PROJECT MANUAL INCLUDING SPECIFICATIONS FOR

DIABLO VALLEY COLLEGE
PAC RESTROOMS
PLEASANT HILL, CALIFORNIA

Diablo Valley College Project #
LCA Architects Project # 16017.001

DSA Backcheck Submittal
April 4, 2017

LCA Architects Inc.
590 Ygncaio Valley Road, Suite 310
Walnut Creek, Ca 94111
(925) 944-1626
# Listing of Structural Tests & Special Inspections - 2013 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.

**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-103.1NSTR.

**Note:** References are to the 2013 edition of the California Building Code (CBC) unless otherwise noted.

<table>
<thead>
<tr>
<th>Required</th>
<th>Test Or Special Inspection</th>
<th>Type</th>
<th>Performed By</th>
<th>Code Reference and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOILS</td>
<td>1. GENERAL:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Verify that:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Site has been prepared properly prior to placement of controlled</td>
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</tr>
<tr>
<td></td>
<td>fill and/or excavations for foundations.</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>• Foundation excavations are extended to proper depth and have</td>
<td></td>
<td>Periodic, GE*</td>
<td>By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)</td>
</tr>
<tr>
<td></td>
<td>reached proper material, and</td>
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</tr>
<tr>
<td></td>
<td>• Materials below footings are adequate to achieve the design</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>bearing capacity.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>2. COMPACTED FILLS:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Perform qualification testing of fill materials.</td>
<td></td>
<td>Test, LOR*</td>
<td>Under the supervision of the geotechnical engineer.</td>
</tr>
<tr>
<td></td>
<td>x. Verify use of proper materials and inspect lift thicknesses,</td>
<td></td>
<td>Continuous, GE*</td>
<td>By geotechnical engineer or his or her qualified representative.</td>
</tr>
<tr>
<td></td>
<td>placement, and compaction during placement of fill.</td>
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<tr>
<td></td>
<td>3. DRIVEN DEEP FOUNDATIONS (PILES):</td>
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<tr>
<td></td>
<td>4. CAST-IN-PLACE DEEP FOUNDATIONS (PIERS):</td>
<td></td>
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<td></td>
<td>5. RETAINING WALLS:</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>6. OTHER SOILS:</td>
<td></td>
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</table>

+ In the CODE REFERENCE AND NOTES column, it indicates DSA-SS/CC sections that may be used by community colleges, per 2013 CBC Sec. 1.9.2.2.
# CONCRETE

## 7. CAST IN PLACE CONCRETE

### Material Verification and Testing:

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>a.</td>
<td>Verify use of required design mix.</td>
<td>Periodic</td>
<td>SI*</td>
</tr>
<tr>
<td>b.</td>
<td>Test reinforcing steel.</td>
<td>Test</td>
<td>LOR</td>
</tr>
<tr>
<td>c.</td>
<td>Perform slump, temperature, air content tests, and sample concrete.</td>
<td>Test</td>
<td>LOR</td>
</tr>
<tr>
<td>d.</td>
<td>Test concrete (compression).</td>
<td>Test</td>
<td>LOR</td>
</tr>
</tbody>
</table>

### Inspection:

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>e.</td>
<td>Batch plant inspection</td>
<td>Continuous</td>
<td>SI</td>
</tr>
<tr>
<td>f.</td>
<td>Batch plant inspection – design complies with 1705A.3.3 Item 2</td>
<td>Periodic</td>
<td>SI</td>
</tr>
<tr>
<td>g.</td>
<td>Not used.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>h.</td>
<td>Welding of reinforcing steel.</td>
<td></td>
<td>SI</td>
</tr>
</tbody>
</table>

* To be performed by qualified batch-plant inspector and concrete sampling technician.

### 8. PRESTRESSED CONCRETE (in addition to Cast in Place Concrete tests and inspections):

### 9. PRECAST CONCRETE (in addition to Cast in Place Concrete tests and inspections):

### 10. SHOTCRETE (in addition to Cast in Place Concrete tests and inspections):

### 11. POST-INSTALLED ANCHORS:

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Inspect installation of post-installed anchors</td>
<td>Periodic</td>
<td>SI*</td>
</tr>
<tr>
<td>b.</td>
<td>Test post-installed anchors.</td>
<td>Test</td>
<td>LOR</td>
</tr>
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</table>

* May be performed by the project inspector when specifically approved by DSA.

### 12. OTHER CONCRETE:

### MASONRY

<p>| | | | |</p>
<table>
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<tr>
<th></th>
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<tbody>
<tr>
<td>TMS 402-11/ACI 530-11/ASCE 5-11</td>
<td>Table 1705A.3</td>
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<td></td>
</tr>
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</table>

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

### Material Verification:

<p>| | | | |</p>
<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Verify that all materials are appropriately marked and that:</td>
<td>Periodic</td>
<td>SI*</td>
</tr>
<tr>
<td>b.</td>
<td>Test unidentified materials</td>
<td>Test</td>
<td>LOR</td>
</tr>
<tr>
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</tr>
</tbody>
</table>

* By special inspector or qualified technician when performed off-site.

### Inspection:

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>d.</td>
<td>Not used.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td>Verify and document steel fabrication per DSA approved construction documents.</td>
<td>Periodic</td>
<td>SI</td>
</tr>
</tbody>
</table>

* Not applicable to cold-formed steel, except for trusses (1705A.2.2.4).
18. HIGH STRENGTH BOLTS:

19. WELDING:

Verification of Materials, Equipment, Welders, etc:

- a. Verify weld filler material identification markings per AWS designation listed on the DSA approved documents and the WPS. Periodic SI
- b. Verify weld filler material manufacturer’s certificate of compliance. Periodic SI
- c. Verify WPS, welder qualifications and equipment. Periodic SI DSA IR 17.3.

19.1 SHOP WELDING:

- a. Inspect groove, multi-pass fillet welds > 5/16", plug and slag welds Continuous SI Per AISC 360 (and AISC 314 as applicable). DSA IR 17.3.
- b. Inspect single-pass fillet welds ≤ 5/16" Periodic SI Per AISC 360 (and AISC 314 as applicable). DSA IR 17.3.
- c. Inspect welding of stairs and railing systems. Periodic SI 1705A.2.2.1; Per AISC 360 (and AISC 314 as applicable). DSA IR 17.3.
- d. Verification of reinforcing steel weldability Periodic SI 1705A.3.1; verify carbon equivalent reported on mill certificates. DSA IR 17.3.
- e. Inspect welding of reinforcing steel Periodic SI 1705A.2.2.1.2, 1705A.2.2.5 and Table 1705A.2.1 Item 5b. AWS D1.4. DSA IR 17.3.

19.2 FIELD WELDING:

- a. Inspect groove, multi-pass fillet welds > 5/16", plug and slag welds Continuous SI Per AISC 360 (and AISC 314 as applicable). DSA IR 17.3.
- b. Inspect single-pass fillet welds ≤ 5/16" Periodic SI Per AISC 360 (and AISC 314 as applicable). DSA IR 17.3.
- c. Inspect end-welded studs (ASTM A-108) installation (including bend test) Periodic SI Per AISC 360 (and AISC 314 as applicable), 2213A.2 (2212.6.2). DSA IR 17.3.
- d. Inspect floor and roof deck welds Periodic SI Per AISC 360 (and AISC 314 as applicable). DSA IR 17.3.
- e. Inspect welding of structural cold-formed steel Periodic SI "May be performed by the project inspector when specifically approved by DSA. DSA IR 17.3.
- f. Inspect welding of stairs and railing systems Periodic SI 1705A.2.2.1.1 and 1705A.2.2.5.
- g. Verification of reinforcing steel weldability Periodic SI 1705A.3.1; verify carbon equivalent reported on mill certificates. DSA IR 17.3.
- h. Inspect welding of reinforcing steel Continuous SI 1705A.2.2.1.2, 1705A.2.2.5 and Table 1705A.2.1 Item 5b. AWS D1.4. DSA IR 17.3.

20. NONDESTRUCTIVE TESTING:

- b. Magnetic Particle Test LOR
- c. Test LOR
- d. Test LOR

21. STEEL JOISTS AND TRUSSES:

22. SPRAY APPLIED FIRE-PROOFING:

23. ANCHOR BOLTS, ANCHOR RODS, & OTHER STEEL:

- a. Anchor Bolts and Anchor Rods Test LOR IR 17-11 Sample and test anchor bolts and anchor rods not readily identifiable.
- b. Threaded rod not used for foundation anchorage Test LOR Sample and test threaded rods not readily identifiable per procedures noted in IR 17-11
- c. 

24. PREFABRICATED WOOD STRUCTURAL ELEMENTS:

Section 1705A.6

25. OTHER WOOD:

- a. Inspect erected framing as required to establish conformity of work with drawings. Periodic SI 1705A.5.3
- b. 

OTHER

* In the CODE REFERENCE AND NOTES column, it indicates DSA-SS/CC sections that may be used by community colleges, per 2013 CBC Sec. 1.9.2.2.
List of required verified report(s):

<table>
<thead>
<tr>
<th>KEY to Columns</th>
<th>Performed By</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Type -</td>
<td>2</td>
</tr>
<tr>
<td>Continuous</td>
<td>GE - Indicates that the special inspection is to be performed by a registered geotechnical engineer or his or her authorized representative</td>
</tr>
<tr>
<td>Periodic</td>
<td>LOR - Indicates that the test or inspection is to be performed by a testing laboratory accepted in the DSA Laboratory Evaluation and Acceptance (LEA) Program. See section 4-335, 2013 CCR Title 24, Part 1.</td>
</tr>
<tr>
<td>Test - Indicates that a test is required</td>
<td>SI - Indicates that the special inspection is to be performed by a special inspector</td>
</tr>
</tbody>
</table>

Name of Architect or Engineer in general responsible charge
John Westphal

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

Special Inspector or Structural Engineer

Appendix: Work Exempt from DSA Requirements for Special Inspection or Structural Testing

Exempt items given in IR A-22 or the 2013 CBC (including DSA amendments) and those items identified below with an "X" by the design professional are NOT subject to DSA requirements for structural tests and special inspections. 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 2013 CBC Table 1805.2 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 2013 CBC Section 1803A.2.

(Optional) List details for applicable exempt items:

### Concrete/Masonry:

1. Post-installed anchors for the following: 1) exempt non-structural components (e.g., mechanical, electrical, plumbing equipment) given in ASCE 7-10, Section 13.1.4 (and modified by CBC Section 1616A 1.18) or 2) interior nonstructural wall partitions meeting criteria listed in exempt item 3 for “Welding.”

2. Concrete batch plant inspection is not required for the following, provided they are identified on the approved construction documents and the licensed weighmaster and batch ticket requirements of Section 1705A.3.3 are implemented: 1) site flatwork, 2) encased site structures, including but not limited to lunch or care shelters, bleachers, solar structures, flag or light poles, or retaining walls less than 4'-0" above the top of foundation not supporting a surcharge and free standing non-bearer non-shear masonry walls up to 6'-0" above adjacent grade, 3) controlled low-strength material backfill, 4) single-story relocatable buildings less than 2,160 square feet.

3. Masonry retaining walls less than 6'-0" above the top of foundation not supporting surcharge and free standing non-bearing non-shear masonry walls up to 6'-0" above adjacent grade do not require mortar or masonry core testing or DSA special inspection. For non-bearing non-shear masonry walls not exceeding total wall height of 12" above wall base, mortar test shall be permitted to be limited to those at the beginning of masonry work for each mix design. Core sampling and testing is not required for non-bearing non-shear masonry walls, not exceeding total wall height of 12" above wall base, built with single wythe hollow unit concrete masonry that attaches opposite face shells using wet cast as single unit, when designed using an f'm not exceeding 1,500 psi (10.34 MPa).

4. Epoxy shear dowels in site flatwork.

(Optional) List details for applicable exempt items:

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### 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); 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., Toledo, B-Line, Africa, 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).

6. 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 ASCE 7-10, Section 13.1.4 (and modified by CBC Section 1616A.1.18) meeting the following: 1) when supported on a roof/roof, <400# and resulting composite center of mass (including component's center of mass) => 4' above supporting floor/roof, 2) when hung from a wall or roof/roof, <20# for discrete units or <5 pf for distributed systems.

(Optional) List details for applicable exempt items:
## INTRODUCTORY INFORMATION

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<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tr>
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<td>00 01 07</td>
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<td></td>
<td>DSA-103 (Structural Tests &amp; Inspection Form-Sample)</td>
</tr>
<tr>
<td>00 01 10</td>
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</table>

### Division 0
**PROCUREMENT & CONTRACTING REQUIREMENTS** (To be provided by Diablo Valley College)

### Division 1
**GENERAL REQUIREMENTS** (To be provided by Diablo Valley College)

### Division 2
**EXISTING CONDITIONS**

<table>
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<tr>
<th>Code</th>
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<tbody>
<tr>
<td>02 41 00</td>
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### Division 3
**CONCRETE**

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<tbody>
<tr>
<td>03 10 00</td>
<td>Formwork</td>
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<tr>
<td>03 20 00</td>
<td>Concrete Reinforcement</td>
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<tr>
<td>03 30 00</td>
<td>Cast-In-Place Concrete</td>
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<tr>
<td>03 30 53</td>
<td>Miscellaneous Cast-In-Place Concrete</td>
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**METALS**

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<td>05 12 00</td>
<td>Structural Steel</td>
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### Division 6
**WOODS & PLASTICS**

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<td>Rough Carpentry</td>
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### Division 7
**THERMAL & MOISTURE PROTECTION**

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<td>Thermoplastic Membrane Roofing</td>
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<td>Flashing and Sheet Metal</td>
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<td>DIVISION</td>
<td>SECTION</td>
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<td>OPENINGS</td>
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<td>Metal Doors and Frames</td>
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<td>SPECIALTIES</td>
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<td>Toilet Compartments</td>
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<td>Testing, Adjusting &amp; Balancing for HVAC</td>
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<td>Low Voltage Lighting Control System</td>
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**Division 28  ELECTRONIC SAFETY**

- 28 31 01  Fire-Alarm System
- 28 31 01  Fire-Alarm Cut Sheets

**Division 31  EARTHWORK**

- 31 10 00  Site Clearing
- 31 20 00  Earth Moving
- 31 23 19  Dewatering

**Division 32  EXTERIOR IMPROVEMENTS**

- 32 13 13  Pedestrian & Vehicular Concrete Paving
- 32 13 73  Concrete Paving Joint Sealants
- 32 14 13  Concrete Pavers
- 32 17 26  Tactile Warning Surfacing
- 32 80 00  Irrigation
- 32 90 00  Landscape Planting

**Division 33  UTILITIES**

- 33 05 00  Common Work Results for Utilities
- 33 41 00  Storm Utility Drainage Piping
- 33 46 00  Subdrainage

**APPENDICES**

**END OF DOCUMENT**
SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Comply with rules and regulations of State of California, California Code of Regulations, Title
   8, Industrial Relations, Chapter 4, Subchapter 4, “Construction Safety Order.”

C. Comply with applicable local and state agencies having jurisdiction.

D. Comply with governing EPA notification regulations.

1.2 SUMMARY

A. Section Includes:
   1. Demolition and removal of selected site elements.
   2. Salvage of existing items to be reused or recycled.

B. Related Requirements:
   1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy
      requirements, and phasing requirements.
   2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of
      existing trees and plants that are affected by selective demolition.
   3. Section 017300 "Execution" for cutting and patching procedures.
   4. Section 013516 "Alteration Project Procedures" for general protection and work
      procedures for alteration projects.
   5. Section 311000 "Site Clearing" for site clearing and removal of above- and below-
      grade improvements not part of selective demolition.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless
   indicated to be salvaged or reinstalled.
B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to District Representative.

1.5 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site if demolition of site is complicated or selective demolition of structures.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.

2. Interruption of utility services. Indicate how long utility services will be interrupted.

3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.

5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.

2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

3. Hazardous material remediation is specified elsewhere in the Contract Documents.
4. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

D. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.11 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
B. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

C. Steel Tendons: Locate tensioned steel tendons and include recommendations for detensioning.

D. Survey of Existing Conditions: Record existing conditions by use of measured drawings, or preconstruction photographs or video.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."

2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off utilities with utility companies.

2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

   a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.

c. Equipment to Be Removed: Disconnect and cap services and remove equipment.

d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

4. Cover and protect furniture, furnishings, and equipment that have not been removed.

5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.
3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. 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. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. 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.

5. Maintain fire watch during and for at least four hours after flame-cutting operations.


7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

10. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:
1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner’s storage area on-site as designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

B. Finish of repaired surfaces shall be uniform and free from blemishes and variations in color and surface texture.

END OF SECTION
SECTION 03 10 00

FORMWORK

PART 1 - GENERAL

1.1 DESCRIPTION


B. Related Sections:
   1. Section 032000 - Concrete Reinforcement.
   2. Section 033000 - Cast-In-Place Concrete.

1.2 REFERENCES

A. Requirements of GENERAL CONDITIONS and DIVISION NO. 1 apply to all Work in this Section.

B. Published specification, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to Work of this Section where cited by abbreviations noted below (latest editions apply).

   3. American Concrete Institute’s “Recommended Practice for Concrete Formwork,” (ACI 347).
   6. West Coast Lumber Inspection Bureau’s “Standard Grading Rules No. 16” (WCLIB).

1.3 QUALITY ASSURANCE

A. Design Criteria: Formwork shall conform to ACI 347 and CBC Section 1906A.
   1. Formwork:
      a. Shall prevent leakage or washing out of cement mortar.
      b. Shall resist spread, shifting, and settling.
      c. Shall reproduce accurately required lines, grades, and surfaces within tolerances specified.
   2. Safety: The Contractor shall be responsible for adequate strength and safety of all formwork including falsework and shoring.

B. Allowable Tolerances: Formwork shall produce concrete within tolerance limits recommended in ACI 347, unless otherwise noted.

1.4 SUBMITTALS
A. Samples: Only as requested by the Architect.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

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

1.6 JOB CONDITIONS

A. Sequencing Schedule:

1. Ensure timely delivery of embedded items. Be responsible for cutting and patching necessitated by failure to place embedded items.

2. Plan erection and removal to permit proper sequence of concrete placing without damage to concrete.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forming Materials:

1. Panel or board forms at the Contractor’s option.
   a. Panel Forms: Minimum 5/8-inch thick exterior grade plywood with sealed edges, PS 1 grade Plyform Class I and II B-B Exterior or HDO Exterior.
   b. Board Forms: Shiplap or tongue and groove lined with PS 1 grade Plyform Class I and II Exterior ½-inch or HDO Exterior ½-inch or 3/16-inch thick fiberboard conforming to FS LLL-B-810a(1), type l.

2. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings.
   a. Use Plywood complying with U.S. Product Standard PS-1 “B-B (Concrete Form) Plywood,” Class I, Exterior Grade or better, with each piece bearing legible inspection trademark. Panels to receive specified form sealer to ensure uniform finish of exposed surfaces.

3. Chamfer Strips: Burke Concrete Accessories’ PVC type CSF ½-inch, all exposed corners.

B. Wood Framing: WCLIB standard grade or better Douglas Fir.
C. Form Ties and Spreaders: Metal type acting as spreaders, leaving no metal within one inch of concrete face and no fractures, spalls, depressions or other surface disfigurements greater than 3/4-inch in diameter.

D. Form Sealer: Same as Grace Construction Material’s “Formfilm”; or equal product substituted per Section 01630.

E. Release Agent: Must not stain or otherwise adversely affect architectural concrete surfaces. Same as The Nox-Crete Co.’s “Nox-Crete Form Coating”; Industrial Synthetics Corp.’s “Synthex;” or equal product substituted per Section 01630.

F. Foam Board: Extruded close cell polystyrene foam, channeled for drainage, with a minimum compressive strength of 25 psi at 0.1-inch deformation when tested in accordance with ASTM D1621-73, and meeting requirements of FS-HH-I-524b, Type II, Class B. Same as The Dow Chemical Co.’s “Styrofoam PD Brand” or equal product substituted per Section 01630.

2.2 SOURCE QUALITY CONTROL

A. Plywood shall bear APA grade-trademark.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where formwork will be constructed and verify that:
   
   1. Excavations are sufficient to permit placement, inspection and removal of forms.
   2. Excavations for earth forms have been neatly and accurately cut.
   3. Conditions are otherwise proper for formwork construction.

B. Do not start work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Obtain necessary information for coordination of formwork with items to be embedded in concrete and other related work.

3.3 CONSTRUCTION

A. General:

   1. Design, erect, support, brace and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position. Maintain formwork construction tolerances complying with ACI 347.
   2. 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.

3. Frame openings where indicated on Architectural, Structural, Mechanical, Plumbing and Electrical drawings.

B. Earth Forms:

1. Construct wood edge strips at top sides of excavations.
2. Provide forms for footings wherever concrete cannot be placed against solid earth excavation.
3. Remove loose dirt and debris prior to concrete pours.
4. Foundation concrete may be placed directly into neat excavations provided the foundation trench walls are stable as determined by the Architect, subject to the approval of DSA. In such case, minimum formwork shown on the drawings is mandatory to ensure clean excavations immediately prior to and during the placing of concrete.

C. Walls and Other Formed Elements:

1. Erect outside forms for exposed exterior walls first and obtain the Architect’s approval before reinforcement is placed. Obtain Architect’s approval of the reinforcement before interior form is erected.
2. Carefully align inside and outside forms before tightening ties.
3. Plywood Forms: Insure vertical joints are plumb and horizontal joints are level; arrange joints and ties in geometrical pattern as approved by the Architect.
4. Form inside corners at exposed conditions with mitered boards or plywood so that no concrete is placed against form ends.
5. After erection, seal all cracks, holes, slits, gaps, and apertures in forms so that they will withstand the pressure and will remain completely watertight.
6. Provide a means to seal the bottom of forms at construction joints such as foam tape or other gasket devices.
7. Apply a coating of release agent prior to the erection of formwork. Follow approved manufacturer’s recommendations.

D. Slab Forms:

1. Establish levels and set screeds.
2. Depress slabs where required to receive special floor finishes.

E. Cleanouts and Openings: Provide on interior face of wall forms as required for effective removal of loose dirt, debris and waste material, for inspection of reinforcing and for introduction of vibrators where the Architect deems necessary.

F. Construction Joints:

1. Provide where shown on the drawings as directed by the Architect and per CBC Section 1906A.4.
2. Provide key indentations at all joints.
3. Provide pour strips on inside face of forms at horizontal joints, but remove strips and thoroughly clean out reglets before placing subsequent portions of wall.
4. Prevent formations of shoulders and ledges.
5. Provide means for drawing forms into firm contact with concrete before placing additional concrete over previous pours where shrinking and warping has separated concrete from forms.

G. Embedded Items:

1. Properly locate, unless locating is specified elsewhere, and place inserts and embedded items required by other trades prior to casting concrete.

3.4 REMOVAL

A. Secure the Architect’s approval for time and sequence of form removal.

B. Form Removal: Forms shall be removed without damage to the concrete, and in no case shall they be removed prior to the concrete member attaining the specified strength.

<table>
<thead>
<tr>
<th>MEMBER</th>
<th>STRENGTH</th>
<th>MINIMUM TIME*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical surfaces of walls, columns, beams,</td>
<td>0.60 f’c</td>
<td>7 days</td>
</tr>
<tr>
<td>Beams, slab</td>
<td>0.75 f’c</td>
<td>14 days</td>
</tr>
</tbody>
</table>

*Estimated curing time required to obtain desired strength. Results of the 7-day test cylinder break shall be presented to the Architect to demonstrate compliance with above specified strength requirements prior to form removal. If a 7-day test cylinder break demonstrates strength that is less than that specified, the Contractor may elect to take additional cylinders at the time of next pour to demonstrate strength requirements. The Contractor shall bear the cost of taking and testing the additional samples.

C. Forms:

1. Remove forms carefully to avoid damaging corners and edges of exposed concrete.
2. Reuse:
   a. The Architect will approve reuse of forms provided they are straight, clean, free from nails, dirt, hardened concrete, or other injurious matter and edges and surfaces are in good condition.
   b. Clean and repair any damage caused by placing, removal, or storage. Reuse of formwork with repairs or patches which would result in adverse effects to architectural concrete finish will not be permitted.
   c. Store formwork in manner to prevent damage or distortion.
   d. Reseal as required to achieve concrete of specified quality.
SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section Includes: Provision of reinforcement for all concrete unless specifically noted otherwise.

B. Related Sections:
   1. Section 031000 - Formwork.
   2. Section 033000 - Cast-In-Place Concrete.

1.2 REFERENCES

A. Requirements of the GENERAL CONDITIONS and DIVISION NO. 1 apply to all Work in this Section.

B. Published specifications, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to Work of this Section where cited by abbreviations noted below (latest editions apply).

   3. American Concrete Institute’s:
      b. “Building Code Requirements for Structural Concrete” (ACI 318).
   4. Concrete Reinforcing Steel Institute (CRSI):
      b. “Recommended Practice for Placing Reinforcing Bars.”
   5. American Welding Society’s:

1.3 QUALITY ASSURANCE

A. Welders’ Qualifications: Welders shall be qualified in accordance with AWS D1.4.

B. Reinforcing steel shall not be permitted to rust where there is danger of staining exposed surfaces of adjacent concrete. The Contractor shall replace rust-stained concrete at his expense.
C. Allowable Tolerances: Reinforcing steel shall be placed within tolerances permitted by
ACI 318, Section 7.5 unless otherwise approved by the Architect.

D. The Owner’s Testing Agency will provide tests in accordance with CBC Section 1913A.
   1. Collect mill test reports for reinforcement.
   2. Take samples from bundles at fabricators.
      a. When bundles are identified by heat number and accompanied by mill
         analysis, two specimens shall be taken from each ten (10) tons, or fraction
         thereof, of each size and grade.
      b. When reinforcement is not positively identified by heat numbers or when
         random sampling is intended, two specimens shall be taken from each 2½
         tons, or fraction thereof, of each size and grade.
   3. Test for tensile and bending strengths.
   4. Provide inspection of welding, including prior fit-up, welding equipment, weld
      quality and welder certification in accordance with AWS D1.4. Chemical analysis
      sufficient to determine carbon equivalent and minimum preheat temperature shall
      be performed when reinforcement does not conform to low-alloy steel
      requirements per CBC Section 1903A.8.

