shall be as follows:

1. Reinforcing bars No. 8, or smaller, shall be lapped at least 45 bar diameters of the smaller bar joined, and reinforced bars Nos. 9, 10, and 11 shall be lapped at least 60 bar diameters of the smaller bars joined, except when otherwise shown on the plans.

2. Splice locations shall be made as indicated on the plans.

B. Accurately place reinforcement as shown on the plans and hold firmly and securely in position by wiring at intersections and splices, and by providing precast mortar blocks or ferrous metal chairs, spacers, metal hangers, supporting wires, and other approved devices of sufficient strength to resist crushing under applied loads. Provide supports and ties of such strength and density to permit walking on reinforcing without undue displacement.

C. Place reinforcing to provide the following minimum concrete cover:

1. Surfaces exposed to water: 4-inches.

2. Surfaces poured against earth: 3-inches.

3. Formed surfaces exposed to earth or weather: 2-inches.

4. Slabs, walls, not exposed to weather or earth: 1-inch.

D. Minimum spacing, center of parallel bars shall be two and one half (2-1/2) times the diameter of the larger sized bar. Accurately tie reinforcing securely in place prior to pouring concrete. Placing of dowels or other reinforcing in the wet concrete is not permitted.

3.5 MIXING AND TRANSPORTING PORTLAND CEMENT CONCRETE

A. Transit mix concrete in accordance with the requirements of ASTM Designation C 94. Transit mix for not less than ten (10) minutes total, not less than three (3) minutes of which shall be on the site just prior to pouring. Mix continuous with no interruptions from the time the truck is filled until the time it is emptied. Place concrete within one hour of the time water is first added unless authorized otherwise by the Owner's Representative.

B. Do not hand mix concrete for use in concrete structures.

3.6 PLACING PORTLAND CEMENT CONCRETE

A. Thoroughly wet subgrade when concrete is placed directly on soil. Remove all standing water prior to placing concrete.
B. Do not place concrete until the subgrade and the forms have been approved.

C. Convey concrete from mixer to final location as rapidly as possible by methods that prevent separation of the ingredients. Deposit concrete as nearly as possible in final position to avoid re-handling.

D. Place and solidify concrete in forms without segregation by means of mechanical vibration or by other means as approved by the Owner’s Representative. Continue vibration until the material is sufficiently consolidated and absent of all voids without causing segregation of material. The use of vibrators for extensive shifting of fresh concrete will not be permitted.

E. Concrete in certain locations may be pumped into place upon prior approval by the Owner’s Representative. When this procedure requires redesign of the mix, such redesign shall be submitted for approval in the same manner as herein specified for approval of design mixes.

3.7 PLACING ACCESSORY MATERIALS

A. Place water stops and other items required to be embedded in of portland cement concrete structures at locations shown or required in accordance with Section 51 of the Caltrans Standard Specifications unless otherwise specifically noted or called for on the Plans.

B. Curing Compounds:
   1. Regular Portland Cement Concrete: Apply "Non-Pigmented Curing Compound - chlorinated Rubber Base-Clear" in accordance with Section 90-7.01B, 7.01D and 7.03 of the Caltrans Standard Specifications.

   2. Color Conditioned Decorative Portland Cement Concrete: Apply LITHOCHROME colorwax in accordance with the manufactures instructions.

3.8 EXPANSION JOINTS

A. Construct expansion joints incorporating premolded joint fillers at twenty (20) foot intervals in all concrete curbs, gutters, sidewalks, median/island paving, valley gutters, driveway approaches and at the ends of all returns. At each expansion joint install one-half inch by twelve inch (1/2" x 12") smooth slip dowels in the positions shown or noted on the detail drawings.

B. Orient slip dowels at right angles to the expansion joint and hold firmly in place during the construction process by means of appropriate chairs.

3.9 WEAKEND PLANE JOINTS

A. Construct weakened plane joints in concrete curbs, gutters, sidewalks, median/island paving and valley gutters between expansion joints at ten (10) foot intervals throughout, or as otherwise indicated. Depth of joint score depth to be one-fourth (25%) the thickness of the concrete.
1. **Grooved Joints:** Form weakened plane joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8-inch. Repeat groving of weakened plane joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

3.10 **FINISHING CONCRETE**

A. Finish curb and gutter in conformance with the applicable requirements of Section 73-1.04 and 73-1.05A of the Caltrans Standard Specifications as modified herein.

B. Where monolithic curb, gutter and sidewalk is specified, separate concrete pours will not be allowed.

C. Provide a medium, slip resistant broom finish to all horizontal surfaces unless otherwise shown.

3.11 **FORM REMOVAL**

A. Remove forms without damage to the concrete. Remove all shores and braces below the ground surface, before backfilling.

B. Do not backfill against concrete until the concrete has developed sufficient strength to prevent damage.

C. Leave forms for cast-in-place walls in place at least 72 hours after pouring.

D. Leave edge forms in place at least 24 hours after pouring.

3.12 **CONSTRUCTION**

A. Form, place and finish concrete walkways, island paving, valley gutters and driveway approaches in conformance with the applicable requirements of Section 73-1.04 and 73-1.06 of the Caltrans Standard Specifications as modified herein.

B. Construct new concrete curb, curb and gutter and valley gutters against existing asphalt concrete by removing a minimum of 12-inches of the asphalt concrete to allow placement of curb or gutter forms. Patch pavement with a 6-inch deep lift of asphalt concrete after gutter form is removed.

3.13 **CONNECTING TO EXISTING CONCRETE IMPROVEMENTS**

A. New curb, gutter, or sidewalk is to connect to existing improvements to remain by saw cutting to existing sound concrete at the nearest score line, expansion joint or control joint. Drill and insert ½-inch diameter by 12-inch long dowels at 24-inches on center into existing improvements. Install pre-molded expansion joint filler at the matching joint.

B. A cold joint to the existing curb is not acceptable.

3.14 **DECORATIVE SURFACING CONSTRUCTION**

A. Decorative surfacing concrete walks, concrete median islands or other installations shall be formed and placed as a concrete slab conforming to the details shown or noted on the Plans.

3.15 **FIELD QUALITY CONTROL**

A. Finish subgrade for concrete improvements shall be subject to approval prior to placement of forms.

B. No concrete shall be placed prior to approval of forms.

C. Concrete improvements constructed shall not contain "bird baths" or pond water and shall be smooth and ridge free.

D. Conform the finish grade at top of curb, flow line of gutter, and the finish cross section of concrete improvements to the design grades and cross sections.
E. Variation of concrete improvements from design grade and cross section as shown or called for on the plans shall not exceed the tolerances established in Sections 73-1.05 and/or 73-1.06 of the Caltrans Standard Specifications.

3.16 RESTORATION OF EXISTING IMPROVEMENTS

A. Replace in kind all pavement or other improvements removed or damaged due to the installation of concrete improvements.
B. Remove, landscaping or plantings damaged or disturbed due to the installation of concrete improvements. Replace in kind.

END OF SECTION
SECTION 32 13 16
LANDSCAPE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes specially colored and finished landscape concrete and appurtenances, including but not limited to:
   1. Sandblast finish concrete.
   2. Concrete mowstrip.

B. All landscape concrete shall be integrally colored unless otherwise shown.

1.2 RELATED SECTIONS

A. Concrete - Division 3.

B. Portland cement concrete paving - Section 03 00 00.

C. Sealants: Section 07900.

1.3 SUBMITTALS

A. Product data: Submit manufacturer's specifications, installation instructions and catalog cuts for all materials.

B. Shop drawings:
   1. Show detailed construction and location of construction and expansion joints and scoring which deviate from drawings.

C. Where slip resistance is specified for paving, submit results of coefficient of friction tests per ASTM C 1028, if requested by District Representative.

1.4 QUALITY ASSURANCE

A. As specified in Division 3.

B. Field samples: Anticipate that up to 2 samples of each type of concrete may be required to establish accepted colors and finishes.
   1. Cast samples from accepted materials identical to those to be used on site.
   2. Cast 2 x 2 foot x 2 inch thick samples as follows:
      a. Integrally colored, light sandblast finish concrete. Representative sample of each color.
      b. Non-shrink grout: Sample of each color (2 inches square), demonstrating match with accepted concrete samples.
3. Landscape Architect will review and accept samples for finish appearance. Refabricate samples until accepted. Accepted samples shall serve as standard for subsequent work.
4. After acceptance, sawcut two 1 foot squares from edge of samples for Landscape Architect’s use. Retain balance of sample at project site.
5. Remove and dispose of samples when directed by District Representative.