1.4 SUBMITTALS
   A. Shop Drawings: Show bending and placing details, size and location of reinforcing steel.
      Include diagrammatic wall elevations at 1/4-inch equals one foot scale to clearly show
      position and erection marks of bars including marginal bars around openings with
      dowels, splices, etc.
   B. Certified mill test reports (tensile and bending) for each heat or melt of steel prior to
      delivery of material to the job site. Where reinforcing is to be welded, mill test reports
      shall verify the weldability of the steel.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING
   A. Deliver reinforcement and accessories to site not more than 48-hours before placement.
   B. Store in manner to prevent excessive rusting and fouling with grease, dirt, or other
      bond-weakening coatings.
   C. Take precautions to maintain identification after bundles are broken.

PART 2 - PRODUCTS

2.1 MATERIALS
   A. Bars: New billet steel, ASTM A615 Grade 60.
   B. Welded Bars: New billet steel ASTM A706 Grade 60.
   C. Tie Wires and Spirals: ASTM A82.

E. Welding Electrodes: Mild steel covered arc-welding types conforming to AWS A5.1.

F. Bar Supports: As required for assembling and supporting reinforcement in place.
   1. CRSI Class 3: Where bar supports do not come in contact with exposed concrete surfaces.
   2. CRSI Class 1 plastic-protected; or Class 2 stainless steel wire: Interior and Exterior Soffits and Other Exposed Conditions:
   3. Precast Concrete Wired Block: At slabs-on-grade and as necessary at other locations.

G. Threaded coupler: Lenton Standard coupler by ERICO or equal product substituted per Section 2.11. Couplers may be Type 1 except where otherwise noted.
   1. Type 1 Couplers shall develop 125-percent of specified yield strength reinforcement.
   2. Type 2 Couplers shall develop 160-percent of the tensile strength or 200-percent of the yield strength of the reinforcement.

H. Welded Deformed Bar Anchors: ASTM A496, $f_y = 70,000$, flux filled deformed bar anchors. Same as Nelson D2L or equal product substituted per Section 2.1 I.

I. Product Substitutions:
   1. Other manufacturers' materials, articles, and methods not named will be considered as substitutions provided required information is submitted on “FORM FOR SUBSTITUTIONS FOR SPECIFIED ITEMS” and will not require substantial revisions of Contract Documents;
   2. Whenever material, article, or method is specified or described without phrase "or equal," no substitutions will be allowed.
   3. Costs for redesigns due to substituted items are responsibility of Applicant.
   4. In making request for substitution, Applicant/Contractor represents that he:
      a. Has personally investigated proposed product or method and determined that it is equal in all respects to that specified.
      b. Will provide same guarantee for substitution as for product or method specified.
      c. Will coordinate installation of accepted substitution into work, making design and construction changes to complete work in all respects following the Contract Documents.
5. In order for substitutions that do not change design intent to be considered, submit no later than 30 days after date of Notice to Proceed, 3 copies of complete data set forth herein to permit complete analysis of proposed substitutions listed on submitted “FORM FOR SUBSTITUTIONS FOR SPECIFIC ITEMS”.

   a. Identification including manufacturer's name and address.
   
   b. Manufacturer's literature, including but not necessarily limited to:
      
      i. Product description, performance, and test data.
      
      ii. Reference standards.
      
      iii. Samples where appropriate.
      
      iv. Name and address of similar projects on which product was used and dates of installation with contact name and telephone number.
      
   c. Approval of Substitution:
      
      i. Contract Manager's decision regarding evaluation of substitutions will be final and binding.
      
      ii. Commission will not be responsible for delays and costs associated with processing the Substitution request.
      
      iii. All approved substitutions will be incorporated into the Contract Documents by plan revision.

2.2 FABRICATION

   A. Shop-fabricate to comply with drawings.
      
   B. Conform to requirements of ACI 315 where specific details are not shown or where drawings and specifications are not more demanding.

PART 3 - EXECUTION

3.1 PLACEMENT

   A. General:
      
      1. Place bars as noted.
      
      2. All reinforcement shall be continuous. See drawings for lap splice schedule. Stagger splices where possible. Contact lap splices shall be securely wired together to maintain alignment.
      
      3. Ensure placement will permit concrete protection in conformance with CRSI or to extent shown.
4. Support and fasten bars securely with spacers, chairs or ties to permit their being walked upon without displacement or movement both before and during placement of concrete. Wire-tie bar intersections.
5. Do not bend bars around openings or sleeves. Wherever conduits, piping, inserts, sleeves, etc. interfere with placing of reinforcement, obtain the Architect’s approval of placing before concreting.
6. Do not field bend bars unless expressly noted in the Contract Documents.

B. Welding:
1. Employ shielded metal-arc method and conform to AWS D1.4.
2. Ensure equipment supplies proper current and voltage and is adjustable to suit arrangement and thickness of items welded.

C. Prior to placing concrete, verify reinforcement has been bent, positioned, and secured in accordance with drawings; ensure removal of oil, grease, dirt, or other bond-weakening coatings; replace severely rust-pitted reinforcing bars.

D. Quality Assurance:
1. The Project Inspector will inspect placement of reinforcement and mechanical splices and notify Structural Engineer of any discrepancies in placement.
2. The Owner’s Testing Agency will inspect shop and field welding of reinforcing bars in accordance with CBC Section 1913A.

END OF SECTION 032000
SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section Includes: Provision of cast-in-place concrete unless specifically noted otherwise.

B. Related Sections:

1. Section 031000 - Formwork.
2. Section 032000 - Concrete Reinforcement.
3. Section 055000 - Metal Fabrications.

1.2 REFERENCES

A. Requirements of GENERAL CONDITIONS and DIVISION NO. 1 apply to all Work in this Section.

B. Published specifications, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to Work of this Section where cited by abbreviations noted below (latest editions apply).

3. American Concrete Institute’s:
   a. “Standard Specifications for Tolerances for Concrete Construction and Materials” (ACI 117)
   b. “Specification for Structural Concrete for Buildings” (ACI 301).
   c. “Recommended Practice for Measuring, Mixing and Placing Concrete” (ACI 304).
   d. “Recommended Practice for Hot Weather Concreting” (ACI 305)
   e. “Recommended Practice for Cold Weather Concreting” (ACI 306)
   f. “Building Code Requirements for Structural Concrete” (ACI 318).


1.3 QUALITY ASSURANCE

A. The Contractor’s Testing Laboratory Qualifications: The Contractor’s Testing Laboratory shall be under direction of a Civil Engineer registered in the State of California, shall have operated successfully for four years prior to this work, and shall conform to requirements of ASTM E329.
B. Requirements of ACI 301 shall govern work, materials and equipment related to this Section; specifications herein set minimum results required, and references to procedures are intended to establish minimal guides.

C. The Contractor shall be responsible for quality of concrete in place and shall bear burden of proof that concrete meets minimum requirements. Tolerances shall meet the requirements of ACI 117 except as modified in the Construction Documents.

D. Placing of concrete by means of pumping will be an acceptable method of placement providing that the Contractor can demonstrate that:

1. Specified concrete strengths will be met.
2. Equipment has a record of satisfactory performance under similar conditions and using a similar mix.
3. Trial batches have been made.

1.4 SUBMITTALS

A. The Contractor’s Testing Laboratory’s certificate of compliance per ASTM E329.

B. The Contractor shall submit:

1. Certified copies of mix designs for each concrete class specified including compressive strength test reports.
2. Certification that materials meet the requirements specified.
3. Samples only as requested by the Architect.
4. Certification from vendor that samples originate from and are representative of each lot proposed for use.

C. The Owner’s Testing Agency will submit reports on tests and inspections performed to the Owner, the Architect, the Contractor, and the DSA.

D. Shop Drawings: Show construction and expansion and contraction joint locations and details.

E. Schedule of placing for the Architect’s review before starting work.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Ensure storage facilities are weather tight and dry.

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

C. Store bulk cement in bins capable of preventing exposure to moisture.

D. Use sacked cement in chronological order of delivery. Store each shipment so that it may be readily distinguishable from other shipments.

PART 2 - PRODUCTS

2.1 CONCRETE
A. Table 2-1: Concrete Properties

<table>
<thead>
<tr>
<th>Class</th>
<th>28-Day Strength (psi)</th>
<th>Aggregate Size (in)</th>
<th>Weight</th>
<th>Water / Cement</th>
<th>% Flyash</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundations/Grade Bms</td>
<td>4000</td>
<td>1</td>
<td>145</td>
<td>0.50</td>
<td>15-25</td>
<td></td>
</tr>
<tr>
<td>Beams, Columns Walls</td>
<td>3000</td>
<td>3/4</td>
<td>145</td>
<td>0.50</td>
<td>15-25</td>
<td>Water-Reducing admixture</td>
</tr>
<tr>
<td>Slab on Grade/Curbs</td>
<td>3000</td>
<td>1</td>
<td>145</td>
<td>0.50</td>
<td>15-25</td>
<td></td>
</tr>
</tbody>
</table>

B. Strength refers to the compressive strength in psi after 28-days when tested in accordance with ASTM C39. All concrete shall develop compression strength specified in 28-days. To meet above requirements, mix shall be designed such that average compressive strength will exceed specified 28-day strength by an amount as specified by ACI 318.

C. Aggregate size refers to the maximum size in inches.

D. Weight refers to pounds per cubic foot, air dry.

E. Water/Cement Ratio is the maximum ratio of water to cementitious material by weight.

2.2 MATERIALS

A. General Requirements:

1. Cement and aggregates shall have proven history of successful use with one another. Sources of cement and aggregate shall remain unchanged throughout work unless the Architect approves request for change made at least 10-days prior to anticipated date of casting.

2. Ready-mixed concrete shall meet requirements of ASTM C94.

3. Deviations in properties of materials tested by the Owner’s Testing Agency shall be cause for their rejection pending additional test results and redesign of mix by the Contractor’s Testing Laboratory.

4. No frozen aggregates will be permitted.

B. Cements: ASTM C150, Type II. Use one brand of cement throughout project unless otherwise directed by the Architect.

C. Fly Ash: ASTM C618, Type F.

D. Aggregates:

1. Coarse: ASTM C33. Coarse aggregate shall consist of a clean, hard, fine grained, sound crushed rock, or washed gravel or a combination of both. It shall be free from oil, organic matter or other deleterious substances and shall not contain more than two percent by weight of shale or cherty material. “Cleanness value shall not
be less than 75 when tested per MM Test Method, 227 and conforming to CBC Section 1903A.6.

2. Fines: ASTM C33. Sand equivalent shall be not less than 75 when tested as per ASTM D2419.

3. Light Weight Aggregates: ASTM C330; expanded shale type uniformly graded from 3/4-inch to No. 200 Mesh. Cleanliness value and sand equivalent not less than 75.

4. Provide aggregates from a single source for exposed concrete.

E. Water: ASTM C1602. Clean and potable, free from impurities detrimental to concrete.

F. Admixtures:

1. Water-Reducing Admixture: ASTM C494, Type A, non-lignini sulfonate. Same as Grace Construction Materials’ “WRDA with Hycol”; Master Builders “Pozzolith 322N”; Sika Corp.’s “Plastocrete 161”; or equal product substituted per Section 01630.


6. Other Admixtures: Only as approved by the Architect.

G. Non-Shrink Grout: Premixed high strength grout requiring only addition of water at the site. Same as Master Builder’s “Masterflow 928 Grout”; Burke’s “Non-Ferrous, Non-Shrink Grout,” or equal product substituted per Section 01630.

H. Curing Materials:

1. Waterproof Paper: ASTM C171, Type 1, regular. Same as Sisalkraft Division of St. Regis Paper Co.’s “Orange Label”; or equal product substituted per Section 01630.

2. Sheet Plastic: Polyethylene, four mils thick, fungus-resistant.


I. Concrete Sealer: Clear water repellent treatment, blend of six resins containing no silicones or stearates, no darkening or change of color. Same as Sonneborn-Contech’s “White Rox M-6-50-8”; Tamms Industries’ “Chemstop” or equal product substituted per Section 01630.
J. Epoxy Adhesive: Two component material suitable for anchoring rebar into dry or damp concrete. Same as Covert’s “CIA-Gel 7000,” Hilti’s “HIT HY-150,” Hilti’s “RE 500 SD,” Simpson Strong-Tie’s “SET” or equal product substituted per Section 01630.


2.3 MIXES

A. General Requirements:

1. The Contractor shall perform tests or assemble the necessary data indicating conformance with specifications.
2. For each mix submit data showing that proposed mix will attain the required strength in accordance with requirements of ACI 318 Section 5.3
3. If sufficient test results for ACI 318 Section 5.3.3.2 are not available, the contractor shall produce trial mixes in accordance with requirements of CBC Section 1905A.3.
4. The Contractor shall instruct Laboratory to base mix design on use of materials tested and approved by the Owner’s Testing Agency.
5. Mix design shall include compression strength test reports per ACI 318 Section 5.3.3.2
6. Mix shall be designed, tested, and adjusted if necessary in ample time before first concrete is scheduled to be placed. Laboratory data and strength test results for revised mix design shall be submitted to Architect prior to using in project.
7. Ensure mix designs will produce concrete to strengths specified and of uniform density without segregation.
8. If mix yield exceeds 1-cubic yard, modify mix design to no more than one cubic yard without changing cement content.
9. The Contractor’s mix designs shall be subject to review by the Architect and by the Owner’s Testing Agency.
10. Introduction of calcium chloride will not be permitted.
11. Unspecified admixtures will not be permitted unless the Architect reviews, the Contractor modifies mix designs as necessary, and modifications are accepted by the Owner’s Testing Agency.

B. Slab-on-Grade Mix requirements: Use of Water-Reducing admixture is required. High Range Water-Reducing admixture (super plasticizer) shall be used when required to maintain workability and pumpability.

C. Patching Mortar: Mix in proportions by volume of one part cement to two parts fine sand.

D. Non-Shrink Grout: Follow approved manufacturer’s printed instructions and recommendations.

2.4 MIXING

A. Batching Plant Conditions:

1. Batch plant shall be certified to comply with the requirements of the National Concrete Ready Mix Association.
2. Ensure equipment and plant will afford accurate weighing, minimize segregation and will efficiently handle all materials to satisfaction of the Architect and the Owner’s Testing Agency.

3. Replace at no additional expense equipment the Architect and the Owner’s Testing Agency deem inadequate or unsuitable.

4. Use approved moisture meter capable of determining moisture content of sand.

B. General Requirements:

1. Thoroughly clean concrete equipment before use for architectural concrete mixes to avoid contamination.

2. Mix cement, fine and coarse aggregates, admixtures and water to exact proportions of mix designs. Method of mixing shall comply with ACI 318 Section 5.8.

3. Measure fine and coarse aggregates separately according to approved method that provides accurate control and easy checking.

4. Adjust grading to improve workability; do not add water unless otherwise directed.

5. Maintain proportions, values, or factors of approved mixes throughout work.

6. Mix concrete in transit mixers five minutes immediately prior to discharge in addition to mixing as called for by ACI 304 and ASTM C94.

C. Admixtures: Use automatic metering dispenser to introduce admixture into mix. Dispenser shall be recommended and calibrated by admixture manufacturer.

2.5 SOURCE QUALITY CONTROL

A. The Owner’s Testing Agency will:

1. Review mix designs, certificates of compliance, and samples of materials the Contractor proposes to use.

2. Test and inspect materials, as necessary, in accordance with ACI 318 and CBC Sections 1903A, and 1913A for compliance with requirements.

3. Take samples as required from the Contractor’s designated sources.

4. Take one grab sample for each 100 tons of Portland cement except that, when used in bulk loading ready-mix plants where separate bins for pretested cement are not available, take grab samples for each shipment of cement placed in bin with not less than one sample being taken for each day’s pour and subsequently test such samples if required by the Architect who may be so advised by DSA.

5. Test both coarse and fine aggregate by use of solution of sodium or magnesium sulfate, or both whenever in the judgment of the Architect such tests are necessary to determine quality of material. Perform such tests in accordance with ASTM C88. Loss shall not exceed 6-percent of either fine or coarse aggregate. Aggregate failing to comply with this requirement may be used in the Work provided it contains less than 2-percent of shale and other deleterious particles and shows a loss in soundness test of not more than 10-percent when tested in the sodium sulphate solution. Test aggregates as required by ACI 318 Section 313 and CBC Section 1903A.6.

6. Test for sand equivalent of fine aggregate in accordance with California Test 217.

7. Test for cleanness value of coarse aggregate in accordance with California Test 227.

8. Inspect plant prior to any work to verify following:
a. Plant is equipped with approved metering devices for determining moisture content of fine aggregate.
b. Other plant quality controls are adequate.

9. Continuously inspect quality and quantity of materials used in transit mixed concrete, in batched aggregates and ready-mixed concrete at mixing plant or other location per CBC Section 1929A.4 where other materials are measured.

B. Waiver of Batch Plant Inspection:

1. Continuous batch plant inspection may be waived by the register design professional in responsible charge, subject to approval by the enforcement agency, under either of the following conditions:

   a. The concrete plant complies fully with the requirements of ASTM C 94, Sections 8 and 9, and has a current certificate from the National Ready Mixed Concrete Association or another agency acceptable to the enforcement agency. The certification shall indicate that the plan has automatic batching and recording capabilities.

   b. For single-story light framed buildings and isolated foundations supporting equipment only, where the specified compressive strength f’c of the concrete delivered to the jobsite is 3,500 psi (24.13 MPa) and where f’c used in design not greater than 3,000 psi (20.68 Mpa).

2. When continuous batch plant inspection is waived, the following requirement shall apply and shall be described in the construction documents:

   a. Qualified technician of the testing laboratory shall check the first batch at the start of the day.

   b. Licensed weightmaster to positively identify materials as to quantity and certify to each load by a batch ticket.

   c. Batch tickets, including actual material quantities and weights shall accompany the load and shall be transmitted to the inspector of record by a truck driver with load identified thereon. The load shall not be placed without a batch ticket identifying the mix. Copies of daily placement record shall be submitted to DSA.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine units of work to be cast and verify that:

   1. Construction of formwork is complete.
   2. Required reinforcement, inserts, and embedded items are in place.
   3. Form ties at construction joints are tight.
4. Concrete-receiving places are free of debris.
5. Dampen subgrade or sand course for slabs-on-grade. Do not saturate.
6. Depths of depressed slab conditions are correct for delayed finish noted and for its proper bonding to concrete.
7. Conveying equipment is clean and properly operating.
8. The Architect has reviewed formwork and reinforcing steel and that preparations have been checked with the Project Inspector.

B. Do not begin casting before unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Ensure availability of sufficient labor, equipment and materials to place concrete correctly in accordance with scheduled casting.

B. Protect finished surfaces adjacent to concrete-receiving places.

C. Clean transportation and handling equipment at frequent intervals and flush thoroughly with water before each day’s run. Do not discharge wash water into concrete form.

3.3 PLACING

A. The Inspector of Record, Architect, Structural Engineer, Testing Laboratory and DSA shall be notified at least 48 hours before placing concrete.

B. Place concrete in accordance with ACI 318 Chapter 5.

C. Place concrete in cycles as a continuous operation to permit proper and thorough integration and to complete scheduled placement. Place no concrete where sun, wind, heat, or facilities prevent proper finishing and curing.

D. Convey concrete as rapidly and directly as practicable to preserve quality and to prevent separation from rehandling and flowing; do not deposit concrete initially set. Complete placement of concrete within ninety (90) minutes after adding water unless otherwise noted. Retempering of concrete which has partially set will not be permitted.

E. Take precautions to avoid damage to under-slab moisture barrier and displacement of reinforcement and formwork.

F. Deposit concrete vertically in its final position. Avoid free falls in excess of six feet where reinforcement will cause segregation and in typical conditions unless the Architect approves otherwise.

G. Keep forms and reinforcement clean above pour line by removing clinging concrete with wire brush before casting next lift. Also remove leakage through forms.

H. Interruption in casting longer than 60-minutes shall be cause for discontinuing casting for remainder of day. In this event, cut back concrete and provide construction joints as the Architect directs; clean forms and reinforcement as necessary to receive concrete at a later time.
I. Hot Weather Concreting: Conform to ACI 305 and following requirements when mean daily temperature rises above 75 degrees Fahrenheit.

1. An upper temperature limit of concrete mixes shall be established by the Contractor for each class of concrete. Concrete temperature during placing shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints, and shall not exceed 90°F. Other project climatic conditions detrimental to concrete quality such as relative humidity, wind velocity, and solar radiation shall also be considered.

2. Trial batches of concrete for each mix design shall be made at the limiting mix temperature selected. In lieu of trial batches, compression strength test reports (20 minimum) at the limiting temperature for each proposed mix shall be submitted to the Owner’s testing laboratory for review.

3. Practices to maintain concrete below maximum limiting temperature shall be in accordance with ACI 305. Concrete ingredients may be cooled before mixing, or flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for part of the mixing water.

4. Practices to avoid the potential problems of hot weather concreting shall be employed by the Contractor in accordance with ACI 305.

5. When the temperature of the reinforcing steel or steel deck forms is greater than 120°F, reinforcing and forms shall be sprayed with water just prior to placing the concrete.

J. Cold Weather Concreting:

1. No placement of concrete will be allowed at temperatures below 20 degrees Fahrenheit or if mean daily temperature for curing period is anticipated to be below 20 degrees Fahrenheit.

2. No concrete placement will be allowed on frozen subgrade.

3. Conform to ACI 306 and following requirements when mean daily temperature falls below 40 degrees Fahrenheit.

   a. Reinforcement, forms or ground to receive concrete shall be completely free from frost.

   b. Concrete at time of placement for footings shall have temperature no lower than 50 degrees Fahrenheit, for all other concrete this minimum temperature at time of placement shall be 60 degrees Fahrenheit. Maximum temperature shall be 90 degrees Fahrenheit.

   c. Concrete shall be maintained at temperature no lower than 50 degrees Fahrenheit for minimum 7-day period after placement by means of blanket insulation, heaters, or other methods as approved by the Architect.

   d. Use of calcium chloride or admixtures containing calcium chloride as accelerators will not be permitted.

   e. The Contractor shall keep a record of concrete surface temperature for first 7-days after each pour. This record shall be open to inspection by the Architect.

K. Consolidating:

1. Use vibrators for thorough consolidation of concrete.
2. Provide vibrators for each location during simultaneous placing to ensure timely consolidation around reinforcement, embedded items and into corners of forms; ensure availability of spare vibrators in case of failures. Vibrate through full depth of freshly placed concrete.

3. Do not place vibrators against reinforcement, attach to forms, or use to spread concrete.

4. Exposed Concrete: Vibrate with rubber type heads and, in addition, spade along forms with flat strap or plate.

L. Construction Joints:

1. Verify location and conformance with typical details; provide only where designated or approved by the Architect. Comply with ACI 318 Section 6.4. Construction joints require keys and additional reinforcement unless otherwise noted; consult architect for details.

2. All horizontal and vertical construction joints to be thoroughly sandblasted to clean and roughen entire surface to minimum 1/4-inch relief exposing clean coarse aggregate solidly embedded in mortar matrix.

3. Just prior to depositing concrete, the surface of the construction joint shall be thoroughly wetted.

M. Contraction (Control) Joints in Slabs-on-Grade:

1. Construct contraction joints in slabs-on-ground to form panels of patterns indicated on Shop Drawings. Use saw cuts 1/8” x 1/4 slab depth, unless otherwise indicated.

2. Time saw cutting to allow sufficient curing of concrete to prevent raveling or broken edges.

3. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.

4. If joint pattern not shown, provide joints not exceeding 15’ in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third-bays).

N. Walls and Other Formed Elements:

1. Space points of deposit to eliminate need for lateral flow. Placing procedures of concrete in forms permitting escape of mortar, or flow of concrete itself, will not be permitted.

2. Level top surface upon stopping work.

3. Take special care to fill each part of the forms by depositing concrete directly as near final position as possible, and to force concrete under and around reinforcement, embedded items, without displacement.

4. After concrete has taken its initial set, care shall be exercised to avoid jarring forms or placing any strain on ends of projecting reinforcement.

5. Where backfill is placed against a wall, it shall be adequately shored until it has attained design strength.

O. Penetrations Through Concrete:
1. Penetrations through structural concrete for conduit, piping or other items must be approved by the Architect.
2. Where such penetrations are approved, provide steel galvanized pipe sleeves as follows:
   a. Reinforcement must not be displaced. Provide minimum ¼” clearance between reinforcement and sleeve.
   b. Sleeves shall be Schedule 40, 60, 80, or 160 as follows based on pipe diameter “D” per Table 3-1.
   c. Spacing and edge distances shall conform to Table 3-1.

P. Table 3-1: Pipe Sleeves at Penetrations

<table>
<thead>
<tr>
<th>Pipe Diameter “D”</th>
<th>A53 Pipe Thickness</th>
<th>Minimum Center-to-Center Spacing</th>
<th>Minimum Edge Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 2”</td>
<td>Schedule 40</td>
<td>6”</td>
<td>4”</td>
</tr>
<tr>
<td>&gt;2” ≤ 4”</td>
<td>Schedule 60</td>
<td>3D</td>
<td>6”</td>
</tr>
<tr>
<td>&gt;4” ≤ 8”</td>
<td>Schedule 80</td>
<td>3½ D</td>
<td>1½ D</td>
</tr>
<tr>
<td>&gt;8” ≤ 12”</td>
<td>Schedule 120</td>
<td>4D</td>
<td>2D</td>
</tr>
<tr>
<td>&gt; 12”</td>
<td>Not Permitted</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.4 CURING

A. General Requirements:

1. Take curing measures immediately after casting and for measures other than application of curing compound, extend for seven days. The Architect may recommend longer periods based upon prevailing temperature, wind and relative humidity. Comply with ACI 318 Section 5.11.
2. Avoid alternate wetting and drying and fluctuations of concrete temperature.
3. Protect fresh concrete from direct rays of sun, rain, freezing, drying winds, soiling, and damage.
4. Do not permit curing method to affect adversely finishes or treatments applied to finish concrete.

B. Curing Method, Typical: Obtain the Architect’s approval of alternate measures.

1. Keep forms and concrete surfaces moist during period forms are required to remain in place.
2. Apply curing compound per manufacturers’ recommendations, except at slabs-on-grade apply curing compound at 150% of manufacturer’s recommended application coverage rate.

3.5 CLEANING, PATCHING AND DEFECTIVE WORK
A. Where concrete is under strength, out of line, level or plumb, or shows objectionable cracks, honeycombing, rock pockets, voids, spalling, exposed reinforcement, signs of freezing or is otherwise defective, and, in the Architect’s judgment, these defects impair proper strength or appearance of the work, the Architect will require its removal and replacement at the Contractor’s expense.

B. Immediately after stripping and before concrete is thoroughly dry, patch minor defects, form-tie holes, honeycombed areas, etc., with patching mortar. Patch shall match finish of adjacent surface unless otherwise noted. Remove ledges and bulges.

C. Compact mortar into place and neatly file defective surfaces to produce level, true planes. After initial set, dress surfaces of patches mechanically or manually to obtain same texture as surrounding surfaces.

D. Rock Pockets:

1. Cut out to full solid surface and form key.
2. Thoroughly wet before casting mortar.
3. Where the Architect deems rock pocket too large for satisfactory mortar patching as described, cut out defective section to solid surface, key and pack solid with concrete to produce firm bond and match adjacent surface.

E. Cleaning:

1. Insure removal of bituminous materials, form release agents, bond breakers, curing compounds if permitted and other materials employed in work of concreting which would otherwise prevent proper application of sealants, liquid waterproofing, and other delayed finishes and treatments.
2. Where cleaning is required, take care not to damage surrounding surfaces or leave residue from cleaning agents.
3. Remove all exposed, loose fibers from stair treads to the satisfaction of the architect.

3.6 PROTECTION

A. Protect concrete from injurious action of the elements and defacement of any nature during construction operations.

B. Protect exposed corners of concrete from traffic or use which will damage them in any way.

C. Make provisions to keep all exposed concrete free from latence caused by spillage or leaking forms or other contaminants. Do not allow laitances to penetrate, stain, or harden on surfaces which have been textured.

3.7 FIELD QUALITY CONTROL

A. The Owner’s Testing Agency will:

1. Perform testing in accordance with ACI 318 and CBC Section 1705A.3, 1903A, and 1913A and Table 1705A.3.
2. Review concrete mix designs.
3. Inspect concrete and grout placement continuously.
4. Test concrete to control slumps according to ASTM C143.
5. Continuously monitor concrete temperature as it arrives on the site.
6. Test concrete for required compressive strength in accordance with CBC Section 1905A.1.2:
   a. Make and cure four specimen cylinders according to ASTM C31 for not more than each 50 cubic yards, or 2000 square ft for of surface areas of slab or walls poured each day.
   b. Retain one cylinder for 7-day test, two for the 28-day test and hold one cylinder for additional testing as required.
   c. Number each cylinder 1A, 1B, 1C, 1D, 2A, 2B, 2C, 2D etc; date each set; and keep accurate record of pour each set represents.
   d. Transport specimen cylinders from job to laboratory after cylinders have cured for 24-hours on site. Cylinders shall be covered and kept at air temperatures between 60 and 80 degrees Fahrenheit.
   e. Test specimen cylinders at age 7-days and age 28-days for specified strength according to ASTM C39.
   f. Base strength value on average of two cylinders taken for 28-day test.
7. Test and inspect materials, as necessary, in accordance with ACI 318, MM Test Method 227 (Coarse Aggregates) and MM Test Method 217 (Fine Aggregates), for compliance with requirements specified in this section.

B. The Contractor shall:

1. Submit ticket for each batch of concrete delivered to job site. Ticket shall bear the following information:
   a. Design mix number.
   b. Signature or initials of ready mix representative.
   c. Time of batching.
   d. Weight of cement, aggregates, water and admixtures in each batch with maximum aggregate size.
   e. Total volume of concrete in each batch.
   f. Notation to indicate equipment was checked for contaminants prior to batching.

2. Pay the Owner’s Testing Agency for taking core specimens of hardened structure and testing specimen according to ASTM C88 and C42 when laboratory tests of specimen cylinders show compressive strengths below specified minimum.
3. Submit Concrete Weighmaster affidavit per section 2.05 (B) 2.d.

3.8 FINISH OF FORMED SURFACES

A. Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish Work or by other construction. Concrete surface shall have texture imparted by 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. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, painting or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

C. 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.

3.9 SLAB FINISHES

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.

1. After placing slabs, plane surface to tolerances for floor flatness FF of 20 and floor levelness FL of 15. 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.

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 tolerances for flatness FF of 25 and levelness FL of 20. 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.

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. Check and level surface plane to tolerances flatness FF of 35 and levelness FL of 25. Grind smooth surface defects which would telegraph through applied floor covering system.

2. Floors to receive traffic topping shall have steel trowel finish.

3. Concrete flooring shall be slip resistant.
D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

E. Medium Broom Finish: Apply medium broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.

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 Architect before application.

3.10 CLEAN UP

A. Perform Work under this Section to keep affected portions of building site neat, clean, and orderly. Remove, immediately upon completion of Work under this Section, surplus materials, rubbish, and equipment associated with or used in performance. Be aware that failure to perform clean-up operations within 24 hours of notice by Architect will be considered adequate grounds for having work done by others at no added expense to the Owner.

END OF SECTION 033000
SECTION 03 30 53

MISCELLANEOUS CAST-IN-PLACE-CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. California Code of Regulations (CCR): Title 24, Chapter 2-71, Site Development Requirements for ADA Accessibility.

C. California Department of Transportation (Caltrans):
   1. Standard Specifications:
      a. Section 26: Aggregate Bases.
      b. Section 40: Concrete Pavement.
      c. Section 41: Concrete Pavement Repair.
      d. Section 51: Concrete Structures.
      e. Section 52: Reinforcement.
      f. Section 73: Concrete Curbs and Sidewalks.
      g. Section 90: Concrete.


E. Highway Design.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:
   1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
   2. Section 321313 "Concrete Paving" for concrete pavement and walks.
3. Section 328000 “Irrigation”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture.

1.4 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. Comply with the following sections of ACI 301 unless modified by requirements in the Contract Documents:

1. "General Requirements."

2. "Formwork and Formwork Accessories."

3. "Reinforcement and Reinforcement Supports."

4. "Concrete Mixtures."

5. "Handling, Placing, and Constructing."

B. Comply with ACI 117.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Plain-Steel Wire: ASTM A 1064, as drawn.

C. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:
   1. Portland Cement: ASTM C 150, Type I or Type II.
   2. Fly Ash: ASTM C 618, Class C or F.
   3. Slag Cement: ASTM C 989, Grade 100 or 120.

C. Normal-Weight Aggregate: ASTM C 33, 1-1/2-inch nominal maximum aggregate size.


F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494, Type A.
   2. Retarding Admixture: ASTM C 494, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

G. Water: ASTM C 94.

2.4 RELATED MATERIALS

A. Vapor Retarder: Plastic sheet, ASTM E 1745, Class A or B.

B. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
2.5 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.6 CONCRETE MIXTURES

A. Comply with ACI 301.

B. Normal-Weight Concrete:

1. Minimum Compressive Strength: 3000 psi or as indicated at 28 days.

2. Maximum W/C Ratio: 0.45.

3. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

4. Slump Limit: 4 inches, plus or minus 1 inch.

5. Air Content: Maintain within range permitted by ACI 301. Do not allow air content of trowel-finished floor slabs to exceed 3 percent.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and furnish batch ticket information.

1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of 1 cu. yd or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For mixer capacity larger than 1 cu. yd, increase mixing time by 15 seconds for each additional 1 cu. yd.

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, construct, erect, brace, and maintain formwork according to ACI 301.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR-RETARDER INSTALLATION

A. Install, protect, and repair vapor retarders according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.

1. Lap joints 6 inches and seal with manufacturer's recommended adhesive or joint tape.

3.4 STEEL REINFORCEMENT INSTALLATION

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Owner.
C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

3.6 CONCRETE PLACEMENT

A. Comply with ACI 301 for placing concrete.

B. Do not add water to concrete during delivery, at Project site, or during placement.

C. Consolidate concrete with mechanical vibrating equipment according to ACI 301.

D. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct concrete bases 6 inches high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.

3. Minimum Compressive Strength: 3000 psi at 28 days.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor them into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding 1/2 inch.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch.

1. Apply to concrete surfaces where indicated.

C. Rubbed Finish: Apply the following rubbed finish, defined in ACI 301, to smooth-formed-finished as-cast concrete where indicated:

1. Smooth-rubbed finish.
2. Grout-cleaned finish.
3. Cork-floated finish.

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

3.8 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.

1. Do not further disturb surfaces before starting finishing operations.
C. Scratch Finish: Apply scratch finish to surfaces indicated and surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes unless otherwise indicated.

D. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, fluid-applied or direct-to-deck-applied membrane roofing, or sand-bed terrazzo.

E. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.

F. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickest or thinnest methods. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.

G. Slip-Resistive Broom Finish: Apply a slip-resistive finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.9 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer’s written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials, as environmental conditions dictate:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests: Perform according to ACI 301.

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

END OF SECTION
SECTION 05 12 00

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section Includes: Provision of structural steel as indicated on the Contract Drawings. Work includes but is not necessarily limited to the following:

1. Structural steel framing, including all structural steel shown on the structural drawings and all standard shapes, plates and rods shown on the Architectural, Mechanical and Electrical drawings that connect to the building structure.
2. Elevator rail bracing.
3. Welded stud connectors for composite construction, concrete engagement, and attachment of building components.
4. Anchor rods.
5. Shop painting.

B. Related Sections:

1. Section 03 20 00 - Concrete Reinforcement
2. Section 03 30 00 - Cast-in-Place Concrete

1.2 REFERENCES

A. Requirements of GENERAL CONDITIONS and DIVISION NO. 1 apply to all Work in this Section.

B. Published specifications, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to Work of this Section where cited by abbreviations noted below (latest editions apply).

3. American Institute of Steel Construction:
      i. No provision of AISC2 shall be effective to change the duties and responsibilities of the Owner, Contractor or Structural Engineer from those set forth in these Contract Documents.
      ii. Where discrepancies exist between the requirements of the Contract Documents and AISC2, the requirements of the Contract Documents shall govern.
   c. “Seismic Provisions for Structural Steel Buildings, AISC-341” Dated June 22,
4. American Welding Society:
   a. “Structural Welding Code -- Steel” (AWS D1.1).
   b. “Structural Welding Code – Seismic Supplement” (AWS D1.8).
   c. “Structural Welding Code – Sheet Steel” (AWS D1.3).
   e. “Filler Metal Specifications” (AWS A5).
   f. “Standard for AWS Certification of Welding Inspectors” (AWS QC1).

5. Society of Protective Coatings:
   a. Solvent Cleaning (SSPC-SP 1).
   b. Hand Tool Cleaning (SSPC-SP 2).
   c. Brush-Off Blast Cleaning (SSPC-SP 7).


7. American Society of Non-Destructive Testing:


1.3 DEFINITIONS

1.4 QUALIFICATIONS

A. Steel Fabricator’s Qualifications: Fabricator shall have had not less than 5 years’ experience in fabrication of structural steel and be able to furnish evidence of his ability, facilities, proficiency of his personnel and completed projects.

B. Steel Erector’s Qualifications: Erector shall have had not less than 5 years’ experience in erection of structural steel and be able to furnish evidence of his ability, facilities, proficiency of his personnel and completed projects.

C. Welder Qualifications: Welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1 and CBC Section 1705A.2.2.1.

1. Welders shall have a valid Welding Performance Qualification Record (WPQR) for each welding procedure to be performed.
2. Welders whose work fails to pass inspection shall be requalified before performing further welding.
3. Qualification Period: Personnel who have not welded for a period of three or more months shall be requalified. Welding personnel required to be tested using the Supplemental Welding Personnel Testing shall be qualified by test within 12 months.
prior to beginning welding on the project.
4. The Contractor shall pay costs of certifying qualifications and requalifications.

1.5 QUALITY ASSURANCE

A. Welding Inspector Qualifications:

1. All Welding Inspectors shall be trained and thoroughly experienced in inspecting welding operations, and qualified as Certified Welding Inspectors (CWI) in accordance with AWS D1.1 and AWS QC1.

2. NDT Personnel Qualifications

   a. NDT personnel shall be qualified under one of the ASNT documents referenced in this specification. NDT performed by NDT Level I personnel shall be under the close, direct supervision of an NDT Level II.

B. Bolting Inspector Qualifications: Competency shall be demonstrated through the administration of a written examination and through the hands-on demonstration by the Inspector of the methods to be used for bolt installation and inspection.

C. Submittals: The Owner’s Testing Agency will submit the following items:

   1. Quality Assurance Plan: The Quality Assurance Plan shall contain the Quality Assurance and Inspection items contained in this Section.

   2. Qualifications of Owner’s Testing Agency management and personnel designated for the project.

   3. Qualification records for Owner’s Testing Agency’s Inspectors and NDT technicians designated for the project.

   4. Owner’s Testing Agency’s Quality Control Plan for the monitoring and control of the Agency’s operations.

   5. Written Practice for Owner’s Testing Agencies: The Owner’s Testing Agency shall maintain a Written Practice for the selection and administration of inspection personnel, describing the training, experience and examination requirements for qualification and certification of inspection personnel, including those of subcontracting agencies. The Written Practice shall also describe the Agency’s procedures for determining the acceptability of the structure in accordance with the applicable codes, standards, and specifications. The Written Practice shall also describe the Agency’s inspection procedures, including general inspection, material controls, visual welding inspection, and bolting inspection.


   b. Welding Inspection Procedures: Meet the requirements of the AWS D1.1 and the Quality Assurance Plan.

   c. Nondestructive Testing Procedures: The Written Practice shall describe the responsibility of each level of certification for determining the acceptability of material and welds in accordance with the applicable codes, standards, specifications and procedures.
1.6 SUBMITTALS

A. The following items shall be submitted to the Architect for review. One reproducible copy will be returned. Do not fabricate material prior to obtaining final review of submittals.

1. Manufacturer’s test reports and literature describing products excluding those listed in Section 1.06B.
2. Plans of all levels showing dimensioned location of edge of slab, deck, and openings. Submit prior to Shop and Erection drawings.
3. Shop and Erection Drawings. Prior to the start of fabrication and erection, submit detailed shop and erection drawings for all structural steel showing:
   a. Size and location of all structural members and connection material.
   b. Type, size and location of bolts and welds.
   c. Identification of high-strength bolted joints as snug-tight, pretensioned or slip-critical, as required by the Contract Documents.
   d. Shop and erection drawings shall clearly identify revisions and revision dates in accordance with AISC2.
   e. Shop drawings shall include the following additional information:
      i. Complete information necessary for the fabrication of members including cuts, copes, holes, stiffeners, and camber.
      ii. Surface preparation and finishes, including both painting and grinding.
      iii. Material grades of all members, connection material, fasteners, and weld filler metal.
      iv. With each set of shop drawings include corresponding erection drawings identifying pieces.
   f. Erection drawings shall include the following additional information:
      i. Identification mark of members.
      ii. Orientation and relation of members to appropriate grid lines.
      iii. Setting elevations for column bases.
      iv. Standard and special details for field connections.
      v. Identification of joints or groups of joints in which a specific assembly order, welding sequence, welding technique, or other special precautions are required.
   g. Samples: Material samples shall be provided as requested by the Structural Engineer or Owner’s Testing Agency.

B. The following items shall be submitted to the Architect and Owner’s Testing Agency. Submittal to the Architect is for record purposes only. No copies will be returned by the Architect.

1. Manufacturer’s test reports and literature describing products:
   a. Structural Steel: Material test reports (MTRs), also called mill test reports, for
all structural steel. MTRs shall comply with the requirements of ASTM A6.
MTRs shall be accompanied by a Certificate of Compliance from the fabricator.
Structural steel shall be identified in accordance with CBC Section 2203A.1.
b. Fastening Material: Manufacturer’s Certifications for fastener components,
including bolts, nuts, washers, and direct tension indicators (if used),
accompanied by a Certificate of Compliance from the Contractor.
Manufacturer certifications shall contain:
i. Heat analysis, heat number, and a statement certifying that prohibited
elements were not added to produce the bolts.
ii. Results of hardness, tensile, and proof load tests, as required and
performed.
iii. If galvanized, measured zinc coating weight or thickness, and the results
of rotational capacity tests, including test method used (solid plate or
tension measuring device) and lubricant present.
iv. Results of visual inspection for bursts.
v. Statement of compliance with dimensional and thread fit requirements.
vi. Lot number and purchase order number.
c. Welding Consumables: Submit the following items:
i. Manufacturer’s Certifications for electrodes, fluxes and shielding gasses
to be used. Certifications shall satisfy AWS A5 requirements. In addition
submit a Certificate of Compliance from the Contractor supplying the
materials. Submit certifications that the product meets any additional
requirements of the project.
ii. Manufacturer’s product data sheets for all welding material to be used.
The data sheets shall describe the product, limitations of use,
recommended welding parameters, and storage and exposure
requirements, including baking and rebaking.
d. Welded Stud Connectors: Submit the following items:
i. Manufacturer’s Certification that the studs, as supplied, meet the
requirements of AWS D1.1.
ii. Certified copies of the stud manufacturer’s test reports covering the last
completed set of in-plant quality control mechanical tests for the
diameter supplied.
iii. Certified material test reports from the manufacturer. The
Manufacturer’s Certification shall be accompanied by a Certificate of
Compliance from the Contractor.

2. Bolting and Welding Procedures: Procedures shall assign responsibility to a person
or position and shall contain enough detail to be useful to the workforce without
reference to governing specifications. The procedures need not act as work
instructions. Procedures shall be dated and indicate the person or position that has
the authority to maintain the procedure.

a. Fastener Installation Procedures: Submit written procedures for the pre-
installation testing, installation, snugging, pre-tensioning, and post-installation
inspection of high strength fasteners.

b. Welding Procedure Specifications (WPSs): Welding Procedure Specifications (WPSs) shall conform to the requirements of AWS D1.1. Submit Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQR) as required by AWS D1.1, to be used on the project to the Owner’s Testing Agency.

c. Use forms provided in Annex E of AWS D1.1 or equivalent.

d. Weld Sequence Procedures: Submit written procedures indicating field welding sequences for each type of connection with multiple field-welded joints, and the sequence of such connections to be field-welded at each level.

3. Welding Performance Qualification Records (WPQRs): Written Welding Performance Qualification Records (WPQRs), in accordance with AWS D1.1, for all welders on the project. Submit documentation that the welder has passed all designated supplemental welder qualification testing required for the types of welding to be performed. Submit documentation showing that the welder continued to use the applicable welding process on an ongoing basis since the WPQR test was conducted.

1.7 STRUCTURAL STEEL PRE-CONSTRUCTION CONFERENCE

Not Used

1.8 PRODUCT 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. Structural steel shall be stored and handled in a manner that prevents damage or distortion. Discharge materials carefully; do not dump onto ground.

C. Do not store materials on the structure in a manner that might cause distortion or damage to members of the supporting structure.

D. Store structural steel members, whether on or off site, above ground on platforms, skids, or other support; store other materials in weather-tight, dry place until use.

E. Store materials to permit easy access for inspection and identification.

F. Electrode Requirements:

1. Packaging of weld filler metals shall conform to the requirements of AWS D.1.1. FCAW electrodes shall be received in undamaged moisture-resistant containers. They shall be protected against contamination and injury during shipment and storage. When removed from protective packaging and installed on machines, care shall be taken to protect the electrodes and coatings from deterioration or damage.

2. Modification or lubrication of an electrode after manufacture is not permitted, except that drying shall be permitted when recommended by the manufacturer.

3. Electrode Storage and Exposure Limits for Demand-Critical Welds: The exposure time limit for FCAW electrodes shall be based upon the results of tests as prescribed in FEMA 353 Part I, Appendix D. Spools shall be identified to facilitate
monitoring of total atmospheric exposure time. FCAW electrodes that have been exposed for periods exceeding the allowable atmospheric exposure may be baked as per D1.1 if manufacturer’s testing and recommendations show that baking is effective.

G. Fasteners shall be stored in a protected place. Except for ASTM F1852 “twist-off” type assemblies, clean and relubricate bolts, nuts and washers that become dry or rusty before use. F1852 fastener components may be relubricated following the manufacturer’s written instructions, and must be retested after relubrication and prior to use to verify suitability for installation.

1.9 JOB CONDITIONS

A. Provide the Owner’s Testing Agency with free access to places on and off job site where materials are stored or fabricated, to places where equipment is stored or serviced, and to job site.

B. Sequencing, Scheduling:

1. Notify the Architect and Owner’s Testing Agency in sufficient time prior to shop or field fabrication and erection to permit testing and inspection without delaying Work.
2. Ensure timely delivery of items to be embedded in work of other sections; furnish setting drawings and directions for installation
3. Provide templates for setting of anchor rods.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Shapes, Plates, Tube, Pipe, and other sections: As noted on drawings.

B. Welding materials:

1. Comply with AWS D1.1 with a nominal 70 ksi tensile strength.
2. Supplemental Requirements for the Complete Penetration welds of the rooftop mechanical unit steel support frames:

   a. Toughness and Elongation: Weld filler metals shall be capable of providing welds with the following minimum mechanical property requirements using AWS A5 classification test methods:

      i. CVN toughness of 20 ft-lb at minus 20°F
      ii. Elongation: 22% minimum.

   b. Weld filler metals shall be low-hydrogen per AWS D1.1.
   c. Weld procedures shall conform to the Hydrogen Control Method in AWS D1.1 Annex XI.

C. Welded Stud Connectors:

   1. Headed Shear Studs: AWS D1.1 “Type B” automatic end-welded headed studs
made from ASTM A29 Grades 1010 thru 1020.
2. Threaded Studs: Automatic end-welded threaded studs made from ASTM A29, Grades 1010 through 1020.

D. Primer:

1. Interior steel: primer shall conform to SSPC Paint Specification No. 13.
2. Exterior steel: primer shall conform to SSPC Paint Specification No. 20 (Zinc-Rich Primer)
3. Primers shall contain no lead or chromates.
4. Contractor shall verify compatibility with finish paint.

E. Zinc-Rich Coating for Repair of Galvanized Surfaces: Zinc-rich coatings shall meet the requirements of ASTM A780.

F. Steel shall conform to the requirements of CBC Section 2203A.1.

2.2 FABRICATION

A. General Requirements:

1. Fabricate structural steel in accordance with AISC1 (Chapter M and the first paragraph of J2.), AISC2, and AWS D1.1 as applicable to Statically Loaded Structures, except as otherwise noted herein.
   a. Assume all thermally cut edges are subject to tension stresses.
   b. Delete paragraph M4.6 from Chapter M of AISC1.

2. Fabricate and assemble work in shop to greatest extent possible.
3. Where possible, use procedures that do not require Architect’s approval. Such approval may not be given in some circumstances.
4. Coordinate as required for attachment of other work to structural steel.
5. Where required for passage of reinforcing steel shapes, sections, plates, or bars, drill or punch holes as indicated on Contract Drawings. Notify Architect of conditions not shown or noted.
6. Allowable Tolerances: Comply with AISC1, Chapter M, and AISC2, Section 6. Where more restrictive tolerances are necessary to properly install other building systems and components then adopt the more restrictive tolerances.

B. Connections:

1. Shop Connections: Bolts or welded as noted.
2. Field Connections: Locate splices only where noted or approved by Architect.
3. To the extent possible, assemble structural steel in the shop prior to galvanization.

C. Bolted Joints:

1. Punch or drill holes 1/16” larger than bolt size. Material having thickness in excess of connector diameter plus 1/8” shall be drilled rather than punched.
2. Ream unfair holes, but only up to next larger bolt size and install a bolt corresponding to the new hole size. Where unfairness exceeds maximum, weld hole
in base material solid and drill hole of proper size.
3. Remove burrs that would prohibit solid seating of connected parts.
4. Mark completely tightened bolts with identifying symbol.
5. Provide hardened washers over slotted holes.
6. Draw up tight, check threads with chisel or provide approved lock washers where bolts are not pretensioned.
7. Assembly with Standard Threaded Fasteners: Provide beveled washers under bolt heads or nuts resting surfaces exceeding five percent slope with respect to head or nut

D. Welded Construction: (shop and field)

1. Weld in accordance with AISC1, AWS D1.1, and CBC Chapter 22A.
2. Welding shall be performed in accordance with the WPS for the joint.
3. Welds that will be permanently exposed to view shall have burrs, flux, welding oxide air spots, and discolorations removed. Surfaces of such welds shall be reasonably smooth and uniform.
4. Exterior welds shall be watertight.
5. Each welder working on the project shall be assigned an identification symbol or mark. Each welder shall mark or stamp this identification symbol at each weld completed. Stamps, if used, shall be the low-stress type.
6. Before testing, all welds to be subjected to ultrasonic testing (UT) shall be given a visible mark, “for UT,” accurately placed on the steel a distance of 4” away from the root of the edge preparation.
7. Groove welds shall be complete-joint-penetration welds, unless specifically designated otherwise.
8. WPSs shall be available to welders and inspectors prior to and during the welding process. Prior to welding, joint fit-up shall be verified by the welder for conformance with the WPS and AWS D1.1.
9. Supplemental Welding Requirements

a. Maximum Preheat and Interpass Temperature: The maximum preheat and maximum interpass temperature permitted is 550° F, measured at a distance of 1" from the point of arc initiation. This maximum temperature may not be increased by the WPS, regardless of qualification testing.

b. Nonfusible Backing: The use of nonfusible backing materials, including ceramic and copper, is permitted only with satisfactory welder qualification testing performed using the type of backing proposed for use and using the test plate shown in AWS D1.1, Figure 4.21, except that groove dimensions shall be as provided in the WPS and PQR. For nonfusible weld tabs and short segments of nonfusible backing bars used at the ends of welds between shear plates and column faces, or at the ends of continuity plate welds, special welding personnel and welding procedure qualification testing is not required.

c. Peening, Controlled Cooling, and Post-Weld Heat Treatment (PWHT): If peening, controlled cooling, or PWHT are used, they shall be performed in accordance with AWS D1.1 and a written procedure for their performance shall be incorporated into the appropriate WPS.

i. If insulating blankets are used to control cooling a written procedure and
temperature measurements are not required.

ii. The application of heat immediately following completion of a joint to maintain a nominal temperature at or below 550° F is not considered PWHT.

d. Intermix of Filler Metals: For Demand-Critical Welds in which different weld filler metals are used, supplemental toughness testing shall be conducted.

e. Weld dams are not allowed.

f. Weld Tabs:

i. Use of Weld Tabs: Welds shall be terminated at the end of a joint in a manner that will ensure sound welds. Whenever necessary, this shall be done by use of weld tabs.

1) Weld tabs shall extend beyond the edge of the joint a distance equal to a minimum of the part thickness, but not less than 1”.

2) Weld tabs shall be oriented parallel to the joint preparation and to the weld direction.