C. Mockups:
   1. Construct mockups where directed by District Representative, from accepted materials identical to those to be used on project.
   2. Cast 4 foot square sample of paving of each type, showing each color and finish, edge treatment, and expansion joint with sealant. Include minimum 4 foot long section of paving band.
   3. Test accepted sealer on each mockup as directed by District Representative.
   4. Demolish and remove mockups when directed by District Representative, unless otherwise shown.

1.5 COORDINATION

A. Coordinate delivery and installation of embedded items and installation of sleeves.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS, REINFORCING, AND FORMWORK: Conforming to Division 3, with additional requirements as specified herein.


B. Do not use materials or products containing calcium chloride.

C. Sources for concrete materials shall be consistent throughout Work.

2.2 MIXES

A. Landscape concrete shall meet requirements of Division 3 unless otherwise shown.
   1. Minimum compressive strength: 3,000 psi.

B. Integral color shall be added as recommended by manufacturer to produce accepted color.

2.3 INTEGRAL COLOR

A. Water-reducing, set-controlling admixture: Chromix Admixture, L.M. Scofield Co., Los Angeles, CA, or approved equal.

B. Color: To match existing adjacent colored concrete.
2.4 OTHER MATERIALS

A. Expansion joint filler: As specified in Section 07900 - Sealants.
B. Grout for concrete exposed to view in the finished work: Non-metallic, non-shrink. Color and texture when fully cured shall match adjacent concrete. Five star grout #130, Five Star Products Co., Fairfield, CT or approved equal.
   1. Coloring agent: Iron oxide pigments as recommended by grout manufacturer. Davis Colors, Los Angeles, CA; L.M. Scofield; or approved equal.
C. Curing material: When Chromix integral color concrete admixture from L. M. Scofield is used in colored landscape concrete provide Lithochrome Colorwax as curing agent. Install curing agent per the manufacturer’s recommendations. L.M. Scofield Co., Los Angeles, CA, or approved equal.
   1. Colored concrete: Lithium quartz sealer; No. HLQ 125.
   3. Manufactured by Sinak Corporation, San Diego, CA or accepted equal. Available from The Burke Company, Oakland, CA.
E. Sealant: Meeting requirements of Standard Specifications; self-leveling, traffic grade polyurethane sealant. Color to match concrete paving, as accepted.
F. Surface retarder: Lithotex Top Surface Retarder; L.M. Scofield; or accepted equal.

PART 3 - EXECUTION

3.1 GENERAL: As specified in Division 3, with additional requirements as specified herein.

3.2 LAYOUT

A. District Representative will review layout of forms. Adjust alignment as directed until accepted.

3.3 PREPARATION

A. Prepare subgrade as shown and specified.

3.4 TOLERANCES

A. Maximum variation from true plane of overall surface:
   1. Sandblast finish: 1/8 inch in 10 feet.
   2. Broom finish: 1/8 inch in 10 feet.

B. Surfaces, including tops of walls, shall be free of depressions and abrupt transitions. At no point shall surface fail to drain.
3.5 FINISHES

A. Sandblast finish:
   1. Provide medium sandblast finish, to match accepted samples.
   2. Apply trowel finish on flatwork.
   3. Sandblast finish paving shall have a static coefficient of friction of 0.8 or greater when wet.
   5. Sealer: As recommended by manufacturer, to match accepted sample.
   6. Finished surface shall match accepted samples and mockups. At no point shall overall surface fail to drain.

3.6 JOINTS AND EDGES

A. Submit shop drawings showing locations and detailing of construction joints if required.

B. Construct joints as shown. Crossing joints shall physically intersect.

C. Expansion joints:
   1. Provide as shown and wherever paving abuts curbs, walls or other structures, unless otherwise shown.
   2. Clean expansion joints after curing and fill with specified joint sealant flush with adjacent paving.
   3. Joints in topping slab shall align with joints in subslab.

D. Tool slab edges, edges of expansion joints, and tooled joints before and after finishing, to form smooth uniform impression.

3.7 CURING

A. As specified in Division 3.

B. Do not use curing compound on surfaces to receive acid etch finish.

3.8 REPAIRING AND PATCHING

A. Defective concrete shall be removed and replaced at Contractor's expense unless it can be repaired to original specifications.

B. Patch and repair cracks, rock pockets, spalling, voids, variations in color and texture, and discolorations that cannot be removed by cleaning.

C. Repairs shall match adjacent finishes and accepted samples and mock-ups, and shall meet approval of District Representative.

3.10 CLEANING

A. Clean exposed surfaces to remove clouding and provide uniform appearance when dry.

B. Apply sealer to all exposed concrete surfaces, as recommended by sealer manufacturer.
1. Do not use sodium silicate products on colored concrete.

END OF SECTION
SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Removal of existing traffic stripes and pavement markers.

B. Removal of existing signs.

C. Cleaning and sweeping of streets before application of traffic stripes and pavement markings.

D. Materials and application for traffic stripes and pavement markings.

E. Materials and application for pavement markers.

F. Traffic control signs and street name signs.

G. Object markers.

H. Survey monuments.

1.2 RELATED SECTIONS

A. Section 32 05 23 – Cement and Concrete for Exterior Improvements.

1.3 RELATED DOCUMENTS

A. Caltrans Standard Specifications:
   1. Section 56, Signs.
   2. Section 81, Monuments.
   3. Section 82, Markers and Delineators.
   4. Section 84, Traffic Stripes and Pavement Markings.
   5. Section 85, Pavement Markers

B. Caltrans Standard Plans:
   7. Plan A73B: Markers.
C. The Manual of Uniform Traffic Control Devices (MUTCD), and the California Supplement to the MUTCD, the editions in effect at time of date on plans.

D. The regulations, standards, and tests of the State of California Department of Transportation Materials and Research Division, edition in effect at time of date on plans.

1.4 QUALITY ASSURANCE

A. Deliver certificates showing conformity with this specification to the Owner with each shipment of materials and equipment to the Project site.

1.5 PROJECT CONDITIONS

A. Do not apply traffic striping or pavement markings to the pavement until after approval to proceed has been given by the Owner.

B. Thoroughly cure new asphalt concrete and Portland cement concrete before application of stripes, markings or markers.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC STRIPES AND MARKING

A. Conform thermoplastic striping and marking materials to Section 84-2.02 of Caltrans Standard Specifications, unless noted otherwise herein or on the Plans.

2.2 PAINTED STRIPES AND MARKINGS

A. Conform painted striping and marking materials to Section 84-3.02 of Caltrans Standard Specifications, unless noted otherwise herein or on the Plans.

2.3 PAVEMENT MARKERS

A. Types: Section 85-1.02 of Caltrans Standard Specifications and as indicated.

B. Sampling, Tolerances and Packaging: Section 85-1.03 of Caltrans Standard Specifications.

C. Material
   2. Retroreflective: Section 85-1.05 of Caltrans Standard Specifications.
   3. Pavement Markers shall be at least as slip resistant as the adjacent pavement surfaces.
2.4 TRAFFIC CONTROL SIGNS
A. General: Section 56-2 of the Caltrans Standard Specifications.

B. Sign Panels: Conform type (regulatory or warning), size, shape and pattern to the State of California, Department of Transportation, Traffic Manual, edition in effect at the date of the Plans. Sign faces to be of reflectorized porcelain enamel.

C. Posts:
   1. Metal: Two (2) inch inside diameter steel pipe. Conform to Section 56-2.02A of Caltrans Standard Specifications, unless otherwise specified.
   2. Wood: Conform to Section 56-2.02B.

D. Mounting Hardware: Section 56-2.02D of Caltrans Standard Specifications, unless otherwise specified.


2.5 STREET SIGNS
A. Conform to manufacturer, style, size, and shape shown on the Plans.

B. Posts: Two (2) inch inside diameter steel pipe unless noted otherwise on the Plans. Conform to Section 56-2.02A of Caltrans Standard Specifications.


2.6 REJECTORIZED OBJECT MARKERS
A. Reflecterized Metal Object Markers: Conform to the applicable requirements of Section 82 of Caltrans Standard Specifications for target plates and reflectors, and Caltrans Standard Plan A73A for type L-1 or L-2 object markers.