3) Nonfusible weld tabs may be used in applications and locations where qualified in accordance with AWS D1.1, Section 4.

ii. Heavy Section Joint Weld Tab Removal and Finish: All welded tension splices in Heavy Sections, shall have the weld tabs removed and ground Extra Smooth.

g. Weld access holes:

i. Weld access holes shall meet the dimensional, surface finish, and testing requirements of AISC1 Chapter J1.6 and AWS D1.1, except as otherwise required by the Contract Documents.

ii. Where the height of the weld access hole exceeds the quantity k-tf+1½” or where the length of the weld access hole exceeds 4 tf (where k and tf are defined in AISC1), welded reinforcement is required. Notify the Architect for specific instruction.

h. Web weld details: A minimum clear distance of ½” shall be provided between the

E. Welded Connectors: Install in accordance with AWS D1.1 and manufacturer’s recommendations. There shall be no porosity or evidence of lack of fusion between the end of the stud and the steel member.

2.3 FINISHES

A. Prime Painting

1. Surfaces to be painted:

a. Apply one coat of exterior primer to structural steel surfaces permanently exposed to weather.
b. Apply one coat of interior primer to structural steel in areas without environmental controls such as bridges between buildings, open-air stair wells, and unoccupied areas with rat slabs.

c. Apply one coat of primer to AESS members and members to be painted unless otherwise noted.

d. Do not prime paint following surfaces:
   i. Surfaces to be encased in concrete except initial 2”.
   ii. Surface to be field welded.
   iii. Surface to receive sprayed-on fireproofing.
   iv. Contact surfaces joined by high-strength bolts.

2. Preparation of Surfaces:

   a. Thoroughly clean mill scale, rust, dirt, grease, and other foreign matter from steel prior to painting.
   b. Where hand-cleaning methods are inadequate, clean in accordance with SSPC-SP1, SSPC-SP 2, or SSPC-SP 7, as required.

3. Painting:

   a. Apply primer in accordance with manufacturer’s specifications to provide minimum dry film thickness of 1.0 mils per coat.
   b. Permit thorough drying before shipment.
   c. Do not prime in temperatures lower than 45 degrees Fahrenheit.

B. Galvanization

   1. Galvanize steel where required by the Drawings or by other sections of the Specification.
   2. Galvanize Shapes in accordance with ASTM A153.
   3. Galvanize Fasteners in accordance with ASTM B695, Class 40 minimum.

2.4 SOURCE QUALITY ASSURANCE

A. The Owner’s Testing Agency will:

   1. Review ladle analysis and certificates of compliance. Where certification is questionable, test material to verify compliance per CBC Section 2203A.1.
   2. Inspect shop fabrication per CBC Section 1704A.2.5 and 1704A.2.
   3. Provide the management, personnel, equipment, and services required to perform the quality assurance functions required below.

B. Welding Inspection: The Welding Inspector will perform the tasks indicated in the following list. This list shall not be considered exclusive of any additional inspection tasks that may be necessary to meet the requirements of AWS D1.1, CBC Section 1704A.2.1, and the Quality Assurance Plan.

   1. Review and understand the applicable portions of the specifications, the Contract Documents and the shop drawings for the project.
   2. Verify that all applicable welder qualifications, welding operator qualifications and
tack welder qualifications are available, current, accurate, and in compliance with these specifications.

3. Verify welder identification and qualification. Verify that any required supplemental welder qualification testing, if required for the joint, has been executed and that the welder has passed.

4. Verify that each welder has a unique identification mark or die stamp to identify welds.

5. Verify that all applicable Welding Procedure Specifications (WPSs), with Procedure Qualification Records (PQRs) as needed, are available, current and accurate, and comply with AWS D1.1 and this specification.

6. Verify that an approved Welding Procedure Specification (WPS) has been provided and that each welder performing the weld has reviewed the WPS. A copy of the appropriate WPS shall be available for each joint, although need not be present at each joint location.

7. Review mill test reports for all main member and designated connection base material for compliance with the project requirements.

8. Verify base material identification with the contract documents.

9. Verify the electrode, flux and shielding gas certifications for compliance with the Contract Documents.

10. Verify welding consumables with the approved WPSs.

11. Verify that electrodes are used only in the permitted positions and within the welding parameters specified in the WPS.

12. Verify that electrodes and fluxes are properly stored, and that exposure limits for the welding materials are satisfied.

13. At suitable intervals, observe joint preparation, assembly practice, preheat temperatures, interpass temperatures, welding techniques, welder performance and any post-weld controlled cooling and heat treatment to ensure that the requirements of the WPS and AWS D1.1 are satisfied.

14. At suitable intervals, verify current and voltage of the welding equipment in application of the WPS, if needed, by a calibrated amp and voltmeter. Current and voltage shall be measured near the arc with this equipment.

15. Inspect the work to ensure compliance with AWS D1.1 and the specified weld acceptance criteria.

16. Schedule NDT technicians in a timely manner, after the visual inspection is complete and the assembly has cooled. The final NDT on a specific weld shall be performed at least 24 hours after the welding has been completed.

17. Mark the welds, parts, and joints that have been inspected, and accepted, with a distinguishing mark or die stamp, or maintain records indicating the specific welds inspected and accepted by each inspector.

18. Document the accepted and rejected items in a written report. Transmit the report to the designated recipients in a timely manner.

C. Nondestructive Testing of Welded Joints

1. Magnetic Particle Testing: Magnetic Particle Testing (MT) shall be conducted by the Owner’s Testing Agency at the frequency designated in Table 2-1. MT shall be performed in accordance with AWS D1.1.

2. Ultrasonic Testing: Ultrasonic testing (UT) shall be conducted by the Owner’s
Testing Agency for the percentage of joints designated in Table 2-1. UT shall be performed in accordance with AWS D1.1.

3. Weld Acceptance Criteria shall be in accordance with AWS D1.1. Regions of welds that cannot be inspected shall be identified and recorded, and the Structural Engineer shall be notified.

4. K-Area Welding Inspection: After welds of continuity plates and doubler plates have cooled to ambient temperature, test column webs for cracking using liquid penetrant (PT) or magnetic particle testing (MT) over a zone 3’’ above and below each weld.
D. Table 2-1: Nondestructive Testing Requirements

<table>
<thead>
<tr>
<th>Weld Category</th>
<th>Nondestructive Testing Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welds not described below</td>
<td>Complete-Joint-Penetration Welds¹ No NDT required unless otherwise noted</td>
</tr>
<tr>
<td>SLRS welds not described below</td>
<td>Partial-Joint-Penetration Welds and Fillet Welds</td>
</tr>
<tr>
<td>Top-flange joints at cantilever beam</td>
<td>MT 25% of joints, full length¹</td>
</tr>
<tr>
<td>connections³</td>
<td>UT 25% of joints, full length¹</td>
</tr>
<tr>
<td>Demand-Critical Welds; Butt joints in</td>
<td>MT 25% of joints, 6&quot; spot at random¹</td>
</tr>
<tr>
<td>column splices</td>
<td>UT 100% of joints, full length</td>
</tr>
</tbody>
</table>
<pre><code>                                                             | MT 100% of joints, full length                                                                       |
                                                             | MT 100% of joints, full length                                                                       |
</code></pre>

Notes:
1. UT is required only when the weld thickness is 5/16" or greater.
2. If any joint fails testing, test 100% of joints until 40 consecutive welds pass. The testing rate may then be reduced to 25%.
3. Test joint on each side of cantilever beam support.
4. Reduce the rate of UT to 25% if after 40 welds have been inspected, an individual welder’s reject rate is less than 5%.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine units of Work to be placed and verify that all anchor rods have been installed properly and have sufficient bolt and thread elevation.

B. Do not begin erection before unsatisfactory conditions have been corrected.

3.2 ERECTION

A. General Requirements:

1. Erect structural steel in accordance with AISC1 Chapter M, AISC2, and AWS D1.1 Structural Steel Welding Code as applicable to Statically Loaded Structures.
2. Requirements for bolted and welded joints specified in Part 2 of this Specification shall also apply to field connections unless otherwise noted.
3. Erection Tolerances: Do not exceed the erection tolerances specified in AISC2, Section 7. Where more restrictive tolerances are necessary to properly install other building systems and components then adopt the more restrictive tolerances.
4. Where erection requires performing work of fabrication on site, conform to applicable standards for fabrication.
5. Ensure steel is plumb, level, and aligned before making final connections.
B. Anchor rods shall be set in conformance with Section 7.5 of AISC2.

C. Field Cutting or Alteration: There shall be no field cutting, alteration, or repair of structural steel members or of connections without prior review and approval by the Architect. Structural elements with fabrication errors or that do not satisfy tolerance limits shall be repaired. Submit drawings showing reasons for, and details of, proposed corrective work.

D. Temporary Shoring and Bracing: Provide shoring and bracing as needed until permanent lateral-support is in place and complete with connections of sufficient strength to bear the imposed loads. Contractor is responsible for identifying the need for temporary shoring and bracing.

E. Erection Procedures: Control erection procedures and sequences to avoid problems caused by temperature differentials and weld shrinkage, and other sources of expansion and contraction.

F. Leveling of Column Base Plates: Contractor shall specify the means and methods for leveling the column base plates during erection. The leveling method shall have sufficient strength to support the imposed loads, including construction loading.

G. Field Assembly:

1. Clean bearing surfaces and surfaces to be in permanent contact before assembling members.
2. Do not fasten splices of columns and other members with bearing joints designated on the drawings before abutting surfaces have been brought completely into contact.
3. Bolted Construction:
   a. Installation of high-strength bolts shall conform to ASTM A325 for slip-critical or snug-tightened type joints, as applicable, in accordance with RCSC. Provide washer under head or nut of high strength bolts. Washer shall be provided under the element being turned during tightening. Bolts in welded connections shall be tensioned after completion of welding.
   b. At bolted joints designated as Slip-Critical or that require pretension, use Twist-off-Type Tension-Control bolt assemblies or Direct Tension Indicators.
   c. Do not use flame cutting to align bolt holes except as permitted by RCSC specifications. Ream holes that must be enlarged to admit bolts. Do not enlarge holes to a diameter greater than 1." When reaming beyond 1/32", drill or ream to the next larger hole size and use the next larger size bolt.

4. Mill scale shall be removed from the column in the area where the beam flanges will be welded to the column.

H. Gas Cutting: Use of flame cutting torch will be permitted only after the Architect’s prior written approval and only where metal cut will not carry stress during cutting, and cut surfaces will not be visible. When thermal cutting is permitted, cutting shall be done with a mechanically guided torch or a torch controlled using a guide bar.
I. Field Touch-Up Painting: After erection, touch-up paint field connections and abrasions resulting from the Work of this Section with same paint used for shop prime painting.

J. Remove and repair galvanized surface as required for field welding in accordance with ASTM-A780, A2; required thickness is 100 micro-inches. Touch up with zinc-rich coating. Repair material shall extend at least three inches beyond edges of damaged areas.

3.3 CLEANING

A. After erection, thoroughly clean surfaces of foreign or deleterious matter such as dirt, mud, oil, or grease that would impair bonding of fireproofing, concrete, or other finishes as applicable.

3.4 FIELD QUALITY ASSURANCE

A. The Owner's Testing Agency will:

1. Verify proper anchor rod group location, elevation, and orientation prior to placement of concrete foundations, and again subsequent to placement of concrete foundations prior to arrival of structural steel.

2. Perform field welding inspection and testing in accordance with the requirements in Part 2 of this Specification for shop fabrication, unless otherwise noted.

3. Inspect and test high strength bolted joints in accordance with RCSC and CBC Sections 1705A.2.1

4. Sample and test bolt assemblies that include direct tension indicators, on a daily basis to verify proper indication of deformation with required bolt tension for each size and lot. The Inspector shall have a torque wrench, calibrated daily, to verify correlation with proper tension as installation proceeds. Test at least 10 percent of the bolts with a minimum of two per connection from the start of bolting and until waived by the DSA Field Engineer upon demonstration of continued good workmanship.

5. Inspect erected structural steel as required to establish conformity of Work with reviewed shop drawings and Contract Drawings.

6. Perform testing and inspection of welded stud connectors in accordance with requirements of AWS D1.1 and CBC Section 2213A.2, except that the test studs shall be subjected to a 90 degree bend test by striking them with a heavy hammer. After the bend test, the weld section shall not exhibit any tearing or cracking.

7. Forward copies of all test and inspection reports to the Owner, Architect, Structural Engineer, Contractor, and DSA.

END OF SECTION 05 12 00
SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section Includes: Provision of all lumber framing, rough hardware and blocking as indicated in the contract drawings.

1.2 REFERENCES

A. Requirements of GENERAL CONDITIONS and DIVISION NO. 1 apply to all Work in this Section.

B. The following published specifications, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to Work in this Section (latest editions apply).


3. (PS) - United States Product Standard, PS-1 and PS-2 “Construction and Industrial Plywood.”

4. (UL) - Underwriters’ Laboratories, Inc., “Fire Hazard Classification, FR-S.”

5. (WCLIB) - West Coast Lumber Inspection Bureau, “Standard Grading Rules No. 16.”

6. (WWPA) - Western Wood Products Association, “Grading Rules for Lumber.”

7. (AWPA) - American Wood Preservers Association Standards.

8. (AF&PA) - American Forest and Paper Association.


1.3 SUBMITTALS

A. Shop Drawings of all specially fabricated rough hardware.

B. Samples only as requested by the architect.
1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Provide proper facilities for handling and storage of materials to prevent damage to edges, ends, and surfaces.

B. Keep materials dry. Where necessary, stack materials off ground on level flat forms, fully protected from weather.

1.5 JOB CONDITIONS

A. Environmental Requirements: Maintain uniform moisture content of lumber at not more than 19-percent during and after installation.

B. Sequencing, Scheduling: Coordinate details with other Work supporting, adjoining or fastening to rough carpentry Work.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Rough Carpentry:

B. Sills on Concrete: Pressure treated Douglas Fir.

C. Lumber (Wood Framing): Meet requirements of following minimum grades.

<table>
<thead>
<tr>
<th>Item</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Studs</td>
<td>D.F. No. 1</td>
</tr>
<tr>
<td>b. Plates</td>
<td>D.F. No. 1</td>
</tr>
<tr>
<td>c. Beams</td>
<td>D.F. No. 1</td>
</tr>
<tr>
<td>d. Joists</td>
<td>D.F. No. 1 or better</td>
</tr>
<tr>
<td>e. Posts</td>
<td>D.F. No. 1</td>
</tr>
<tr>
<td>f. Blocking</td>
<td>D.F. No. 2 or Standard or better</td>
</tr>
</tbody>
</table>

D. Plywood: Provide thickness, grade, and panel identification index shown on drawings. For plywood thickness 5/32 or greater provide a minimum of 5 ply.

E. Rough Hardware: All exterior hardware shall be hot-dipped galvanized.

1. Nails: Common wire, typical; hot-dipped galvanized at exposed conditions and pressure-treated lumber.

3. Expansion Bolts: Reverse cone, self-wedging, expansion type. Tightening of nut or increased tension on bolt shank shall act to force wedges outward to create positive increased resistance to withdrawal. Ramset/Read Head “Tru-Bolt,” Hilti Kwik-Bolt 3 or equal product substituted general conditions.

4. Metal Framing Connectors: Fabricate from hot-dipped galvanized steel (G90 coating). Connectors in contact with pressure treated lumber shall have G185 hot dipped galvanized coating per ASTM A653. Connectors shall be at least 16-gauge material, 1/8-inch plate materials where welded, unless otherwise shown or specified, punched for nailing. Nails and nailing shall conform to the manufacturer’s instructions, with a nail provided for each punched nail hole. Use maximum nail size listed by manufacturer. Manufactured by Simpson Company or equal product substituted general conditions.

5. Miscellaneous Hardware: Provide all common screws, bolts, fastenings, washers and nuts required to complete rough carpentry Work.

6. Bolts and sill bolts in wood shall be ASTM A307 with standard cut threads; full diameter bolts (no rolled or “upset” threads permitted) per ANSI/ASME standard B18.2.1.

2.2 TREATMENTS

A. Fire-Retardant Treatment: Same as Koppers Co., Inc.’s “Non-Com” J.H. Baxter and Co.’s “Baco-Pyresote”; or equal product substituted general conditions.

B. Preservative Treatment: Furnish in accordance with AWPA. Preservatives with an ammonia base, including Ammoniacal Copper Zinc Arsenate (ACZA) are not permitted.

2.3 FABRICATION

A. Preparation:

1. Verify measurements at job site.

2. Verify details and dimensions of equipment and fixtures integral with finish carpentry for proper fit and accurate alignment.

3. Coordinate details with other work supporting, adjoining, or fastening to casework.

Lumber:

4. Air- or kiln-dry to maximum 19-percent moisture content at time of surfacing.

5. Furnish surfaced four sides, S4S, unless otherwise noted.

6. Size to conform with rules of governing standard. Sizes shown are nominal unless otherwise noted.
B. Wood Treatments:

1. Preservative Treatment:
   a. Treat lumber and plywood sheathing.
      i. In contact with concrete and masonry less than six feet above the ground.
      ii. Exposed to weather permanently.
      iii. Where specified in the Contract Documents.
   b. Lumber: Treat in accordance with AWPA C2
   c. Plywood: Treat in accordance with AWPA C9
   d. After Treatment and prior to shipping, air- or kiln-dry lumber to maximum 12-percent moisture content.

2.2 SOURCE QUALITY CONTROL

A. Lumber shall bear grade-trademark or be accompanied by certificate of compliance of appropriate grading agency.

B. Plywood shall bear APA grade-trademark.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive rough carpentry Work and verify following:
   1. Completion of installation of building components to receive rough carpentry Work.
   2. That surfaces are satisfactory to receive Work.
   3. That spacing, direction, and details of supports are correct to accommodate installation of blocking, backing, stripping, furring and nailers.
   4. That all anchor bolts and holdown bolts are properly installed.

3.2 INSTALLATION

A. Cutting: Perform all cutting, boring, and similar Work required.

B. Studs, Joists, Beams, and Posts: Install all members true to line. No wood shingle shims are permitted. Place joists with crown up; maximum 1/4-inch crown permitted.
C. Nail joints in accordance with applicable requirements of the CBC Table 2304.9.1 unless otherwise shown or specified. Predrill where nails tend to split wood. Nails into pressure-treated lumber shall be hot-dipped galvanized.

D. Bolt holes to be 1/16-inch oversize. Threads shall not bear on wood. Use standard malleable iron washers against wood. Carriage bolts require washers under the nut only.

E. Provide blocking, grounds, nailers, stripping, and backing as shown and as required to secure other Work.

F. Maintain 1/8-inch gap between all plywood panel edges.

G. Do not utilize plywood sheets having a width smaller than 2-feet 0-inches.

H. Plywood flooring shall be field glued with adhesive meeting APA specification AFG-01 applied in accordance with the manufacturer’s recommendations. Apply continuous line of glue on joists and in groove of tongue and groove panels.

I. Where wood is cut, sawed, planed, bored or marred after preservative or fire-retardant treatment, apply two heavy brush coats of same material used in treatment.

J. Nail heads shall be driven flush with plywood surface. Overdriven nails (nails which fracture the outer ply layer) shall be replaced one for one.

K. Screws (Wood or Lag): Screws shall be screwed and not driven into place. Screw holes for the unthreaded portion shall be predrilled to the same diameter and depth of shank. Holes for threaded portion shall be predrilled less than or equal to the diameter of the root of the thread. Provide standard cut washers under head of lag screws.

3.3 CLEANING AND ADJUSTING EXPOSED TIMBER

A. Remove damaged or otherwise disfigured portions and replace with new prior to the Owner’s acceptance.

B. Wash finished Work in strict accordance with product manufacturer’s directions and ensure that washed surfaces do not differ from clean unwashed surfaces. Any difference will be considered unsatisfactory work.

3.4 FIELD QUALITY CONTROL

A. The Owner’s Testing Agency shall:

1. Inspect erected timber framing as required to establish conformity of work with Drawings.

2. Inspect all bolted connections.
3. Inspect roof diaphragm nailing for nail size, spacing and penetration at plywood panel edges, and special nailing at collector and drag members.

4. Inspect shear wall nailing for nail size, spacing and penetration at plywood panel edges, and nailing at holdown posts.

B. Machine Nailing: Use of machine nailing is subject to a satisfactory jobsite demonstration for each project and the approval of the Project Inspector, the Structural Engineer and DSA. The approval is subject to continued satisfactory performance. If the nail heads penetrate the outer ply more than would be normal for a hand-held hammer, or if minimum allowable edge distances are not maintained, the performance will be deemed unsatisfactory and machine nailing shall be discontinued.

END OF SECTION 06 10 00
SECTION 07 21 00
INSULATION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide thermal and sound insulation as shown and specified for a complete installed system, including the wire hangers for installation between roof joists, and all required accessories.

B. Related Sections:

   1. Section 06 10 00 – Rough Carpentry
   2. Section 07 20 00 – Firestopping
   3. Section 07 90 00 – Sealants & Caulking
   4. Section 09 29 00 – Gypsum Board
   5. Section 09 91 00 – Painting

1.02 SUBMITTALS

A. Product Data: Manufacturer’s information on materials, fabrication and installation.

B. Certificates: Certification that products proposed for use comply with design criteria specified.

1.03 QUALITY ASSURANCE

A. Design Criteria:

   1. Insulation shall be certified by the manufacturer to comply with California standards for insulating materials.

   2. Insulating materials shall be installed in compliance with Flame Spread Rating and Smoke Density requirements of CBC, Section 719.

B. Fiberglass Batt Insulation: Manufactured from minimum ten percent (10%) post-consumer (recycled) glass.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturers’ original packaging.

B. Clearly identify manufacturer, contents, brand name, applicable standard, and R-value.

C. Store materials off ground, protected against weather, condensation, and damage.

D. Comply with manufacturer’s recommendations for handling, storage, and protection during installation.
PART 2 - PRODUCTS

2.01 MATERIALS

A. Thermal Insulation:

1. Unfaced fiberglass insulation batts: Johns-Manville, Gustin Bacon or products of comparable quality and utility. Formaldehyde free.
   a. 11" thick, R30 for roof joists
   b. 5-1/2" thick, R21 for exterior wood stud walls

2. Tapered Insulation: Thermal Foams Inc. (www.thermalfoams.com), Expanded Polystyrene (EPS) tapered insulation boards, or products of comparable quality and utility. Flame spread Index 25 or less, Smoke Developed Value less than 250.

B. Acoustic Insulation

1. 3" thick unfaced mineral Thermafiber SAFB (or similar) sound batts where shown on drawings. Formaldehyde free.

C. Accessories:

1. Stick Clips for Installation: As recommended by the insulation manufacturer for the particular materials and installation conditions.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces to receive insulation are satisfactory for their installation. If unsatisfactory conditions exist, do not commence installation until such conditions have been corrected.

B. Examine areas scheduled to receive insulation to ensure protection against inclement weather and other hazards and to verify that work of preceding trades is completed.

C. Examine space allocated for insulation for proper depth to receive material.

D. Proceed with installation when conditions are satisfactory.

E. Prior to closing walls or ceilings, obtain Architect's acceptance of insulation installation.

3.02 INSTALLATION

A. General: Install materials where shown, as specified, and in accordance with manufacturer's instructions.
B. Installation of Thermal Insulation:

1. Install in accordance with manufacturer’s instructions, unless otherwise noted.

2. Unless otherwise noted, install batt insulation at ceiling spaces over conditioned spaces, with foil facing, where occurs, towards conditioned spaces.

3. Unless otherwise noted, install batt insulation in stud spaces of all perimeter walls to exterior and install in common wall between heated and unheated spaces, with foil facing, where occurs, towards conditioned spaces.

4. Maintain integrity of insulation over entire area to form a continuous thermal-insulating shell around the heated spaces.

5. Fit batt insulation snugly between framing members and around piping, wiring, and other obstructions.

6. Fill spaces completely with insulation.

C. Installation of Acoustical Insulation

1. Install insulation "Sound-Control Battts" in sound insulated spaces as indicated on Drawings.

2. Fill voids to create a continuous sound-isolation plane.

3. Fit insulation tightly between framing members, at end joints of insulation, and around piping and electrical work.

4. Stagger and joints between studs and, where occurs, between two planes of insulation.

3.03 CLEANING

A. Remove from the site all debris resulting from the work of this section.

END OF SECTION
SECTION 07 25 00

WEATHER RESISTIVE BARRIER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Weather-resistive barrier.

1.2 RELATED SECTIONS

A. Section 05400 - Cold Formed Exterior Metal Framing: Metalstuds framing in exterior walls and soffits.

B. Section 07413 - Sheet Metal Soffit Panels: Weather resistive air barrier associated with metal soffit panels.

C. Section 07620 - Sheet Metal Flashing and Trim: Head flashing at steel door and window frames; counterflashings and reglets; collar flashings for plumbing and pipe penetrations other than specified in this section.

D. Section 07650 - Flexible Flashing: Self-adhering sheet membrane flashing.

E. Section 07900 - Joint Sealers: Sealant types.

F. Section 09253 - Gypsum Sheathing: Walls sheathing under weather resistive barrier and self-adhering sheet membrane flashing.

1.3 REFERENCES


F. FS UU-B-790 - Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellent and
1.4 SYSTEM DESCRIPTION

A. Weather Resistive Barrier: Asphalt saturated Kraft sheathing paper installed behind with exterior cladding to prevent moisture penetration of and condensation in exterior wall assemblies.

1.5 DESIGN REQUIREMENTS

A. Sustainable Design Requirements: Asphalt saturated Kraft sheathing paper used in work of this section is intended to:

1. Contribute to meeting requirements for recycled content outlined in LEED™-NC3.0 Credit MR4.

2. Contribute to meeting requirements for regional materials outlined in LEED™-NC3.0 Credit MRS.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's data on material characteristics, performance criteria and limitations for each component in system.

B. Samples: Submit samples, minimum 6 x 6 inches in size, of weather resistive barrier.

C. Manufacturer's Installation Instructions: Submit preparation, installation requirements and techniques, product storage and handling criteria.

D. LEED Documentation:

1. Recycled Content: Submit letter or product data from manufacturer indicating recycled contents. Designate percentage of post-consumer and post-industrial recycled content.

2. Regional Materials: Submit letter or product data from manufacturer or fabricator stating products in this submittal were extracted and manufactured locally; identify location of origin listing city, state and country. If only portion of product qualifies for this credit, submit product data or letter clearly designating percentage of product that is manufactured and extracted locally.

3. Submit hard copies of completed Online Documentation required for LEEDTM MR Credit 4 and MR Credit 5.
1.7 QUALITY ASSURANCE

A. Source Limitation: Provide primary materials for each component of system which are products of single manufacturer.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture of weather resistive barriers with minimum 10 years documented experience.