B. Posts: Metal posts conforming to the applicable requirements of Section 82-1.02B of Caltrans Standard Specifications and Caltrans Standard Plan A73B.

C. Mounting Hardware: Conform to the applicable requirements of Section 82-1.02G of Caltrans Standard Specifications.

PART 3 - EXECUTION
3.1 REMOVAL OF TRAFFIC STRIPES, PAVEMENT MARKINGS AND PAVEMENT MARKERS
A. Where blast cleaning is used for the removal of painted traffic stripes and pavement markings, or for removal of objectionable material, remove the residue, including dust and water, immediately after contact with the surface being treated. Remove by a vacuum attachment operating concurrently with the blast cleaning operation.
B. Where grinding is used for the removal of thermoplastic traffic stripes and pavement markings; remove the residue by means of a vacuum attachment to the grinding machine. Do not allow the residue to flow across or be left on, the pavement.

C. Where markings are to be removed by blast cleaning or by grinding, the removed area shall be approximately rectangular so that no imprint of the removed marking remains on the pavement.

D. Contractor will be responsible for repairing any damage to the pavement during removal of pavement markers. Damage to the pavement, resulting from removal of pavement markers, shall be considered as any depression more than 1/4-inch deep.

3.2 TEMPORARY PAVEMENT MARKERS

A. If permanent pavement markers cannot be installed immediately, and the street or road is to be placed in service, install short term, temporary pavement markers on the new pavement prior to opening the street or road to traffic.

B. Place markers, at a minimum, of 24 feet on centers or as required by the governmental agency having jurisdiction, in the appropriate colors to delineate centerlines and travel lanes on multi-lane roadways.

3.3 THERMOPLASTIC TRAFFIC STRIPES AND PAVEMENT MARKINGS

A. Apply in conformance with the manufacturer’s instructions and the applicable requirements of Section 84-2.04 of Caltrans Standard Specifications and Caltrans Standard Plans A20A through A20D, and A24A through A24E.

3.4 PAINTED TRAFFIC STRIPES AND PAVEMENT MARKINGS

A. Apply in conformance with the manufacturer’s instructions and the applicable requirements of Section 84-3.03, 3.04 and 3.05 of Caltrans Standard Specifications and Caltrans Standard Plans A20A through A20D, and A24A through A24E.

3.5 PAVEMENT MARKERS

A. Place in conformance with the requirements of Section 85-1.06 of the Caltrans Standard Specifications.

B. Pavement recesses are not required. Markers shall be installed accurately to the line established by the Engineer. No markers shall be installed until the surface has been approved by the Owner.

3.6 TRAFFIC CONTROL SIGNS

A. Install in conformance with Sections 56-2.03 and 2.04 of Caltrans Standard Specifications, Caltrans Standard Plan RS1, the applicable requirements of the State of California Department of Transportation Maintenance Manual and the details shown on the Plans. The horizontal locations shown on Caltrans Standard Plan RS1 shall not be applicable, the horizontal location shall be as shown on the Plans.
B. Portland cement concrete for post foundations shall be of the configuration shown on the Plans.

C. After erection, damage to traffic sign faces shall be touched up or the sign replaced.

3.7 STREET SIGNS

A. Install in accordance with the manufacturer’s instructions and as shown on the Plans.

B. Horizontal location shall be as shown on the Plans.

C. Portland cement concrete for post foundations shall be of the configuration shown on the Plans.

3.8 REFLECTORIZED OBJECT MARKERS

A. Install in conformance with the requirements of Section 82-1.03 of Caltrans Standard Specifications, except that the metal marker posts shall not be driven in place without prior approval of the Owner.

B. Install at locations shown on the plans.

3.9 PROTECTION

A. Protect the newly installed and traffic stripes and pavement markings from damage until the material has cured.

B. Replace any traffic stripes or pavement markings or markers broken, misaligned or otherwise disturbed prior to opening roadway to traffic.

3.10 RESTORATION OF EXISTING IMPROVEMENTS

A. Existing signs striping or other markings removed or damaged due to the installation of new facilities shall be replaced in kind

B. Existing landscaping or planting removed, damaged or disturbed due to the installation of traffic control signs or street name signs shall be replaced in kind.

END OF SECTION