B. Installer: Company specializing in installation of weather resistive barriers with minimum 3 years documented experience.

1.9 REGULATORY REQUIREMENTS

A. Weather Resistant Barrier: Comply with requirements of CBC Section 1403.2.

1.10 PREINSTALLATION CONFERENCE

A. Convene preinstallation conference minimum 1 week prior to beginning work of this section.

B. Attendance: Contractor, weather resistive barrier system installer, sheet metal flashing installer, flexible membrane flashing installer, Project Manager, Project Inspector and Architect.

C. Agenda: Review installation procedures and coordination required with related construction. Conduct inspection of substrate.

1.11 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site, store, handle and protect in accordance with manufacturer's instructions and recommendations.

B. Sequence deliveries to avoid delays while minimizing on-site storage.

C. Deliver products to job site in their original unopened containers with labels intact and legible at time of use.

D. Protect products from sunlight, weather, excessive temperatures, and construction operations.

E. Remove damaged material from site and dispose of in accordance with applicable regulations.
1.12 COORDINATION

A. Coordinate installation of weather resistive barrier with installation of metal flashings and reglets specified under Section 07620 - Sheet Metal Flashing and Trim and with self-adhered sheet membrane flashings specified under Section 07650 – Flexible Flashings.

PART 2 PRODUCTS

2.1 WEATHER RESISTIVE BARRIER

A. Manufacturer:


B. Weather Resistive Barrier: FS UU-8-790, Type 1, Grade D, Style 2; asphalt saturated kraft sheathing paper; water vapor permeable; uncreped; not reinforced; single ply; nominal 6.4 lbs/100 sq ft.

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Resistance</td>
<td>ASTM D779</td>
<td>&gt;60 minutes</td>
</tr>
<tr>
<td>Water Vapor Transmission</td>
<td>ASTM E96</td>
<td>75 grams; 11 perms</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>ASTM D828</td>
<td>70 lbf/inch MD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 lbf/inch CD</td>
</tr>
</tbody>
</table>

C. Accessories:

1. Fasteners: Exterior grade staple sized to hold weather resistive barrier in place until final wall cladding is installed but no to penetrate through sheathing.

2. Sealant: ASTM C920, Type S, Grade NS, Class 25; single components polyurethane elastomeric compatible with weather resistive barrier; moisture curing; non-sag; Moistop Sealant.

3. Tape: Pressure sensitive tape; Fortifiber Sheathing Tape
PART 3  EXECUTION

3.1  EXAMINATION

A. Examine substrate conditions to determine acceptability for installation. Verify that substrates are acceptable for product installation in accordance with manufacturer's instructions and recommendations.

B. Verify that installed work of other trades and verify that such work is complete to point work of this section may begin.

C. Verify that substrates are structurally sound, free of voids and contaminants and ready for work of this section.

D. Verify that substrates are plumb, level, square and aligned.

E. Verify that substrate joints and fasteners are flush.

F. Do not begin installation until unsatisfactory conditions have been corrected.

3.2  PROTECTION

A. Protect elements surrounding work from damage and disfiguration.

B. Protect installed roofing adjacent to work of this section.

1. Cover roof surfaces with minimum 3/8 inch thick asphalt-coated fiberboard laid over minimum 6 mil plastic sheeting with ends and edges lapped 6 inches.

2. If storage is necessary, cover roof surfaces with minimum 3/8 inch thick plywood over minimum 3/8 inch thick asphalt coated fiberboard over minimum 6 mil plastic sheeting with ends and edges lapped 6 inches; offset plywood and fiberboard joints.

C. Repair damage to other surfaces caused by work of this section.

3.3  INSTALLATION

A. Install weather resistive barrier in accordance with manufacturer’s instructions and recommendations and as specified herein.

B. Install 2 layers of weather resistive barrier weatherboard fashion to exterior exposure of sheathed framed construction.

C. Starting at bottom of 1 end of wall or soffit, place roll horizontally overlapping corner minimum 6 inches; roll out first course evenly covering rough window and door openings.
D. Attach weather resistive barrier so that it is tight and flat; secure at corners and in field with sufficient fasteners to hold in place until final wall cladding is installed.

E. Overlap weather resistive barrier minimum 6 inches at vertical seams; ensure weather resistive barrier is pulled tightly and properly fastened.

F. Place succeeding courses horizontally over first course; overlap weather resistive barrier minimum 3 inches at horizontal seams.

G. Stagger seams between adjacent courses of weather resistive barrier and between layers of weather resistive barrier.

H. Integrate weather resistive barrier with installation of flexible flashing and sheet metal flashing ensuring weather board lap is maintained.

I. Examine installed product for holes, tears, punctures and other damage which may adversely affect barrier integrity; seal with tape or sealant.

J. Coordinate installation of final wall cladding; ensure weather resistive barrier is covered in timely fashion.

3.4 PROTECTION OF INSTALLED WORK

A. Provide means necessary to protect weather resistive barrier until final wall cladding is installed.

END OF SECTION
SECTION 07 41 13
METAL ROOF PANELS

PART 1 – GENERAL

1.01 DESCRIPTION:
   A. Work described in this section includes factory finished complete Class A preformed metal roofing system including clips, perimeter and penetration flashing, ridge cap, drift stiffeners, closures, ridge cap, drip stiffener, site screens, coping and gutters. (including gutter expansion joints).
   B. Related Work Specified Elsewhere:
      1. Section 05 50 00 - Metal Fabrications.
      2. Section 06 10 00 - Rough Carpentry.
      3. Section 07 62 00 - Sheet Metal Flashing and Trim.

1.02 SUBMITTALS: Comply with requirements of Submittal Section 01 33 00.
   A. Shop Drawings: Show roofing system with flashings and accessories in plan and elevation; sections and details. Include metal thickness’ and finishes, panel lengths, joining details, anchorage details, flashings and special fabrication provisions for termination and penetrations. Indicate relationships with adjacent and interfacing work. Shop drawings must be completed by the metal panel manufacturer’s engineering department. Any and/or all changes recommended by the successful bidder must be approved by the manufacturer in writing prior to submittal.
   B. Product Data: Include manufacturer’s detailed material and system description, sealant and closure installation instructions, engineering performance data and finish specifications.
   C. Design Test Reports:
      1. Indicate fastener types of spacings; and provide fastener pullout values.
      2. Submit copy of manufacturer’s minimum design load calculations according to ASCE-7-10.
      3. Submit copy of certification from manufacturer stating that specified system has been tested in accordance with ASTM-1592 requirements by an independent Engineering Firm. All test results must be submitted including Air (ASTM E 283) Infiltration Tests. These test results must meet or exceed those listed in Section 1.8 (Design and Performance Criteria) and be stamped by an independent Engineering Firm.

1.03 INSTALLER QUALIFICATIONS:
   A. Installer:
      1. Engage an experienced metal roofing contractor (erector) to install standing seam system who has a minimum of three (3) years experience specializing in the installation of structural standing seam metal roof systems.
2. Contractor must be certified by manufacturer specified a supplier of structural standing seam system and obtain written certification from manufacturer that installer is approved for installation of specified system. If requested, contractor must supply owner with a copy of this certification.
3. Successful contractor is required to maintain a full-time supervisor/foreman who is on the job-site at all times during installation of new roof system. Foreman must have a minimum of five (5) years’ experience with the installation of system similar to that specified.

1.04 MANUFACTURER QUALIFICATIONS:

A. The materials outlined in the Material and Method Specifications are based on the performance characteristics of the Rubber Span system by the Garland Company. Bidder will not be allowed to supply panels formed at the job-site on portable rollformers; metal panels must be pre-manufactured and engineered for this project. Bidder will not be allowed to change materials after the bid opening date. If the bidder wishes to propose an alternate manufacturer and/or material than that specified, the following manufacturer criteria must be submitted and approved in writing by the Architect 10 days prior to bid due date. Failure to comply with this requirement is grounds for disqualification of Bid.

1. Submit certified test reports from a testing laboratory that bear the stamp of a registered California P.E. to show compliance with specified performance criteria. Test reports must meet the specified negative uplift pressures as listed per this specification for the gauge, panel width and clip spacing specified as confirmed by manufacturers ASTM-E-1592 test results.
2. Tests shall have been made identical systems within the ranges of specified performance criteria.
3. Empirical calculations for roof performance shall only be acceptable for positive loads.
4. Indicate fastener types and spacings and provide fastener pullout values.
5. Submit copy of manufacturer’s Factory Mutual Certification for specified system.
6. Submit copy of certification from manufacturer stating that specified system has been tested in accordance with ASTM-1592 requirements by an independent Engineering Firm. All test results must be submitted including Air (ASTM E 283) Infiltration and meet or exceed those listed in Section 1.8 (Design and Performance Criteria).
7. A list of a minimum of five (5) jobs where the proposed alternate material was used under similar conditions. The reference list shall include date of project, size of project, address and contact telephone number.
8. A financial statement demonstrating a current ratio of 2:1 (current assets to current liabilities).
9. A written statement from the manufacturer stating that they will provide the building owner with a daily site inspection for a minimum of one (1) hour by an experienced, full time employee of the company.
10. A written statement from a corporate officer of the manufacturing company stating that he or she has reviewed the specifications and confirms that the proposed system meets or exceeds all performance requirements listed as well as meets the panel size, gauge, weight, clip design, sealant design, uplift pressures and height of the vertical seam.
11. A copy of manufacturer’s 30 year NDL standing seam/modified built up warranty.

B. The following samples must be submitted by alternate manufacturers:
1. Submit sample of panel section, at least 6" x 6" showing seam profile and also a sampler of color selected.
2. Submit sample of panel clip.
1.05 DELIVERY, STORAGE, AND HANDLING:

A. Manufacturer’s responsibility:
   1. Protect components during fabrication and packing from mechanical abuse, 
      stains, discoloration, and corrosion.
   2. Provide protective interleaving between contact areas of exposed surfaces to 
      prevent abrasion during shipment, storage, and handling.

B. Installer’s responsibility:
   1. Store materials off ground providing for drainage; under cover providing for air 
      circulation; and protected from wind movement, foreign material contamination, 
      mechanical damage, cement, lime or other corrosive substances.
   2. Handle materials to prevent damage to surfaces, edges and ends of roofing 
      sheets and sheet metal items. Damaged material shall be rejected and removed 
      from the site.

1.06 JOB CONDITIONS:

A. Determine that work of other trades will not hamper or conflict with necessary fabrication 
   and storage requirements for preformed metal roofing system.

B. Protection:
   1. Provide protection or avoid traffic on completed roof surfaces.
   2. Support no roof-mounted equipment directly on roofing system.

C. Ascertaining that the work of other trades which penetrates the roof or is to be made watertight 
   by the roof is in place and approved prior to installation of roofing.

1.07 QUALITY CRITERIA:

A. Applicable standards:
   1. American Iron and Steel Institute (AISI):
      S100-07 Specification for the Design of Cold-Formed Steel Structural 
      Members.
      A792-10 Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated 
      by the Hot-Dip Process.
      A653 Specification for Steel Sheet Zinc-coated (galvanized) or Zinc-
      Iron Alloy-coated (Galvannealed) by the Hot-Dip process.
      E283 Test Method for Rate of Air Leakage Through Exterior Windows, 
      Curtain Walls, and Doors Under Specified Pressure Differences 
      Across the Specimen.
      E1592-01 Standard Test Method for Structural Performance of Sheet Metal 
      Roof and Siding Systems by Uniform Static Air Pressure 
      Difference.
   3. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
   4. Underwriters’ Laboratories (UL):
      Standard UL – 790 Class A Fire Rated Materials.

B. Applicable erection tolerances: Maximum variation from true planes or lines: ½” in 20’-0”;
   3/8” in 40’-0” or more.
1.08 DESIGN AND PERFORMANCE CRITERIA:

A. Thermal Movement:
1. Completed metal roofing and flashing system shall be capable of withstanding expansion and contraction of components caused by changes in temperature without buckling, producing excess stress on structure, anchors or fasteners, or reducing performance ability.
2. Interface between panel and clip shall provide for unlimited thermal movement in each direction along the longitudinal direction.

B. Uniform wind load capacity:
1. Capacity shall be determined using pleated airbag method in accordance with ASTM E 1592, testing of sheet metal roof panels as follows:
   (7.1) Roof test specimens shall be either full length or representative of the main body of the roof, free from edge restraint or perimeter attachments, continuous over one or more supports, and containing at least five panel modules for standing seam roof.
   (7.1.2) No attachments shall be permitted at sides or end perimeter other than those that occur uniformly throughout roof. Side and end seals shall be flexible and in no way restrain crosswise distortion of panels.
   (7.2.1) Panels and accessories shall be production materials of same type and thickness proposed for use on project.
2. Installed roof system shall carry positive uniform design loads with a maximum system deflection of L/180 as measured at the rib (web) of the panel.


D. ASTM E283: Static pressure air infiltration:

<table>
<thead>
<tr>
<th>Pressure</th>
<th>Leakage Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.57 PSF</td>
<td>0.0007 cfm/sq.ft.</td>
</tr>
<tr>
<td>6.24 PSF</td>
<td>0.0002 cfm/sq.ft.</td>
</tr>
<tr>
<td>20.0 PSF</td>
<td>0.0036 cfm/sq.ft.</td>
</tr>
</tbody>
</table>

E. Water penetration (dynamic pressure): No water penetration, other than condensation, when exposed to dynamic rain and 70 mph wind velocities for not less than five minutes duration, when tested in accord with principles of ASMA 501.1.

F. Capacities for gauge, span or loading other than those tested may be determined by interpolation of test results within the range of test data. Extrapolation for conditions outside test range are not acceptable.

G. Cool Roof Features:
   - Aged Solar Reflectance = 0.20 or higher
   - Thermal Emittance = 0.75 or higher
   - SRI+ = 106 (initial) / 97 (3 years)
   - CRFC ID product = 0700-0028

Verify that colors selected meet this minimum criteria.
1.09 WARRANTIES:

A. Owner shall receive ONE (1) WARRANTY from manufacturer of roof panels covering ALL of the following criteria. Multiple warranties are NOT acceptable:

1. Manufacturer’s 30 year near NDL watertight warranty.
2. Manufacturer’s warranty shall be a total systems warranty including all metal soffit and standing seam roofing. The same company shall manufacture the soffit and standing seam roof systems. This composite warranty shall provide the District with a single source of liability by guaranteeing both waterproofing systems against leaks for a period of 30 years.
3. Installer shall provide manufacturer with 5 year warranty covering roofing system installation and watertightness.

1.10 PRE-INSTALLATION CONFERENCE:

A. Conduct pre-installation meeting at project site before each construction activity that required coordination with installation of preformed metal roofing system.

B. Other trades involved in or affected by installation of metal roof system shall attend.

C. Advise Architect/Engineer of scheduled meeting dates minimum of seven (7) days in advance.

D. Review progress of other construction activities and preparations for particular activity under construction at each pre-installation conference.

E. Record significant discussions and agreements/disagreements of each conference, along with approved schedule. Distribute record of meeting to everyone concerned, promptly, including Owner and Architect.

F. Do not proceed if conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of work and reconvene conference at earliest feasible date.

PART 2 – PRODUCTS

2.01 MATERIALS:

A. Metal Roofing System:

1. Whenever a particular make of material, trade name and/or manufacturer’s name is specified herein, it shall be regarded as being indicative of the minimum standard of quality required. A bidder who proposes to quote on the basis of an alternate material and/or system will only be considered if the proposed alternate is submitted on time and is documented as being equivalent or superior in quality to the specified system as described in these specifications. Additionally, all manufacturer and contractor/fabricator guidelines must be met as specified.

B. Panel Material:

1. Panel material: 24 ga., Galvalume steel, type AZ-55, grade 50 B, smooth as per ASTM A792-96.
2. Flashing, gutters, and flat stock material: Fabricate in profiles indicated on drawings of same material, thickness, and finish as roof system, unless indicated otherwise.
C. Finish on surfaces:
1. Exposed surfaces on Galvalume: Metal roofing, gutters, ridge caps, drip stiffener, and flashing components shall receive factory applied Kynar 500 paint finish. Color shall be as selected by Architect from Manufacturer’s standard or designer colors available.
2. Coating system shall provide nominal 1.0 mil dry film thickness, consisting of primer and color coat.
3. Color shall be as selected by Architect from manufacturer’s stock colors available and shall match preformed metal roofing color.

D. Characteristics:
1. Configuration: Standing seams incorporating mechanically interlocked, concealed anchor clips allowing unlimited thermal movement, and of configuration which will prevent entrance or passage of water.
   a. Panel/Cap configuration must have a total of four (4) layers of steel surrounding anchor clip for prevention of water infiltration and increased system strength designed to limit potential for panel blow-off.
   b. Profile of panel shall have mesa’s every ½” o.c. continuous throughout panel which are a minimum of 1.5” wide. These will absorb thermal stresses, reduce oil canning in panel and increase load carrying capacity.
   c. Exposed fasteners, screws and/or roof mastic is unacceptable and will be rejected. System configuration only allows for exposed fasteners at panel overlap (if required) and trim details (as per manufacturer’s guidelines).
   d. Panels must be furnished in continuous lengths from ridge to eave with no overlaps unless approved by manufacturer to length of run.
2. Seam must be 2-3/8” minimum height for added upward pressures and aesthetic appeal. Seam shall have continuous anchor reveals to allow anchor clips to resist positive and negative loading and allow unlimited expansion and contraction of panels due to thermal changes. Integral (not mechanically sealed) seams are not acceptable.
3. Concealed Anchor Clips: Clips must be 16 gauge, 40,000 p.s.i. (G-90 galvanized steel) ONE (1) piece clip with projecting legs for additional panel alignment and provision for unlimited thermal movement in each direction along the longitudinal dimension.
   a. Two-piece (2) clips are NOT acceptable.
   b. Clip design must isolate sealant in panel cap from clip to insure that no sealant damage occurs from the clip during expansion and contraction.
   c. Clip must maintain a clearance of a minimum of 3/8” between panel and substrate for proper ventilation to help prevent condensation on underside of panel and eliminate the contact of panel fastener head to panel.
4. Seam cap: Snap-on cap shall be a minimum of 1” wide “T” shaped of continuous length up to 45 feet accordingly to job condition and field seamed by means of manufacturer’s standard seaming machine.
   a. Cap shall be designed to receive continuous double bead of hot applied, foamed in place gasketing sealant which will not come in contact with the anchor clip to allow unlimited thermal movement of panel without damage to cap sealant.
   b. Sealant shall be non-fatigue, nitrogen injected water barrier.
5. Standing Seam Panel Width: 18”
6. Replaceability: Panels shall be of a symmetrical design with snap on cap configuration such that individual panels may be removable for replacement without removing adjacent panels.
7. Panel ends shall be panned at ridge, headwall, and hip conditions where applicable.

E. Accessories:
1. Gable anchor clips: Standing Seam styles galvanized minimum thickness 16 gauge.
2. Fasteners:
   a. Concealed fasteners: Corrosion resistant steel screws designed to meet structural loading requirements. The normal minimum screw size shall be #12.
3. Closures: Factory pre-cut closed cell foam meeting ASTM D3575-93 a cross-linked closed cell polyolefin foam, enclosed in metal channel matching panels when used at hip and ridge.
4. Panel joint (endlap) sealant: Non-curing modified isobutylene tri-polymer tape of thickness to fully adhere to both surfaces being joined with indicated service life of 30 years.

2.02 ACCESSORY PRODUCTS:
A. Sealant:
   1. Acceptable product:
      a. Concealed Application: PT1-707 or Bostik Chem-Calk butyl sealant.

B. Underlayment:
   1. The Garland Company, Rmer Seal or Equal.

2.03 FABRICATION:
A. Shop fabricate metal roofing, gutter, and flashing components to the maximum extent possible, forming metal work with clear, sharp, straight, and uniform bends and rises. Hem exposed edges of flashings.
B. Form flashing components and gutters from full single width sheet in minimum 10'-0" sections. Provide mitered corners, joined using closed end pop rivets and joint sealant.
C. Fabricate roofing and related sheet metal work in accord with approved shop drawings and applicable standards.

PART 3 – EXECUTION

3.01 PREPARATION:
A. Inspection: Examine the alignment and placement of the building structure and substrate. Correct any objectionable warp, waves or buckles in the substrate before proceeding with installation of the preformed metal roofing. The installed roof panels will follow the contour of the structure and may appear irregular if not corrected.
B. Establish straight side and crosswise benchmarks.
C. Use proper size and length fastener for strength requirements. Approximately 5/16" is allowable for maximum fastener head size beneath the panel.
D. Pre-roofing conference: Prior to beginning metal roofing work, a pre-roofing conference shall be held to review work to be accomplished.
   1. Contractor, metal roofing subcontractor, metal roofing system manufacturer’s representative and all other subcontractors who have equipment penetrating roof or whose work involves access to roof shall be present.

3.02 ROOFING AND FLASHING INSTALLATION:

A. All details will be shown on manufacturer’s shop drawings to successful bidder; install roofing and flashings in accordance with approved shop drawings and manufacturer’s product data, within specified erection tolerances.

B. Install a high temperature peel and stick underlayment over the entire wood deck surface.

C. Install 3” x 5” (16 gauge) pre-punched bearing plates with the 16 gauge one piece panel clips as necessary to provide even panel seam height. Bearing plates shall possess two pre-slotted holes and be fastened into the deck. Clip spacing are shown on Sheet K-A2.2

*See roof plan for extent of zones.
**This clip spacing must be followed to ensure integrity of the completed installation. These have been determined based on the uplift calculations for the specified roof and the test results of ASTM-E-1592.

D. Installation of Roof Panels: Roof panels can be installed by starting from either end and working towards the opposite end. Due to the symmetrical design of the specified panel system, it is also acceptable to start from the middle of the roof and work toward each end.

   1. A stainless steel pop rivet shall be secured through the anchor reveal of the panel leg and extend into the arms of the panel clip located at the ridge of the system. This is done at each arm of the clip along the ridge. The panel is then anchored at both sides of the clip.
      a. Be sure to capture all drilling debris during this operation with a rag or cloth placed on the panels at the drilling operation.

   2. The seam caps are shipped with two rolls of factory applied hot melt sealant located inside the caps. To install the caps, hook one side of the cap over the panel edge and rotate over the opposite panel leg. For ease of installation, start at one end of the panel and work toward the opposite end.

   3. A hand crimping tool is used to crimp the cap around the top of two adjacent panels.

   4. Caps shall then be permanently seamed with manufacturer’s mechanical seamer.

E. Isolate dissimilar metals and masonry or concrete from metals with bituminous coating. Use gasketed fasteners where required to prevent corrosive action between fastener, substrate, and panels.

F. Limit exposed fasteners to extent indicated on shop drawings.

G. Anchorage shall allow for temperature expansion/contraction movement without stress or elongation of panels, clips, or anchors. Attach clips to structural substrate using fasteners of size and spacing as determined by manufacturer’s design analysis to resist specified uplift and thermal movement forces.

H. Seal laps and joints in accordance with roofing system manufacturer’s product data.
I. Coordinate flashing and sheet metal work to provide weathertight conditions at roof terminations. Fabricate and install in accordance with standards of SMACNA Manual.

J. Provide temperature expansion/contraction movement of panels at roof penetrations and roof mounted equipment in accordance with system manufacturer’s product data and design calculations.

K. Installed system shall be true to line and plane and free of dents, and physical defects with a minimum of oil canning.

L. Form joints in linear sheet metal to allow for ¼” minimum expansion at 20'-0" o.c. maximum and 8'-0" from corners.

M. At joints in linear sheet metal items, set sheet metal items in two ¼” beads of butyl sealant. Extend sealant over all metal surfaces. Mate components for positive seal. Allow no sealant to migrate onto exposed surfaces.

N. Remove damaged work and replace with new, undamaged components.

O. Touch up exposed fasteners using paint furnished by roofing panel manufacturer and matching exposed panel surface finish.

P. Install expansion joints on all gutters exceeding 50'-0" long or a minimum of 1 per 12 units. SMACNA Figure 1-7- Butt Type gutter expansion joint.

3.03 CLEANING:

A. Clean exposed surfaces of work promptly after completion of installation. To prevent rust staining on finished surfaces, immediately remove filings produced by drilling or cutting.

C. Clean roofs in accordance with manufacturer’s recommendations.

D. Clean exposed surfaces of roofing and accessories after completion of installation. Leave in clean condition at Date of Substantial Completion for Project. Touch up minor abrasions and scratches in finish.

E. Touch up exposed fasteners using paint furnished by roofing panel manufacturer and matching exposed panel surface finish.

F. Remove all scrap and construction debris from the site.

3.04 FINAL INSPECTION:

A. Final inspection will be performed by a firm appointed and paid for by the owner in accordance with general requirements.

END OF SECTION
July 9, 1999

Engineering Report 96019-32-S

The Garland Company
R-MER SPAN RMS18
24 gage Steel Panel and Cap

Uplift Load Span Table

**Summary**

Allowable span tables were tabulated for the Garland Company R-MER SPAN RMS18, 24 gage steel standing seam roof panel under uniformly distributed negative (uplift) loads. The allowable spans were determined from full scale uplift tests in accordance with ASTM E1592 "Standard Test Method For Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference" at spans of 6'-0", 2'-6" and 1'-0". Intermediate span values were interpolated between tested spans. All allowable spans include safety factors as recommended in section F1 of the Cold Formed Steel Design Manual by the American Iron and Steel Institute.

Gerard J. Boyce, P.E.

Arthur C. Ivey, P.E.
INTRODUCTION:

Allowable span tables were tabulated for the Garland Company R-MER SPAN RMS18, 24 gage steel standing seam roof panel under uniformly distributed negative (uplift) loads. The span tables are typically used to determine the adequacy of roof panels to resist design wind loads. The allowable spans were determined from full-scale uplift tests in accordance with ASTM E-1592, "Standard Test Method For Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference". The tests included negative loads at spans of 6'-0", 2'-6", and 1'-0". Allowable spans were interpolated between tested spans. None of the spans were determined by extrapolation outside of the test values. Straight-line interpolation was assumed. Factors of safety were applied to all span values as recommended by the "Cold Formed Steel Design Manual" - 1989, by the American Iron and Steel Institute (AISI).

FACTORS OF SAFETY:

Different factors of safety were applied depending on whether the test roof failure occurred in the panel or the panel-to-clip connection. The clip-to-substrate connection was not a part of the test. All factors of safety were decreased to account for a one-third increase in allowable stress or strength for use with wind or seismic loads. These decreased factors of safety are generally not allowed in combination with other live load reductions. It is the responsibility of anyone using these span tables to determine the proper factor of safety for the particular application of this product under consideration. The span tables are based on the following safety factors:
CONNECTIONS:

AISI Section F1(b)(3) SF = 2.5

For Wind SF = 2.5 / 1.333 = 1.875

PANEL:

Based on yield or ultimate strength

AISI Section F1(b)(1) SF = 2.0 (dead load included in test)

For Wind SF = 2.0 / 1.333 = 1.5

SPAN TABLES:

The attached span tables present the allowable span for a three span continuous panel under varying negative uniformly distributed pressure
## Allowable Panel Span for Uplift Pressure

**The Garland Company R-MER SPAN RMS18**  
**Steel, 24 ga. (0.024")**

### Three Span Continuous Panel

<table>
<thead>
<tr>
<th>Test Data</th>
<th>Span</th>
<th>Test Pressure (psf)</th>
<th>F.S.</th>
<th>Wind Factor</th>
<th>Allowable Pressure (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6'-0&quot;</td>
<td>55.6</td>
<td>2.5</td>
<td>1.333</td>
<td></td>
<td>29.6</td>
</tr>
<tr>
<td>2'-6&quot;</td>
<td>86.3</td>
<td>2.5</td>
<td>1.333</td>
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<tr>
<td>67</td>
<td>1.65</td>
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</tbody>
</table>
THE GARLAND COMPANY, INC.
HIGH PERFORMANCE ROOFING AND FLOORING SYSTEMS
2070 STEEL DRIVE • TUCKER, GA 30084-5832
PHONE: (770) 908-1030 • FAX: (770) 908-2264
TOLL FREE: 1-800-M-METCO

UNDERWRITERS LABORATORY LISTING

Manufacturer: The Garland Co.
3800 East 91st Street
Cleveland, OH 44105
Listing Number: R18494
See UL Directories for Specific Information.

Wind Uplift Resistance

Category: Roof Deck Constructions (TGXX): Metal Roof Deck Panels (TJPV).
Test Procedure: UL 580 Rating: Class 90 Wind Uplift Resistance

Product/Construction Numbers:
R-MER Span (Steel or Aluminum): 268, 268A, 268B.
R-MER Span Batten (Steel or Aluminum): 269, 269A, 269B.
R-MER Loc (Steel): 362, 362A, 362B.
R-MER Seam (Steel): 280.

Flame Spread Rating

Test Procedure: UL 790 Rating: Class A
Deck: NC or C-15/32 Incline: Unlimited
Products: R-MER Span, R-MER Span Batten, R-MER Loc, R-MER Seam.

Fire Resistance Ratings

Test Procedure: UL 263 Rating: Up to 3 Hours
Products: R-MER Span, R-MER Span Batten, R-MER Loc, R-MER Seam.

Rated Assemblies:

George R. Jones
Engineering Manager

Joe Orlando
Metal Division Manager
**Project** | **DVC PAC Restrooms**  
---|---
**Roof Section** | **Upper Roof**  
**Sales Rep.** | **Joe Salazar**  
**County / Parish** | **Contra Costa**  

| Zone 1 (mid roof) | 18.1 | Zone 2 (eaves, ridge, hip) | 30.3 | Zone 3 (corners) | 45.7 |

| Zone 2' | | Zone 3' | |

**Edge Zone Width "a"** | 3 ft. | 0 in. |

**Safety Factor** | 1.67  
**Importance Category** | III  
**Importance Factor** | 1  
**Wind Speed (mph)** | 115  
**Ultimate Pullout Value (lbs/screw)** | 407  
**Exposure Category** | C  
**Design Roof Height** | 18.50  
**Minimum Building Width** | 17.00  
**Roof Pitch (X, Y)** | 0.625 : 12  
**Snow Load (psf)** | |

**Recommended Panel Clip Spacing:**  
**R-MER Span** | 18 in. | 24/24 GA Steel |

| Zone 1 | 4 ft. | 6 in. | Zone 2 | 2 ft. | 8 in. | Zone 3 | 1 ft. | 9 in. |
| Zone 2' | 0 ft. | 0 in. | Zone 3' | 0 ft. | 0 in. |

**NOTES:** Clip spacing based on attachment of clips into 1/2" plywood.

*Unless specifically stated otherwise on the R-MER SS Data Sheet, these calculations are based on ASCE 7-10 (American Society for Civil Engineers); if a specific building code is required, please specify.  
*It is recommended to include the "Negative Uplift Pressures" in the specifications as well as the Safety Factor, Importance Factor, Building Category, Wind Speed, Ultimate Pullout Value, and Exposure.  
*The Wind Speed is determined based upon geographical location.  
*The Exposure and Importance Factors are needed to determine the uplift pressures.  
*This roofing project has not been evaluated for additional loading due to roof mounted equipment and accessories including but not limited to mechanically attached photovoltaic modules, walkway systems, mechanical roof top units, etc. Future addition of roof mounted systems may require modification of the roof system described in these documents.

If you have any questions, please call 800-321-9336 or respond to engineering@garlandind.com
### Panel & Fastener Data

<table>
<thead>
<tr>
<th>PANEL TYPE</th>
<th>R-MER Span</th>
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<tbody>
<tr>
<td>PANEL WIDTH</td>
<td>18 in</td>
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<tr>
<td>PANEL/CAP MATERIAL</td>
<td>24/24 GA Steel</td>
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<tr>
<td>SUBSTRATE MATERIAL</td>
<td>Wood</td>
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<tr>
<td>SUBSTRATE THICKNESS</td>
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<td>FASTENER TYPE</td>
<td>Wood: Concealer #14-13 DP1</td>
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<tr>
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<td>FASTENER SAFETY FACTOR</td>
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<td>ULTIMATE FASTENER PULLOUT</td>
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<tr>
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### Building & Site Data

| BASIC WIND SPEED | 115 mph |
| EXPOSURE CATEGORY | C |
| TOPOGRAPHY FACTOR | 1.00 |
| BUILDING TYPE | Enclosed |
| ROOF PITCH (X, Y) | 0.625 12 |
| RUN TO RIDGE | 12 |
| EAVE HEIGHT | 18.5 |
| DESIGN ROOF HEIGHT | 18.50 ft |
| IMPORTANCE CLASS / FACTOR | III 1 |
| MIN. BLDG WIDTH | 17 ft |
| WIND-BORNE DEBRIS REGION | No |
| PARAPET | No |
| PROTECTED OPENINGS | Yes |
| ROOF TYPE | Monoslope |
| EXTREME THERMAL RANGE | 200 deg F |

### Roof Data

<table>
<thead>
<tr>
<th>ZONE 1</th>
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<td>EDGE ZONE WIDTH &quot;a&quot; =</td>
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SECTION 07 54 05

THERMOPLASTIC MEMBRANE ROOFING SYSTEM

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Single-ply roof system complying with California Title 24 (Cool Roofing) regulations as shown on the Drawings.

1.2 RELATED SECTIONS

A. Section 07 60 00 – Flashing and Sheet Metal

B. Section 07 90 00 – Sealants

1.3 SCOPE

A. Membrane and related items shall be classified by Underwriters Laboratories, Inc. as a Class A Sheathing Material for use in construction of Class A coverings and amendments. Wind: Factory (FM) 1-75.

1.4 APPLICATION

A. Duro-Last/Duro-Fleece (DLDF) membrane is composed of PVC film laminated to both sides of a weft insertion knitted scrim and laminated to fleece backing.

B. Install new single-ply, fully-adhered reinforced PVC roofing and PVC overlay systems, as shown on the Drawings.

C. Install new fully-adhered membrane flashings and associated components along walls, curbs, or as shown in the Drawings and as required to properly terminate the roof membrane.

D. Clean and restore all areas damaged, stained or otherwise affected by the Work.

E. Include Operation/Maintenance manual and PVC repair kit with instructional course as provided by the manufacturer for use by the Owner’s maintenance staff.

F. Attend a roof-related preconstruction meeting after the submittals were transmitted and prior to the start of Work. Required attendees are the Owner Representative, Engineer, Contractor, and Roof Manufacturer.
1.5 PHYSICAL PROPERTIES

A. The single-ply membrane shall allow installation at any time of the year and shall provide resistance to ultra-violet rays, superb tear and puncture strength, the ability to be impervious to most caustic chemicals and acids, and show no ill effects to heat or cold.

1.6 ROOFING CONTRACTOR’S QUALIFICATIONS

A. Contractor shall submit work history data showing successful warranted installation experience of the specified system, and of being authorized by the roofing system manufacturer to install the specified manufacturer’s materials.

B. The Contractor shall use adequate amounts of such qualified workmen to install the specified roofing system.

C. The Contractor shall have an experienced, pre-qualified, superintendent having experience installing the roof system specified, familiar with the requirements of this project, on the job at all times when roofing system work is in progress. Training for superintendent shall include certification of completion of manufacturer’s in-house training course and on-site training.

1.7 REQUIREMENTS OF THE MEMBRANE MANUFACTURER

A. Roofing system components shall conform to the current published specifications and details of the membrane manufacturer.

B. There shall be no deviation made from this specification without prior written approval of the membrane manufacturer and the Owner or Owner representative.

C. Any manufacturer proposing to supply material for this project shall within fourteen (14) days prior to bid date, provide financial information regarding their roofing company, i.e. a current D&B report. A manufacturer who has less than $50,000,000 in annual roofing material sales, a net worth of less than $3,000,000 or a history of late payments to creditors will not be permitted to submit their roofing material for use on this project. Manufacturer may be asked to submit an audited document listing the long-term warranty liability commitment of manufacturer.

D. Provide primary thermoplastic membrane factory prefabricated roofing system from a single manufacturer, which has successfully manufactured raw materials into specified products for not less than five (5) years. No secondary private labels will be accepted. Provide secondary materials, such as insulation, gypsum board, vapor barriers as recommended and approved by manufacturer of primary materials.

E. Products primary and secondary shall be manufactured in the United States of America.
by a company owned by citizens of the United States.

1.8 FIELD INSPECTION

A. The Owner reserves the right to retain, at the Owner’s expense, an independent inspection service to provide part-time or full-time inspection of the roofing system installation. The inspector shall have free access to the work area.

B. The Contractor shall arrange for the membrane manufacturer to provide inspection of the roofing system installation. Upon completion of the installation, an inspection shall be made by a Quality Assurance Specialist of the membrane manufacturer at no extra charge to the Owner or Contractor. The inspection is to confirm the roofing system is installed in accordance with the membrane manufacturer’s published specifications and details and Contract Documents.

1.9 DEFECTIVE WORK

A. Should the roofing system not be approved by the manufacturer’s technician, correcting the defective work shall be done by the Contractor until the roofing system satisfactorily meets all the specifications and manufacturer’s requirements. Corrective work shall be done with no additional expense to the Owner.

1.10 WARRANTIES

A. The Contractor shall warrant the roof application with respect to workmanship and proper application for two (2) years from the date of acceptance by the membrane manufacturer. Should any leaks covered under the warranty occur during this period, corrective action shall be taken by the Contractor to repair the roof to the satisfaction of the Owner and the manufacturer. All corrective work shall be done at no cost to the Owner.

B. The warranty shall be full roofing system repair and/or replacement fifteen (15) year warranty covering materials and labor. The warranty shall be a no-dollar limit type and provide for completion of repairs, replacement of membrane or total replacement of the roofing system at the then current material and labor prices throughout the life of the warranty. Warranty shall contain no exclusions for ponded water, biological growth, incidental or consequential damages.

C. Warranty shall be issued by the original manufacturer of the roofing membrane. No private label membranes will be accepted.

D. No future work shall be done on the roof, including but without limitations, openings made for flues, vents, drains, sign braces, or other equipment fastened to or set on the roof, without prior notification of the Contractor or membrane manufacturer. Contractor or membrane manufacturer shall be given the opportunity to make the necessary roofing application recommendations, and require such recommendations to be
complied with. Failure to observe this condition can render the warranty null and void.

E. Corrective measures on leaks shall be undertaken within seventy-two (72) hours after Owner notification has been received by the Contractor or the roofing manufacturer from the Owner.

1.11 SUBMITTALS

A. The contractor shall submit the following:

1. Written confirmation from membrane manufacturer of approved applicator status and that the Contractor is qualified for the specified warranty.

2. Manufacturer literature and MSDS sheets for the items listed in Part 2.

3. Submit 6 in. long samples of the following items for approval prior to ordering:
   a) Pre-manufactured pipe flashing
   b) Termination bar
   c) Sample of membrane
   d) Mechanical fasteners and metal distribution plates
   e) Lap splice sample (factory and field)
   f) Roofing insulation

4. Shop drawings including outline of the roof and roof size, perimeter and penetration details, special details and section layout, location of factory dielectric and field welds, accessory and material list.

5. Pullout Tests: Perform pullout tests and submit engineering results of manufacturer's random location pull tests. Manufacturer shall obtain at least two (2) pull resistance tests from indicated locations of a sections of decking, where integrity is in question. Submit pull test results with drawing indicating the locations of the tests. Engineering results shall demonstrate the manufacturer's reasons for selection of anchorage, frequency and the seaming patterns.

6. Membrane Data: Prior to receipt of bids, Contractor shall submit all forms and other required data to roofing system manufacturer for pre-approvals. Advise building Owner or Owner Representative in writing of any recommendations made or revisions required by manufacturer to particular job conditions. In the absence of any comments, the Owner and/or his representative shall assume the manufacturer's most recently published specifications shall be followed.

7. Provide Operations/Maintenance manual and repair procedures to the Owner
and/or Owner’s representative.

B. INSULATION

1. The Contractor shall verify dimensions and existing roof penetration locations to ensure proper layout and tapered insulation quantities. Submit a tapered insulation layout drawing (full size: 24 inch x 36 inch) from the insulation manufacturer. The drawing should include an outline of the roof area and locations of drains and major roof penetrations (i.e., smoke hatches and fan units). Provide a profile of tapered sections; indicate minimum and maximum thicknesses at perimeters, for the proposed insulation system.

2. Submit certification from each insulation manufacturer stating the roof membrane manufacturer for the specified warranty accepts the submitted products.

1.12 PRODUCT DELIVERY, STORAGE AND HANDLING PROCEDURES

A. Deliver materials in original unopened packaging.

B. Containers labeled with manufacturer’s name, brand name, and identification of various items.

C. Store materials in a dry area and protect from inclement weather. Damaged materials shall be replaced at contractor’s expense.

D. Do not allow roofing membrane to come in contact or be exposed to any materials that would be detrimental to or cause degradation of the roofing membrane.

1.13 JOB CONDITIONS

A. Environmental Conditions

1. In making field heat welds, make sure all welding surfaces are clean and free of moisture or foreign items.

2. Weather Precautions: Proceed with roofing work when existing and forecasted weather conditions permit work performance in compliance with manufacturer’s recommendations.

3. Roofing system shall not be applied when the surrounding air, surface temperature, relative humidity or wind velocity is not within the range acceptable under the manufacturer’s recommendations.

B. Protection

1. Prior to starting work, protect all work in an approved manner including all paving and faces of building walls. Provide special protection of the face of the building wall adjacent to hoist.
2. Complete the whole roofing section or any portion of the roof in a single day to avoid exposure to rain, dew, or moisture of any kind. If rain threatens during the day or in an emergency, protect the unfinished exposed roofing components and provide temporary water cut-offs around exposed edges and incomplete flashing areas.

3. All hoisting equipment shall bear on solid pad blocking. If on the roof surface, pad shall be large enough to evenly distribute the load to avoid crushing insulation and roof system. Pad shall consist of two separate layers of material to eliminate vibration and movement to directly affect the roofing membrane. Pad shall be of sufficient size to accommodate work tools and weights used around hoisting operations.

4. Repairs: Clean or repair surfaces damaged or soiled by operations under this contract to the satisfaction of the Owner or Owner’s representative without additional cost to the Owner. These would include, but not be limited to, windows, doors, floors, walls, stairs, elevators, steps, walks, curbs, lawn areas, or other roofs.

PART 2 – MATERIALS

2.1 ROOF MEMBRANE

A. A special formulated, permanent, thermoplastic alloy, bonded to a high tenacity, low shrinkage weft inserted polyester fabric with resistance to ultraviolet rays, microorganisms and impervious to most caustic chemicals.

B. Membrane shall be factory dielectrically welded, prefabricated sheets up to 2,500 square feet or as determined by job condition.

C. The new roofing shall be a prefabricated fully adhered installation of single-ply reinforced co-polymer alloy (CPA) membrane. Product: 60 mil thick fleece-back membrane by Duro-Last Corporation or approved equal. Manufacturer’s physical specifications and minimum performance criteria shall be in accordance with the following table.

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<tr>
<th>Physical Property</th>
<th>Test Method Used</th>
<th>Specification Requirements</th>
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<tr>
<td>Minimum Thickness</td>
<td>ASTM D-751</td>
<td>0.060 inch (60 mils) Nominal (with fleece)</td>
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<tr>
<td>Tear Strength,</td>
<td>ASTM D-751 – Procedure B</td>
<td>50 x 200 lbf.</td>
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<tr>
<td>Breaking Strength</td>
<td>ASTM D-751 – Grab Method</td>
<td>554 x 408 lbf.</td>
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<tr>
<td>Elongation at Break</td>
<td>ASTM D-751 – Grab Method</td>
<td>34%</td>
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<td>Low Temperature Bend</td>
<td>ASTM D-2136</td>
<td>no cracks, -40 degrees F</td>
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<td>Static Puncture</td>
<td>ASTM D 5602</td>
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<tr>
<td>Property</td>
<td>Specification</td>
<td>Result</td>
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<tr>
<td>--------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
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<tr>
<td>Water Absorption</td>
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<td>Linear Dimensional Change</td>
<td>ASTM D1204 – 6 hrs. @176°F</td>
<td>-0.10%</td>
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<td>Accelerated Weathering</td>
<td>ASTM G 154 (Formerly G53)</td>
<td>No cracking, checking, crazing, or erosion at 5000 hours of exposure.</td>
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<tr>
<td>Factory Mutual Research</td>
<td>ASTM E-108; FM 4450 &amp; FM 4470</td>
<td>Rated 1-75</td>
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<tr>
<td>Underwriter's Laboratory</td>
<td>UL-790</td>
<td>Class A, B and C approved</td>
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<tr>
<td>scrim: Weft Inserted Polyester</td>
<td>-</td>
<td>18 x 9, 1000 denier</td>
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</tbody>
</table>

D. Membrane Adhesive: Duro-Last WB II or approved equal (for only Duro-Last membrane at walls).

E. Fleece Membrane Adhesive: Duro-Fleece CR-20 or approved equal (for only Duro-Fleece membrane at roof deck and at walls).

F. Underseal Adhesive: Duro-Last SB 240 or approved equal – trowelable mastic.

G. Perimeter Flashing Adhesive: Duro-Caulk Advanced.

H. Slip Sheet: Atlas FR-50 or approved equal

I. Manufacturer

1. Manufacturers requesting approval must submit acceptable information certifying that they are the direct manufacturer from raw material into specified membrane, factory prefabricate the membrane into roofing panels if any, and meet the performance and financial criteria required.

2. Fire resistance of CPA roofing system shall meet UL Class A. All packaging of membrane and insulation shall bear UL Class A label.

3. Membrane color shall be white.

2.2 MATERIALS

A. Membrane-Related Materials

1. All membrane components, including pipe and curb flashings, shall be factory prefabricated from the same fabric reinforced material used for the deck membrane.

2. Termination Sealant: Compatible with materials to which membrane is to be bonded, conforming to Federal Specifications TT-598 and TT-S-00230C as furnished by the membrane manufacturer.

3. Distribution Plates: Factory Mutual approved stress distribution plates formed from a minimum 24 gauge, G-90 C.Q. steel with a galvalume coating for cover
board, insulation and membrane attachment.

4. Water Cut-Off Mastic: Compatible with materials with which it is used and furnished by the membrane manufacturer.

5. Fasteners: Compatible with roof deck as furnished by the membrane manufacturer. Fasteners shall be furnished by the membrane manufacturer and be Duro-Coated Duro-Last HD #14 and must pass 30 cycles in the Kesternich Cabinet, DIN #50018-2 Liter. The FM approved fastener is inserted through the hole in the distribution plate and properly secured to the roof deck.

6. Terminus/Everdetails: Shall be manufactured from rigid exterior vinyl with slotted holes for securement and furnished by membrane manufacturer. All other terminations/edge details must be approved and warranted by the membrane manufacturer.

7. Termination Bars: Duro-Last or approved equal.

8. Pourable Sealer: Duro-Last Pitch Pocket Filler or approved equal.

2.3 COVERBOARD & INSULATION

A. Cover Board: Board shall be a minimum of 1/4 inch thick by 4 feet by 8 feet. Dens-Deck Prime roof board by Georgia Pacific or approved equal – at roof decks. 1/2 inch thick 4 feet by 8 feet Dens-Deck roof board – at walls.

B. Tapered and Flat Stock Insulation: A rigid isocyanurate board with factory-applied fiberglass bituminous felts on both sides. Conforming to HH-I-530A (Type II, unfaced) and C1289-02, Type II, Class 1, Grade 2 with an average density of 2.0 lbs. per cubic foot. Manufacturer: DuroLast, Duro-Guard Polyisocyanurate ISO II or an approved equal flat and tapered panels. The board size: 4 foot by 8 foot, ¼ in. per foot slope for tapered insulation.

2.4 MISCELLANEOUS

A. Roofing Nails: Stainless Steel “Stronghold” type: (for use on parapet walls, wood nailers).

B. Pipe Clamps: Stainless steel draw band clamps.

C. Fasteners and Accessories
1. Fasteners for securement of each layer of gypsum fire barrier board under pvc roof system through the isocyanurate insulation (where applicable) and into the wood deck shall be fluorocarbon-coated, No. 14 self-drilling, self-tapping screws, long enough to penetrate the receiving substrate 1-¾ inches minimum and 1-½ inches maximum. Fasteners shall be in conformance with FM 4470 specifications.

2. Provide screws with stress distribution plates by Duro-Last, minimum 0.024 inch thick, 3 inch square plate.

D. Nailers & Blocking

1. Blocking/Lumber: Grade #2 Douglas Fir with 19% moisture content max conforming to standard 15 grading and dressing rules of the West Coast Lumber Inspection Bureau, or other species of wood of equal strength. All lumber shall be grade marked at the mill and pressure treated by a method approved by the roofing membrane manufacturer: “Wolmanized” or “Osmose K-33” is acceptable.

2. Nailer Fasteners: Nailers shall be securely anchored to the deck to resist the minimum force required in the recent edition of Loss Prevention Data Sheet I-49, “Perimeter Flashing,” Factory Mutual Systems, for FM 1-75, fasteners spacing must be 4 inches o.c. maximaum. 16 d common nails must be minimum size fasteners.

3. PVC(Vinyl)-Clad Metal Flashing: GSM flashing coated on one side by membrane manufacturer with weldable, PVC-clad surface or pre-manufactured with factory/shop welded piece of membrane pre-welded to surface by membrane manufacturer.

4. Other Accessories: Shall be furnished and approved by the membrane manufacturer.

PART 3 – EXECUTION

3.1 SUBSTRATE INSPECTION AND PREPARATION

A. Inspect all surfaces to receive roofing for condition that will adversely affect execution, performance.

B. All roof surfaces and all sloped surfaces to gutters and outlets shall be checked and approved by the roofing contractor prior to the start of the roofing work.

C. Install roofing material only under satisfactory conditions as specified by the membrane manufacturer.
D. Scheduling: Schedule the roofing work in areas and sections in such a manner as to keep the new and existing insulation, roofing materials, and building dry and watertight during new roofing work.

E. Damage sustained to the facility or contents as a result of the scheduling of roofing work shall be the Contractor’s responsibility.

F. Preparation shall comply with the membrane manufacturer’s recommendations.

G. Mechanically secure separation material units to roofing deck independent of membrane attachment and cover immediately with membrane. Butt units tightly together, limiting joint separation to 1/8 inch, maximum. Meet attachment pattern requirements of the membrane manufacturer.

H. Prior to insulation installation, remove all dirt, debris and dust from deck surfaces with a vacuum. Insulation systems shall be installed on properly installed, clean, dry surfaces. Should surface moisture such as dew exist, the Contractor shall provide the necessary equipment to dry the surface prior to application. Do not dry with open flames.

I. Inspect insulation boards for defects, including but not limited to: broken corners, improperly adhered skins, excessive moisture content, dimensional irregularities, or other defects which may adversely effect the replacement roof system. Mark defective insulation boards and remove them from site.

J. Cut insulation to the minimum dimension of 12 inches; the minimum surface area shall be 2 square feet.

K. Do not deliver to site or install any material or system that has not been approved. Materials installed without approval may be required to be removed. All containers must bear the label and material classification of the manufacturer. Partially used containers and unlabeled containers may not be incorporated into the work.

L. Comply with the manufacture’s written instructions and these specifications. In case of discrepancies, the greater quantity and/or better quality of work, as determined by the Owner, will be provided by the contractor at no additional cost.

M. Flashings shall be installed concurrently with the roof membrane to assure watertight terminations.

N. Do not cut any material with a solvent or dilutant unless approve by the owner in writing.

O. Keep covers tightly sealed on all canned and evaporative products to prevent premature curing.

P. Report any damaged or unsuitable deck sections immediately to the Owner’s
representative prior to covering and replacing.

Q. The contractor shall ensure that all applicable safety requirements are strictly followed. This includes OSHA, CALOSHA and other applicable requirements regarding work with construction equipment for workers and building occupants.

R. Welded seams shall be checked after cooling for continuity with a dull, flat head screwdriver or other suitable object. Daily, on-site evaluation of welded seams shall be made by the Contractor at locations as directed by the Owner's representative or membrane materials representative. Two inch wide cross-section cuts shall be taken through completed seams. Correct weld displays failure from shearing of the membrane prior to separation of the weld. Each test cut cross-section area shall be patched by the Contractor at no extra charge to the Owner.

S. Membrane specified to be fully adhered to insulation and various other horizontal and vertical substrates must be adhered completely without voids, bridging of membrane or unattached membrane.

3.2 GENERAL REQUIREMENTS

A. Precautions

1. Do not lay out or expose insulation that cannot be covered by membrane on the same day.

2. In making field heat welds, make sure edges are clean and free of tar, mastic or other foreign items.

3. Do not expose membrane and accessories to a constant temperature in excess of 120 degrees Fahrenheit.

4. Sealants and adhesives should be applied according to the manufacturer's specifications and all containers shall be disposed of properly.

5. Start securing the membrane at the highest point and work towards the drains.

6. Storing, wheeling, or trucking directly on roof insulation or membrane surface is not recommended. Smooth, clean plywood or plank walkways, runways and platforms shall be provided as necessary.

B. Comply with local, state, and federal regulations regarding the removal and disposal of roofing materials.

C. Roofing shall not be applied when ambient temperature is less than 40° F or more than 100° F. Materials which have a temperature other than the recommended application
temperature by the manufacturer shall not be installed.

D. Surfaces to receive membrane or flashings shall be thoroughly dry. Should surface moisture such as dew exist, the Contractor shall provide the necessary equipment to dry the surface prior to application. No open flames will be allowed.

E. Completed roof areas shall not be trafficked. Work shall be coordinated to prevent this situation by working toward the roof edges and access ways. Should access to completed roof areas be necessary, the Contractor shall provide (membrane covered) plywood protection for the trafficked areas.

F. Temporary waterstops shall be installed at the end of each day’s work, and shall be removed before proceeding with the next day’s work. Waterstops shall be compatible with all materials and shall not emit dangerous or incompatible fumes.

G. The Contractor is cautioned that thermoplastic membranes are incompatible with oil-based and asphaltic-based cement. Creosote and penta-based materials are also incompatible. The Contractor should consult the manufacturer with respect to material compatibility and shall provide protection against contamination of PVC membrane and flashings.

H. The Contractor shall provide necessary temporary protection and barriers to segregate the work area and to prevent damages to adjacent areas.

I. Prior to and during application, dirt, debris and dust shall be removed from surfaces either by vacuuming, sweeping or similar methods.

J. Liquid materials such as solvents and adhesives shall be stored and used away from open flames, sparks and excessive heat.

K. The Contractor shall be a licensed and approved applicator recommended by the manufacturer of the roof system specified. The Contractor shall notify the manufacturer prior to initiating the construction. It is the responsibility of the Contractor to arrange for the membrane manufacturer’s technical representative to be on site when construction commences and a minimum of once per week until construction is completed. The Owner and Owner’s Representative should be notified of scheduled visits so that they may attend.

L. The building will be open to normal use during the time of construction. The Contractor shall take all precautions to create as little disruption as possible during the course of the work.

M. The Contractor shall provide and equip as many work crews as is necessary to complete the project within the Contract period and according to the Contract Specifications without sacrificing quality.

N. The Contractor shall closely follow adhesive application rates when adhering membranes and flashings. The contents within adhesive containers shall be thoroughly mixed prior to
application. Submit adhesive container tags to the Owner’s Representative on a daily basis.

3.3 INSULATION INSTALLATION

A. Tapered Insulation (Roof Replacement Only)

1. Insulation shall be installed mechanically attached to the deck per drawings. Comply with FM I-75 rating and have minimum ¾ in. per foot slope.

2. Insulation shall have a maximum dimension of 4 feet by 8 feet

3. The insulation shall be staggered 50% from row to row.

4. Butt each insulation board firmly to the adjacent board. Do not jam insulation boards or allow cracks between insulation boards.

5. Cut boards to allow a maximum ¾ in. gap away from vertical surfaces.

6. Mechanical attachment may be done through roof cover board.

B. Crickets (Roof Replacement and Roof Overlay)

1. Install cover board over tapered isocyanurate insulation. Crickets shall be constructed to ensure a minimum slope of 1/2 in. per foot along the valley towards the drainage point.

2. Butt each insulation board firmly to the adjacent board. Do not jam insulation boards or allow cracks between insulation boards.

3. Cut boards to allow a maximum ¾ in. gap away from vertical surfaces.

3.4 COVERBOARD INSTALLATION (Roof Replacement and Roof Overlay)

A. Cover Board Installation

1. Cover board shall be installed mechanically attached and through insulation and/or existing roofing to the structural deck.

2. Cover boards shall have a maximum dimension of 4 feet by 8 feet.

3. The cover boards shall be staggered 50% from row to row.

4. Butt each cover board firmly to the adjacent board. Do not jam cover boards or allow cracks between cover boards.

5. Cut boards to allow a maximum ¾ in. gap away from vertical surfaces.
3.5 MEMBRANE INSTALLATION

A. Layout

1. Select the proper factory marked rolled sheet of roofing membrane for an outside corner or high point.

2. Orient the roofing membrane so the membrane long seams are running perpendicular to the direction of roof slope.

3. When laying out, pull the membrane tight.

B. Roof Sections

The intent of this Specification Section is to provide the Owner with a fully adhered membrane, 100% bonded to the substrate.

1. Ensure all bituminous substances and contaminants of the original system are removed or covered with slip sheet mechanically fastened to existing substrate at walls/curbs and adhered at roof deck. Clean flashings, etc., of all bitumen residue.

2. Install membrane system in accordance with the recommendations and requirements of the membrane materials manufacturer, as amended in these Specifications.

3. Duro-Fleece CR-20 membrane adhesive shall be used as the contact adhesive for the roof membrane.

4. Solvent-based adhesive, specially formulated for vertical surfaces, shall be used as the contact adhesive for flashings installed.

5. Inspect surface of roof cover boards prior to installation of roof membrane. Surfaces shall be clean and smooth with no excessive surface roughness. Contaminated surfaces or unsound surfaces shall be cleaned and voids shall be filled.

6. Over the properly installed and prepared gypsum fiberglass mat fire barrier board substrate, the adhesive shall be sprayed onto substrate only at a rate as recommended by the membrane manufacturer. Apply the adhesive in an even coating with no globs, puddles, or similar irregularities. Allow the adhesive to dry slightly but not completely.

7. The membrane shall be carefully unrolled into the wet adhesive. The adhesive shall be spread and the membrane rolled out until the entire roll has been set into adhesive. The membrane shall be pressed firmly in place with a weighted foam covered lawn roller by frequent rolls in two directions. Lap the adjacent sheets a
minimum of 3 inches. **Note that adhesive shall not be applied in seam areas.**

C. Field Welding

1. Weld adjacent sheets in accordance with the manufacturer's written instructions. Both sides and end lap joints shall be hot-air welded. Hand welded laps shall be 4 inches wide minimum; machine welded laps shall be 3 inches wide minimum. Sheets must be welded immediately after installation.

2. Use welding equipment provided by the membrane materials manufacturer. All technicians shall successfully complete a course of instruction provided by the roof membrane manufacturer's representatives prior to welding. All weld surfaces must be clean and dry. **No adhesive or other contaminant shall be present within the lap areas.**

3. Hand welded seams shall be completed in three (3) stages. Warm up equipment for at least one (1) minute prior to welding.
   
   a. Tack weld the lap every 3 feet to hold seam in place.
   
   b. Weld the back edge of the lap with a thin, continuous weld to prevent loss of the hot air during the final weld.
   
   c. Insert the hot air nozzle into the lap, keeping the welding equipment at a 45° angle to the side lap. Once the material starts to flow, apply the hand roller at a right angle to the welding gun and press lightly. For straight laps, use the 1-1/2 inch wide nozzle. Correct weld speed will complete approximately 20 inches per minute. The hot air weld equipment shall have temperature adjustments to provide this proper speed and weld.

4. Alternately, an automatic lap welding machine may be used. Follow the manufacturer's strict requirements, instructions and local codes for electric supply, grounding and over current protection. The automatic weld machines power requirement is 218 to 230 volts at 30 amps. The availability of this voltage shall be verified at the work site on the roof before using the automatic welding machine. The use of portable generators is recommended. Prior to utilizing the automatic weld machine on the roof, detailed instructions and operating procedure shall be obtained from the membrane manufacturer's technical representatives.

5. Terminate the membrane at perimeters and penetrations once welding of adjacent sheet seams is completed. Membrane shall be terminated with the manufacturer's recommended metal termination bar fastened at 6 inches (maximum) on center.

6. Flashings shall be installed concurrently with the roof membrane in order to achieve a watertight condition as the work progresses. When a situation arises where a break in the day's work occurs in the central area of a roof, a temporary waterstop shall be constructed to provide a 100% watertight seal utilizing a raised temporary...
waterstop. Sweep back and totally clean a 6 inch edge along the existing roof and set a 2 inch x 4 inch stud atop the prepared area in roof cement. Carry the new membrane up and over 2 inch x 4 inch waterstop. Seal the edge of the membrane in a continuous heavy application of water cut-off mastic. Weight the membrane down in the sealant with a 2 inch x 10 inch wood member with ballast on top. Ballast should be approximately 20 pounds per linear foot. When restarting work, remove all sealant, membrane, insulation fillers, etc. from the work area. Do not reuse any of the temporary cut-off material in the new work. Cut off contaminated membrane and dispose of immediately. If inclement weather occurs while a temporary waterstop is in place, the Contractor shall provide the labor necessary to monitor the situation to maintain a watertight condition.

7. Inspect all field welds with a probe. Re-weld loose laps at the end of each workday.

D. Perimeter Nailing and Around All Types of Penetrations Fastening

1. The membrane shall be mechanically fastened at all roof perimeters, parapets, curbs, walls, penetrations, in accordance with the Contract Documents and roofing manufacturer's specifications and details, but not less than 1 fastener per every 12 inches of length.

E. Cut-Outs

1. Make cut-outs in roofing membrane for protrusions through the roof. Some situations might require that the deck membrane be slit to the section edge for fitting around protrusions.

2. Fasten around cut-outs with approved fasteners (see Section 2.02 Materials), 12 inches on center or a minimum of one per side.

F. Membrane Flashings

1. All flashings shall be installed concurrently with the roof membrane as the job progresses. No temporary membrane flashings shall be allowed without the prior written approval of the Owner. Approval shall only be given for specific locations on specific dates.

2. Follow the manufacturer's requirements and these Specifications. Ensure that shop drawings and material submittals have been approved.

3. Fully adhere polyester slip sheet at specified locations as detailed. Ensure that felt isolates bituminous products (new and existing) from new PVC flashings.

4. Wall flashings shall be fully adhered to the plywood/wood substrates or roof Dens-Deck boards, where occurs on walls using a solvent-based adhesive. Cut the
Membrane in six (6) foot long sections. Apply adhesive at walls to both substrate and membrane at rates per membrane manufacturer 50-60 square feet. Do not apply adhesive in lap areas. Allow the adhesive to become tacky when touched with a dry finger on both surfaces. The product on the membrane cannot be permitted to dry completely. The coated membrane shall be rolled onto the coated substrate being careful to avoid wrinkles. Adjacent sheets shall be overlapped 3-inches. Bring the top of the membrane up and over the parapet wall or wood blocking and secure with annular ring nails as shown in the contract drawings. The wall flashing membrane shall extend 4 inches onto the root membrane.

5. Membrane flashings shall be hot-air welded at their seams and at their connections with the adhered roof membrane or membrane clad metal flashings.

6. Vent pipes shall be flashed to the top of the pipe. Asphalt contaminated vent pipes which cannot be thoroughly cleaned shall be wrapped with aluminum tape prior to the installation of membrane flashing. Field or shop fabricated pipe caps of the PVC membrane shall be installed as shown in the detail drawings. Provide stainless steel pipe clamp (drawband) terminations at all locations.

7. Membrane termination shall be flashed in with reinforced membrane. Termination bars shall be utilized as detailed in the contract drawings. Set termination bars in a bed of sealant with fasteners spaced at 3 inches on center.

8. All perimeter edge termination details must include sealant.

3.6 SPECIAL REQUIREMENTS

A. Do not apply adhesive in lap areas.

B. The applicator shall keep track of the amount of adhesive used to confirm required by manufacturer adhesive rate.

3.7 CLEAN-UP

A. Upon completion of the membrane installation, the Contractor shall remove all foreign matter, rubbish and scrap material from the roof.

B. The membrane surface shall be cleaned using cleaners recommended by the membrane manufacturer.

3.8 INSPECTION & WARRANTY

A. Inspection: The Contractor shall submit all required drawings, details, and completed questionnaires to the roofing manufacturer before obtaining the specified warranty. After the authorized Manufacturer has inspected the roof for determining acceptability for warranty issuance, deficiencies on the final inspection report shall be corrected by the Contractor and made ready for reinspection within five (5) working days.
B. Warranty: Upon receipt of required materials, certifying inspection, and acceptance of the roofing system by the roofing manufacturer, the warranty shall be duly executed and issued to the Owner.

3.9 REPAIRS

A. Future repairs or additions to the roofing system shall be made using the heat welding process.

B. Contractor shall provide repair procedures to the Owner and/or Owner’s representative.

3.10 CONSTRUCTION DAMAGE

A. Upon completion of work, repair or replace as required, building materials damaged as a result of the roofing operations. Match existing materials and construction as determined by the Owner.

END OF SECTION
SECTION 07 60 00
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sheet metal flashings shown on the Drawings

1.2 RELATED WORK

A. Section 07 54 00 — Thermoplastic Membrane Roofing System
B. Section 07 90 00 — Sealants

1.3 REFERENCES

A. ASTM A153 — Zinc Coating Hot-Dip Galvanized
C. MIL-S-687ZB — General Specifications for Soldering Process
D. AWS D1.1 — Structural Welding Code

1.4 SUBMITTALS

A. Submit three (3), 6 inch by 6 inch samples, of each type and thickness of sheet metal to be used in the construction.
B. Submit three (3), samples of gutter assembly and flashings to be used in the construction.
C. Submit shop drawings with dimensions of all sheet metal details.
D. Submit mill certification.
E. Submit manufacturer literature for all accessory items in Part 2 of this Section.

1.5 STORAGE

A. Stack performed material to prevent twisting, bending, or abrasion, and provide ventilation.
B. Prevent contact with materials during storage, which may cause discoloration, staining or damage.
PART 2 - PRODUCTS

2.1 SHEET MATERIALS

A. Sheet Metal
   1. 22 gauge galvanized steel: ASTM A123 and A525.

B. Steel bars
   1. ASTM A36.

C. Vinyl Coated Drip Edge: 24 gauge galvalume with PVC coating by Duro-Last.

2.2 FINISHES

A. Not applicable.

2.3 ACCESSORIES

A. Fasteners
   1. Sheet Metal-to-Wood Blocking: No.12, 1-1/2 inch minimum long Stubbs stainless steel nails, annular-thread shank at 24” O.C.
   2. Sheet Metal-to-Sheet Metal: No. 10, 1 inch long stainless steel sheet metal screws with metal capped neoprene washers per SMACNA.
   3. New Flashing-to-Existing: Stainless steel pop rivets, spacing per SMACNA.
   4. Unistrut: 3/8 inch diameter lag bolts, 3 inch long minimum.

B. Solder
   1. 50% tin and 50% lead.
   2. Flux: ASTM B32

C. Sealant and Backer Rod
   1. Refer to Section 07 90 00 – Sealants.

D. Miscellaneous
   2. Cold galvanized compound: Zinc-rich, spray-applied compound.

2.4 FABRICATION SCHEDULE
A. All sheet metal to be 22 gauge galvanized steel unless noted below.

2.5 FABRICATION
A. Form sections true to shape, accurate in size, square and free from distortion or defects.
B. Form pieces to maximum length of 8 feet.
C. Mechanically fasten and solder watertight joints, splices and transitions which are not designed for expansion/contraction.

1. Fasten metal for strength and watertightness by solid riveting, welding or forming double lock seams.
2. Sealing for water tightness by soldering: after soldering, immediately remove all traces of acid or flux with appropriate neutralizer, followed by repeated washing and scrubbing.
3. Sealant-filled joints may not be substituted for solder joints: Use sealant as indicated on the Drawings.
D. Do not fabricate any sheet metal components without approved shop drawings and fabrication samples.

PART 3 - EXECUTION

3.1 INSPECTION
A. Field measure site conditions prior to fabricating Work Notify Architect/Engineer immediately of any inconsistency between existing conditions and the drawings.
B. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION
A. Allow substrates to dry thoroughly. Do not proceed with flashing application if moisture content of exposed wood supporting metal flashing is above 19%.
B. Clean debris from all substrates.

3.3 INSTALLATION
A. General
1. Proceed with sheet metal installation in conjunction with roofing and flashing in each area.

2. Do not dilute primers, coatings, or sealants.

3. Keep containers closed except when removing materials from them.

4. Field fabricate sheet metal following the same criteria set forth in Paragraph 2.05 – FABRICATION.

5. Except as otherwise specifically shown on the Drawings or approved shop drawings, conform to the drawing details included in the SMACNA manual.

6. Comply with Military Specification MIL-S-68728 entitled, "General Specifications for Soldering Process" when forming soldered joints. Use conduction soldering methods. Areas to be joined shall be cleaned of all oil, grease, pencil marks, paint, dirt or other foreign substances. Remove all burrs using files, grinding stones or other methods. Hold parts in place using clamps, jigs and supports or by self-fixturing. If parts are tack-soldered to hold them in place, the area of tack-soldering shall be reworked into the final soldering. Parts cannot be allowed to move during the soldering process.

7. All corners, transition and termination pieces shall be mechanically fastened and soldered to provide strength and a weatherproof connection.

8. Apply sealant over the head when using pop rivets for fastening.

9. All sheet metal edges shall be hemmed 1/4 inch minimum.

10. Roof deck flanges shall be 4 inches wide minimum.

11. Roof flanges shall be nailed 3 inches on center staggered.

12. Flash all roof flanges (top and bottom) in accordance with this Specification.

13. Flux shall be applied to all surfaces that will receive solder. Flux-cored solder shall not be used. Flux shall be fluid when heated and be effective in removing oxides and other impurities from the joint. Flux should be readily displaced by the molten solder.

14. Areas to be joined shall be heated above the liquious temperature of the solder. To deliver maximum heat, the copper bit of the soldering iron shall be applied at the right angle so that the flat side of the iron's bit provides maximum contact area. Solder shall be applied to the joint and not the bit of the iron. Allow solder to flow in place to provide a minimum 1 inch final width of solder over the joint. Joint shall not be disturbed until it has been allowed to completely cool. After soldering, completely remove all flux and acid by washing and scrubbing with a neutralizing agent.
B. Hook Strips/Cleats

1. Hook strips/cleats shall be formed with a 3 inch face and a 3/4 inch kick, bent out at a 60˚ angle to the face (or 30˚ to the wall).

2. Secure continuous hook strips/cleats to wood nailers with nails spaced at 6 inches on center.

3. Provide 1/8 inch gap at butt joints between hook strip/cleat sections.

C. Securement Clips

1. Securement clips shall be 6 inches long, 2 inches wide, and hemmed along each side of the long dimension.

2. Secure these clips to substrate with specified fasteners. Use a minimum of two (2) fasteners per clip and use 2 clips minimum. Space clips 32” o.c. maximum.

3. Bend clips a minimum of 1 inch over bottom drip edge of counterflashing and crimp tightly.

D. Counterflashing

1. Install counterflashing in accordance with approved shop drawings and manufacturer’s product data to comply with specified performance requirements. Reglet and counter flashing components shall be true to line, without buckling, creasing, warp or bind in finished surfaces.

2. Coordinate counterflashing at roof surfaces with roofing work to provide weather tight condition at roof terminations.

3. Isolate dissimilar materials to prevent electrolysis. Separate bituminous coating.

4. Secure counterflashing using continuous cleats, clips and fasteners in accordance with product data and as indicated.

E. Skirt Flashing

1. Skirt flashings shall be formed with a 4 inch face and a ¼ inch kick, bent out a 60˚ angle to the face (or 30˚ to the wall).

2. Secure skirt flashings to the existing counterflashings with stainless steel rivets at all areas where existing counterflashings are being reused. Clean existing counterflushing and apply sealant over rivet heads.

F. Gravel Stop and Edge Metal
1. Secure continuous hook strips with the specified fasteners as previously noted.

2. Form gravel stop/edge metal cover plates to the dimensions indicated.

3. Provide 6 inch wide cover plates, set in full bed of sealant over all 1/8-inch gaps at butt joints in sheet metal sections. Hem edges of cover plates to fit snugly against fascias. Stagger butt joints between the hook strips and the fascias. At PVC coated edge metal, apply sealant at vertical edges of the back of two adjoining pieces, typical.

G. Sleeve Flashing and Storm Hoods

1. Storm hood and sleeve flashing shall be formed with locked and soldered seams. Sleeves shall have integral deck flanges with hemmed edges to the configurations shown on the Drawings. Storm hood shall counterflashing sleeves flashing 3 inches, minimum.

2. Secure sleeve flashings to wood blocking and flash into roof system.

3. Storm hood shall be secured to exhaust pipe with stainless steel band clamp. Set storm hood in full bed of sealant.

H. Mechanical Unit Cover Fasteners

1. Secure existing light mechanical unit covers to wood curbs with #10 stainless steel wood screws with integral metal-capped neoprene washers. Install screws at 12 inches on center, maximum, with a minimum of two screws per side of curb.

2. Secure mechanical unit to curb using 1/4 inch lag bolts installed through EPDM gasketed metal cap washer. Set EPDM gasket in bed of polyurethane sealant.

I. Vent, Duct, and Fan Flashings

1. Contractor shall provide samples or shop drawing for new vent, duct, and pan flashing with sheet metal covers. Do not fabricate prior to approval of samples and shop drawings.

2. Flashings shall be fabricated to be vandal resistant with solid welds and have slope toward free edges, on all four sides.

END OF SECTION
PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Self-adhering sheet flashing (flexible flashing) and sealant for concealed flashings as indicated, along window, door and louver opening perimeters; under cement plaster trim accessory joints; over concealed sheet metal flashing flanges and cement plaster termination trim accessories, at all inside and outside corners over building paper; ridge and rake edges; as required to make the building weather-tight and not specified in other sections.

B. Related work:

1. Section 07 60 00 – Sheet metal flashing
2. Section 08 11 00 – Metal Doors & Frames
3. Section 08 51 13 – Aluminum Windows
4. Section 09 20 00 – Lath & Plaster

1.02 SUBMITTALS

A. Procedure: In accordance with Division 1 Section 01340 - Submittals

B. Data: Copies of manufacturer data for each product.

C. Shop drawings: Show interface between flashings and other membranes, different surfaces, and any special conditions or other pertinent data.

D. Samples: 12 in. square samples of flashing and 12 in. long samples of sealant.

1.03 PRE-INSTALLATION CONFERENCE

A. Division 1 Section 01200 – Project Meetings: Pre-installation conference.

B. Convene one week prior to commencing work of this section.
PART 2 PRODUCTS

2.01 MANUFACTURERS/MATERIALS

A. Self-adhering (peel and stick) flexible modified bitumen flashings by the following:

   1. Ice & Water Shield by W.R. Grace & Company, or equal

PHYSICAL PROPERTIES FOR GRACE ICE & WATER SHIELD COLD APPLIED, SELF-ADHERING MEMBRANES:

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST METHOD</th>
<th>TYPICAL VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Gray-Black</td>
<td></td>
</tr>
<tr>
<td>Cured Film Thickness</td>
<td>ASTM D 3767 Method A</td>
<td>1.02 mm (40-mil.)</td>
</tr>
<tr>
<td>Material Weight Installed</td>
<td>ASTM D 461</td>
<td>0.3 lb/ft2</td>
</tr>
<tr>
<td>Low Temperature Flexibility At –29F(-20C)</td>
<td>ASTM D 1970</td>
<td>Unaffected</td>
</tr>
<tr>
<td>Elongation,</td>
<td>ASTM D 412</td>
<td>250%</td>
</tr>
<tr>
<td>Adhesion to Plywood</td>
<td>ASTM D 903 *</td>
<td>525 N/m (3 lb/in. width)</td>
</tr>
</tbody>
</table>

B. Primer and sealant: As recommended by the flashing manufacturer.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify conditions and measurements affecting the work of this Section at site. Make sure that detrimental conditions are corrected before proceeding with installation.

3.02 INSTALLATION

A. Install flashings in compliance with the manufacturer’s printed instructions, and the following.

B. Press and form material tightly against the substrate. Insure complete adhesion by using a roller or by hand; pressure is essential to eliminate wrinkles and bubbles.

3.03 FIELD QUALITY CONTROL

A. Before the paper backing and metal lath are installed, inspect the flashings and roll again where not in firm contact with the substrate. Make sure that all joints are weathertight.

END OF SECTION
PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish and install all sealant and caulking as shown, as specified and as required for complete and proper installation.

B. Related work described elsewhere: Refer to the various sections for particular sealant locations and requirements, including materials and methods different from those specified in this Section.

1.02 SUBMITTALS

A. Product Data: Manufacturer's specification, recommendations, and application equipment and procedures, installation instructions including cleaning of joint surfaces, for each type of material required.

1. Certification that joint sealant materials are compatible with adjacent materials.

B. Samples:

1. Samples for color selection of exposed sealant.

2. 12" samples of sealant applied between one (1) type of material used on project.

3. 12" sample of backer rod.

1.03 QUALITY ASSURANCE

A. Comply with manufacturer's printed instructions, except where more stringent requirements are indicated.

B. Before purchase of each required material, confirm its compatibility with each other material it will be applied to in joint system as well as itself during and after curing.

C. Qualifications of Applicators: Installation shall be by workmen skilled and trained in the techniques of sealants and caulking and who are completely familiar with the published recommendations of the manufacturers of sealants and caulking being used.

D. Rejection of Installed Work: Faulty installation of sealants or caulking shall be removed and redone to the approval of the Architect at no additional cost to the Owner.
E. Manufacturer’s Representative: Technically qualified and approved by product manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, tightly sealed containers or unopened packages with manufacturer’s name, labels, and product identification.

B. Store materials out of weather in original containers or unopened packages as recommended by manufacturer.

1.05 ENVIRONMENTAL CONDITIONS

A. Environmental Requirements: Do not apply materials under extreme temperature conditions when joint openings are at maximum or minimum width and during wet weather when surfaces are not dry.

1.06 SCHEDULING

A. General: Coordinate Work with the work of Sections affected by sealants to assure Work is performed in proper sequence and in manner to cause no delay. Where applicable, furnish proper setting templates and layouts affecting Work of other Section.

1.07 GUARANTEE

A. All sealant and caulking work shall be guaranteed from material defects and workmanship for a period of five (5) years against leaks, adhesion, cohesion, resistance to weather, migration, glow, stain and other forms of deterioration and defects. Should these occur, material shall be removed and replaced at no cost to the Owner, including any other material or work damaged by the leaks.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Colors:

2. Exposed Material: Manufacturer’s standard colors, as selected by Architect.

B. Sealant for general use: PRC #5000-S, Pecora GC-9 one part polysulfide, Vulkem #116 one-part polyurethane sealant, or equal meeting requirements of Fed. Specifications TT-S-00230c. Color shall match finished adjacent surfaces and are to be approved by the Architect. Consistencies as required for application by gun or knife, as necessary.
C. Silicone Sealant: Use at concrete, masonry, and glazing applications. Tremco, Dow Corning, or equal.

D. Polyurethane Sealant: Sonneborn Sonolastic NP1, Sikaflex 2cNS, or equal.


F. Acoustical Sealant:

2.02 MISCELLANEOUS MATERIALS

A. Compressible Sealer: Neoprene shapes and sizes as shown and required. Provide tapes with pressure sensitive adhesive one side.

B. Joint Primer/Sealer: Provide type of joint primer/sealer recommended by sealant manufacturer for joint surfaces to be primed or sealed.

C. Sealant Backer Rod: Applied Extrusion Technologies’ Sof Rod, or equal; flexible, permanent, durable, non-gassing, non-absorptive material as recommended for compatibility with sealant by sealant manufacturer.

D. Cleaning Solvent: Non-corrosive type recommended by manufacturer; compatible with joint forming materials.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work and field measurements are as shown on Drawings and recommended by manufacturer.

B. Verify that surfaces in contact with sealant are free of form release agents and other coatings applied during fabrication.

C. Begin installation only when conditions are satisfactory.

3.02 INSTALLATION

A. Clean joint surfaces immediately before installation of sealant.
   1. Remove dirt, insecure coating, moisture, and other substances which would interfere with bond of sealant.
   2. Use cleaning solvent to clean joint surfaces.
3. Wipe joints free of solvent, using clean, dry white cotton cloths or white, lintless paper.

B. Prime or seal joint surfaces.
   1. Do not allow primer/sealer to spill or migrate to adjoining surfaces.

C. Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air packets, with complete "wetting" of joint bond surfaces equally on opposite sides.
   1. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces.
   2. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

D. Use one (1) piece backer rod filler about one-third (1/3) to one-half (1/2) wider than the width of joint so sufficient pressure is exerted by filler to provide substantial resistance to displacement.

E. Install joint backer rod for backup to control limits for receiving sealant. Depth shall be as recommended by sealant manufacturer. Use blunt tools. Remove and replace all broken or punctured backer rods.

F. If joint is too shallow for use of backer rod, apply bond breaker to back of joint as recommended by sealant manufacturer. If bond breaker is used, apply it carefully to avoid prevention of sealant bond to sides of joints.

G. Use guns where possible to insure penetration and density. Finish joint densely and completely filled, producing a smooth surface.

H. Manufacturer's directions shall be followed for installation of sealants or caulking during extreme weather conditions. Do no installation during freezing weather or temperature limits set by manufacturer, or against wet or damp materials.

I. Install fire resistant sealant systems in strict conformance to manufacturer's printed instructions, complete with required joint backing.

3.03 SOUND ISOLATION

A. Sound-insulated walls indicated on the Drawings shall be sealed airtight with acoustical sealant specified.

B. Penetrations Through Non-Fire-Rated Partitions and Floors:
   1. Penetrations or openings as a result of conduits, ducts, pipes, and around electrical junction boxes in sound-insulated walls shall be sealed airtight.
   2. Holes smaller than 1" but too large to seal with sealant shall be first packed with mineral wool fiber and then sealed airtight.
   3. Holes larger than 1" shall be first packed with glass fiber, then sealed over with 1/16" thick lead sheet, and then sealed airtight.
3.04  CLEANING AND CURING

A. Clean adjoining surfaces to eliminate evidence of spillage; do not mar surfaces.

B. Cure sealants in compliance with manufacturer's instructions and recommendations to obtain high early-bond strength, internal cohesive strength, and surface durability.

END OF SECTION
SECTION 07 95 13
EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes expansion joint assemblies for exterior wall & roof, and interior floor, wall, & ceiling surfaces, including fire rated assemblies.

B. Related Sections:
   1. Section 05 50 00 - Metal Fabrications.
   2. Section 06 10 00 - Rough Carpentry.
   3. Section 07 51 00 - Built-up Bituminous Roofing.
   4. Section 07 62 00 - Sheet Metal Flashing and Trim.
   5. Section 07 90 00 - Joint Protection.
   6. Section 09 29 00 - Gypsum Board Systems.
   7. Section 09 51 00 - Suspended Acoustical Ceilings.
   8. Section 09 65 16 - Resilient Sheet Flooring.

1.02 REFERENCES

A. American Standards Testing Materials International:

B. ANSI: Prefabricated fire barrier assemblies tested in accordance with ANSI / UL 2079 procedures for 1 and 2 hour classification, unless otherwise detailed.

1.03 SUBMITTALS

A. Section 01 30 00 - Submittal Procedures.

B. Product Data: Submit joint assembly profiles, dimensions of individual components, anchorage devices, product specifications, installation instructions, details of construction relative to materials, colors, and finishes.

C. Shop Drawings: Submit detailed drawings showing layout of expansion joint cover assemblies and all special connections, jointing and accessories which are not completely shown in the manufacturer's data. Indicate joint and splice locations, miters, layout of work, affected adjacent construction, and anchorage locations.

D. Samples: Submit 6" long samples of each expansion joint cover assembly for approval.
1.04 QUALITY ASSURANCE
   A. Single Source Responsibility: Obtain expansion joint cover assemblies from one source from a single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Storage and Protection: Protect expansion joint cover assemblies from damage, after delivery to site and, before installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
   A. C/S Group (contact: 1-800-233-8493 | www.c-sgroup.com)
   B. Substitutions as allowed in General Conditions.

2.02 ASSEMBLIES
   A. Roof to wall: BRJW series with SSF as indicated on the drawings (EJ-1 EJ-5).
   B. Exterior Walls: SC with SSF as indicated on the drawings. (EJ-2 & EJ-3),
   ASM WITH SSF AS INDICATED ON DRAWINGS (EJ-4)
   C. Transitions & Waterproofing: Provide complete set of factory-fabricated transitions and ends for continuous, uninterrupted seal at all expansion joint conditions.
   D. Construction: Aluminum with continuous silicone face seals with continuous waterproofing back seal for exterior roof and wall systems. Expansion joint seals to accommodate 100% joint-width movement and compression to 1-1/4 inch.

2.03 MATERIALS
   A. Extruded Aluminum: Alloy 6063-T5.
   B. Silicone:
   C. Vinyl: 70 Duro PVC Standard.

2.04 FINISHES
   A. Mill: Standard finish.
   B. Colors: As indicated in drawings.

2.05 FABRICATION
   A. Shop assemble components and provide with all required components, anchors and fittings.
B. Fabricate special transitions, connections, corner fittings, etc. as required.

C. Provide assembled components in single lengths wherever practical. Minimize site splicing.

D. Provide assembly components of design, basic profile, materials and operation indicated.

E. Back paint components in contact with cementitious materials.

F. Galvanize embedded ferrous metal anchors and fastening devices.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Division 1 - General Requirements: Coordination.

B. Verify joint preparation and affected dimensions are acceptable.

3.02 PREPARATION

A. Verify field measurements on Shop Drawings.

B. Provide anchoring devices for installation.

C. Provide templates and rough-in measurements.

3.03 INSTALLATION

A. Align work plumb, level, and flush with adjacent surfaces.

B. Rigidly anchor to substrate to prevent misalignment.

C. Install expansion joint cover assemblies in accordance with manufacturer's instructions for each type of condition encountered.

D. Provide continuous waterproof back seal at all exterior expansion joints.

E. Adjust joint cover to freely accommodate joint movement.

F. Provide continuous fire rated assemblies at rated walls, floors, ceilings, and roof as required.

3.04 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements
B. Install removable strippable coating to protect finish surface. Do not remove protective material until finish work in adjacent areas is complete. When protective material is removed, clean exposed metal surface to comply with manufacturer’s instructions.

END OF SECTION
SECTION 08 11 00
METAL DOORS & FRAMES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide hollow metal doors, steel door frames

B. Related Sections:
   1. Section 08 71 00 – Door Hardware
   2. Section 09 91 00 – Painting

1.02 SUBMITTALS

A. Shop Drawings: Show door and frame type, material description and gauges, exact profile, elevations, fire-resistive rating and complete details, including reinforcing, anchors, and connections.

   1. Use same reference numbers for details and openings as those indicated on Drawings.

B. Manufacturer and product data.

C. Certificates: Submit certificates for specified doors and frames indicating compliance with fabrication and minimum labeling requirements. Certificates shall be signed by Contractor and authorized representative of hollow metal manufacturing company.

1.03 QUALITY ASSURANCE

A. Standard steel door frames shall comply with the Steel Door Institute (SDI) "Recommended Specifications for Standard Steel Doors and Frames" (ANSI/SDI 100) and other requirements as specified herein.

B. Labeled doors and frames

   1. All doors and frames for rated openings (Classes A, B, C, D, or E) shall be of the construction and design having specific Underwriters' Laboratories approval according to current procedures for three (3) hour, one and one half (1½ ) hour, three-quarter (¾) hour, or twenty (20) minute fire rating.

   2. Identify each fire-rated door and frame with permanent, metal labels from approved testing agency indicating applicable fire rating.

   3. Construct and install assemblies to comply with National Fire Protection Association (NFPA) Standard No. 80 and as specified herein.

1.04 DELIVERY, STORAGE, AND HANDLING

Contra Costa Community College District
Diablo Valley College
PAC Restroom Renovation
A. Deliver, store, and handle steel doors and frames in manner to prevent damage or deterioration.

B. Provide packaging such as cardboard or other containers, separators, banding, spreaders, and paper wrappings to protect items during transit and Project site storage.

C. Follow special storage and handling requirements of manufacturer.

D. Mark each door and frame, on a surface which will be hidden after installation, with designation of opening for which it is furnished. Mark opening designation also on exterior packaging for each door and frame.

1.05 WARRANTY

Warrant materials and workmanship for the lifetime of the original installation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Manufacturer: Must be a member in good standing of the Steel Door Institute, Curries, Steelcraft, or equal.

B. Hot-Rolled Steel Sheets and Strip: Commercial carbon steel, pickled and oiled, complying with ASTM A568 and A569.

C. Cold-Rolled Steel Sheets: Commercial-quality carbon steel complying with ASTM A366 and ASTM A568.

D. Shop-Applied Paint: Rust-inhibitive primer, either air dried or baked on, suitable as a base for specified finish paints complying with ANSI, A224.1 - 1990.

E. Hardware: Specified in Section 08710.

F. Doors: Fourteen (14) gauge stretch clear - beveled hot-dipped, galvanized steel.

G. Frames: Fourteen (14) gauge, hot-dipped, galvanized sheet steel. Steel for fire-resistive frames according to Underwriters' Laboratories, Inc. requirements for labeled frames of the ratings shown on the drawings.

   1. Frames shall be seamless welded construction.

H. Frame Anchors: As per manufacturer’s sixteen (16) gauge x 1¼" wide steel angle frames welded to frame typical, except anchors for fire-resistive frames to be required for Underwriters' Laboratories, Inc. labeling.

I. Vision Panel Frames:

   1. Manufacturer: Anemostat, or product of comparable quality and utility.
2. Style: Slim line steel frame, square.
   a. Non-Rated Doors: Eighteen (18) gauge cold rolled steel, with corners and intersections mitered, welded, and ground smooth; shop primed with manufacturer's standard primer.
   b. Fire-Rated Doors: In addition to requirements specified above, frames shall be provided in accordance with applicable labeling requirements for door rating shown, and shall bear appropriate label.

2.02 FABRICATION - GENERAL

A. Fabricate metal doors and frames to required profiles and sizes by forming and welding with exposed edges straight and sharp.

B. Fit and fabricate accurately with corner hairline joints and all surfaces free from warp, wave, buckle, and other defects.

C. Welding:
   1. In accordance with AWS standards for high-grade hollow metal work.
   2. Grind all exposed beads and faces smooth.

D. Exposed Fasteners: Unless otherwise indicated, provide countersunk, flat Phillips, or Jackson heads for exposed screws and bolts.

E. Finish Hardware Preparation:
   1. Prepare metal doors and frames to receive mortise and concealed hardware, including cutouts, reinforcing, drilling, and tapping in accordance with final Finish Hardware Schedule and templates provided by hardware suppliers.
      a. Preparation shall be in accordance with SDI-107.
   2. Provide minimum gauge hardware reinforcing in accordance with Table IV of ANSI/SDI-100.
   3. Reinforce metal doors and frames to receive surface-applied hardware.
      a. Drilling and taping for surface-applied finish hardware shall be done at Project site by hardware installer.
   4. Locate finish hardware as shown on final shop drawings or, if not shown, in accordance with "Recommended Location for Builder's Hardware" published by the National Builders' Hardware Association.

F. Shop Finishing and Painting:

2. Fill joints with mineral filler, and finish surfaces smooth and flush.

3. After fabrication, thoroughly clean surfaces of mill scale, rust, oil, grease, dirt, and other foreign matter, and chemically treat with phosphate compound to assure maximum paint adhesion.

4. Apply one (1) coat of rust inhibitive primer, baked at three hundred degrees (300°F) for thirty (30) minutes.

5. Coat inside of frame profile with bituminous coating to a thickness of 1/16".

2.03 METAL FRAME CONSTRUCTION

A. General construction shall be welded units, corners mitered and fitted. All welds shall be full depth of all frame and ground smooth. Provide not less than three (3) anchors per side suitable for wall conditions, or provide special anchors when detailed specifically on the Drawings. Include floor angles or clips, welded to frame for concealed fastening to floor. Provide additional anchors for large frames as required to prevent twisting or other movement from door operations.

B. Reinforcement shall be furnished for all mortise type hardware, drilled and tapped at factory. Hinge reinforcing shall be seven (7) gauge minimum. Butt and lockset reinforcing shall be ten (10) gauge minimum and surface applied hardware reinforcing shall be twelve (12) gauge minimum.

C. Door closer reinforcement shall be 3/16" thick steel plate welded to frame with six (6) (minimum) 1" long fillet welds. Drill and tap for door closer screws.

2.04 METAL DOOR CONSTRUCTION

A. The two face sheets shall be formed from stretcher-levelled cold rolled steel not less than fourteen (14) U.S. gauge and shall be rigidly connected and reinforced inside by fourteen (14) gauge steel “C” channels, spaced 8” on center, full height of door and all around door edges. Fabricate with welds at all ends and at 3” on center.

B. Sound deadening material shall be mineral composition, incombustible, moisture resistant, chemically inert and shall fill all voids between stiffeners and face sheets.

C. Suitable provision shall be made to receive glass panels and/or louver of size shown on drawings.

D. Glass moldings shall be welded units and shall be watertight at exterior locations.

E. Tops of doors to be flush and be made watertight at exterior locations.

F. Door edges to be welded and to be free of seams or cracks. Bevel lock edge 1/8" in 2". Minimum door thickness 1¾".
G. Faces of doors to be flat with no joints, weld marks or bumps.

H. Doors shall be neatly mortise and reinforced for all mortise type hardware and shall be drilled and tapped at the factory. Do not cut through door edge at hinge mortise. For surface applied items such as closers, push and pull plates, kickplates, escutcheons, stops, etc., doors shall be reinforced but drilling and tapping shall be done in the field by the door erection contractor.

I. Minimum reinforcing as follows: Surface hardware .0747" steel, hinge reinforcing .180" steel, lock reinforcing .127" steel-for cylindrical locks .0747" steel box type reinforcing unit.

J. Close top and bottom edges with fourteen (14) gauge minimum continuous channel extending full width of door and continuously sealed welded to both faces. Exterior door tops shall be flush and closed to moisture, bottoms with weep holes for elimination of condensation. Fill interior spaces between stiffeners with inorganic, non-combustible insulation.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrate and conditions under which steel door frames are to be installed and notify the Architect, in writing, of any conditions detrimental to proper and timely completion of the work.

B. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF FRAMES

A. Install frames in accordance with SDI-105, "Recommended Erection Instructions for Steel Frames."

B. Exercise care in setting of frames to maintain scheduled dimensions, hold head level, and maintain jambs plumb and square.

C. Coordinate installation of sheet metal head flashing above exterior side of all frames, where detailed.

D. Secure anchorages and connections to adjacent construction.

   1. Anchors shall be furnished to suit wall conditions and floor angles or clips welded to frame for fastening to floor. Install a minimum of three (3) anchors on each side of jamb.

E. Whenever possible, leave frame spreader bars intact until frames are set perfectly square and plumb and anchors are securely attached.

F. Allow for expansion movement as required.

G. Install fire-rated frames in accordance with NFPA Standard No. 80.
H. Grout ends at jambs and thresholds at exterior frames into blockouts in floor slabs with concrete.

3.03 INSTALLATION OF DOORS

A. All doors shall be expertly hung and installed in proper frames as scheduled and shall fit snug against all stops. Fit accurately and hang free from hinges bind with uniform clearance of 1/16" at heads and jambs.

B. General: Install complete with all hardware. Fit doors to provide uniform 1/16" to 1/8" clearance at jambs and head. 1/4" to finish floor at bottom where there is no threshold or carpet. 1/4" at bottom to top of carpet or threshold.

C. Weatherstripped Doors: Install and trim complete with gaskets, strips, and bottoms in accordance with details and specifications.

D. Do not erect members which are observed to be warped, bowed, deformed, or otherwise damaged or defaced to such extent as to impair strength or appearance.
   1. Remove and replace members which have been damaged in process or erection.

E. Adjust and lubricate operable parts as required for correct function.

F. Install fire rated doors in accordance with NFPA Standard No. 80.

3.04 PRIME COAT TOUCH-UP

A. Immediately after erection, items with prime coat which has been damaged shall be sanded smooth and touched up with same prime as applied at shop.

B. Remove rust before above-specified touch-up is applied.

C. Touch-up shall not be obvious.

3.05 ADJUSTMENT

A. Replace or rehang doors which are hinge bound or do not swing or operate freely.

3.06 PROTECTION

A. Protect installed work against damage from other construction work.

3.07 CLEANING

A. Remove from the site all debris resulting from the work of this section.

END OF SECTION
SECTION 08 31 00
ACCESS DOORS & PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes fire resistive rated and non-rated access doors and panels with frames.

1. Provide for access to controls, valves, traps, dampers, cleanouts, attics and similar items requiring operation behind inaccessible finished surfaces.

2. Coordinate exact locations with various trades to assure proper placement of access doors and panels.

B. Related Sections:

1. Section 09 91 00 - Painting
2. Division 23 – Heating, Ventilation & Air Conditioning

1.02 REFERENCES

A. ASTM International:

B. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

C. National Fire Protection Association:

D. Underwriters Laboratories Inc.:
   1. UL - Building Materials Directory.

1.03 SUBMITTALS

A. Section 01 30 00 - Submittals: Submittal procedures.

B. Shop Drawings: Indicate exact position of access door units.

C. Product Data: Submit literature indicating sizes, types, finishes, hardware, scheduled locations, fire resistance listings, and details of adjoining Work.

E. Manufacturer's Installation Instructions: Submit installation requirements and rough-in dimensions.
1.04 CLOSEOUT SUBMITTALS

A. Section 01 70 00 – Contract Closeout.
B. Project Record Documents: Record actual locations of access units.

1.05 QUALITY ASSURANCE

A. Fire Resistance Ratings: Where indicated as fire rated provide assemblies from manufacturers listed in UL Directory or Intertek Testing Services (Warnock Hersey Listed) Directory.
B. Fire Rated Horizontal Access Doors: Rating 1 hour or as indicated on Drawings.
   1. Tested Rating: Determined in accordance with ASTM E119.
C. Attach label from agency approved by authority having jurisdiction to identify each fire rated access door.

1.06 QUALIFICATIONS

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

1.07 COORDINATION

A. Coordinate Work under provisions of Division 1 - Project Coordination.
B. Coordinate Work with work requiring controls, valves, traps, dampers, cleanouts, and similar items requiring operation being located behind finished surfaces.

PART 2 - PRODUCTS

2.01 ACCESS DOORS AND PANELS

A. Manufacturers:

1. Bauco Access Panel Solutions
2. J. L. Industries.
3. Nystrom Products Co.
5. Substitutions: under the provisions of Section 01 63 00.

B. Concealed Access Panels: As indicated on the drawings.
C. Flush Framed Access Doors: Frames and nominal 1 inch wide exposed flanges of 16 gauge steel and door panels of 14 gauge steel.

D. Fire Rated Access Doors: Frames and nominal 1 inch wide exposed flanges of minimum 16 gauge steel and door panels of 20 gauge steel. Provide self closing and latching doors with keyed lock.

E. All interior wall access panels to be stainless steel, and lockable.

2.02 FABRICATION

A. Fabricate units of continuous welded construction; weld, fill, and grind joints to assure flush and square unit.

B. Wall and Ceiling Access Door and Panel Hardware:
   1. Hinge: Standard continuous or concealed spring pin type, 175 degree steel hinges.
   2. Lock: Self-latching lock. Screw driver slot for quarter turn cam lock.

C. Size Variations: Obtain acceptance of manufacturer's standard size units which vary slightly from sizes shown or scheduled.

2.03 SHOP FINISHING

A. Base Metal Protection: Galvanized, hot dipped Prime coat units with alkyd baked on primer.

B. Finish: Two coats baked enamel, color as selected.

C. All interior ceiling-mounted access panels to be 24" x 24" inch size unless otherwise noted, screwdriver slot lock, and either factory-finished baked enamel white or primed and painted in the field white to match the adjacent ceiling finishes.

D. All exterior wall-mounted access panels at the roof level must be 24" wide x 36" wide, lockable with handle, continuous hinge, and weather-tight seals, 16 gauge galvanized sheet metal - prime and paint to match.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Division 01 - General Requirements: Coordination and project conditions.

B. Verify rough openings for access doors and panels are correctly sized and located.

3.02 INSTALLATION

A. Secure frames rigidly in place, plumb and level in opening, with plane of door and panel face aligned with adjacent finished surfaces.
1. Set concealed frame type units flush with adjacent finished surfaces.
2. Coordinate and set concealed frame type units between full tiles and between grout joints.
3. Secure tile with epoxy adhesive to panel. Grout to match adjacent tiled wall.

   B. Position unit to provide convenient access to concealed work requiring access.

   C. Install fire rated units in accordance with NFPA 80 and requirements for fire listing.

   D. All access panels to be mounted tight to wall/ceiling finishes and sealed.

   E. All exterior wall access panels to have painted GSM head flashing with hemmed drip edge.

END OF SECTION
SECTION 08 51 13
ALUMINUM WINDOWS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Architectural Aluminum Windows, including glass and glazing at window manufacturer’s factory, metal panels, perimeter trims, sills and stools, window installation hardware and accessories, shims and anchors, and perimeter sealing of window units.

1.02 SYSTEM DESCRIPTION


B. Test Units.

1. All test unit sizes and configurations shall conform to the minimum size in accordance with ANSI/AAMA 101 and AAMA 910.

2. Units submitted for laboratory testing shall be units of the manufacturer’s standard construction, glazed and assembled in accordance with the manufacturer’s specifications and ANSI/AAMA 101.

C. Performance Requirements

1. Air Infiltration: The test specimen shall be tested in accordance with ASTM E283 at a minimum window size of 6' x 6' for F-HC100 and 5' x 8' for F-AW100. The air infiltration rate shall not exceed 0.06 cfm/ft at a static air pressure differential of 6.24 psf.

2. Water Resistance: The test specimen shall be tested in accordance with ASTM E547 and ASTM E331 at a minimum window size of 6' x 6' for F-HC100 and 5' x 8' for F-AW100. There shall be no leakage as defined in the test method at a static air pressure differential of 12 psf.

3. Uniform Load Deflection: A minimum static air pressure difference of 100 psf shall be applied in the positive and negative direction in accordance with ASTM E330. There shall be no deflection in excess of L.175 of the span of any framing member.

4. Uniform Load Structural Test: A minimum static air pressure difference of 150 psf shall be applied in the positive and negative direction in accordance with ASTM E330. The unit shall be evaluated after each load.

5. Component Testing: Window components shall be tested in accordance with procedures described in ANSI/AAMA 101.
6. Condensation Resistance Test: (CRF) when tested in accordance with AAMA 1503.1, the condensation resistance factor shall not be less than 53.
7. Thermal Transmittance Test: (U-Value): When tested in accordance with AAMA 1503.1, the conductive thermal transmittance (U-Value) shall not be more than .59 BTU/hr/sf/°F.
8. Sound Performance: When tested in accordance with ASTM E90 and E413, the sound transmission loss (STL) shall not be less than 39.
   a. Testing shall be in general accordance with AAMA TIR-A8, Structural Performance Poured and Debrided Framing System.

1.03 SUBMITTALS

A. General: Prepare, review, approve, and submit product data, shop drawings, glazing and frame samples, and other submittals in accordance with "Conditions of the Contract" and Division 1 Submittals Sections. Product data, shop drawings, samples, and similar submittals are defined in "Conditions of the Contract."

B. DEFERRED SUBMITTAL: WINDOW WALLS, as noted on drawings:

1. Contractor shall submit drawings and calculation, per CBC 2013 Section 1609A and ASCE 7-10, Section 26.1.2-1 for the AOR and SEOR review and acceptance prior to submittal to DSA.
2. Drawings shall show Section and Material Properties of mullions and horizontal Members including aluminum alloy number, A, T(min), I(x), I(y), S(x), and S(y).
3. Show properties of screws (corrosion resisting type, threads per inch and length) for each size used. Show drill-in anchor information (manufacturer, embedment, length, proof tension test load <2x80% of ICC values).
4. Submit stress and deflection calculations for wind load (Delta<1/175).
5. Submit calculations for inter-story drift in accordance with Section 13.5 ASCE 7-10

6. Show connection detail between mullion and horizontal member with calculations. (Positive connection required.) "Marked "1" on drawing"
7. Show end support detail of mullion of horizontal member (whichever is main support member) with calculations. "Marked "2" on drawing"
8. Show window wall framing support detail at floor / roof level. "Marked "3" on drawing"
9. Submit calculations to show adequacy of screw or bolt of anchor bolt. The fastener is under bending, shear and tension due to shim over ¼" and/or other members sandwiched between. (Drill-in anchors use 80% ICC values. Screws use safety factor of 3. "Marked "**" on drawings"
10. Submit calculations to check local bending of flange or lip of mullion or A horizontal member. "Marked '<--- >' on drawing"
11. Specify shim material. (No plastic shim over ¼")
12. Provide special detail at window wall supports when the gap between window wall framing and supporting structural member exceed ¼".

1.04 WARRANTY

Contra Costa Community College District
Diablo Valley College
PAC Restroom Renovation
A. Minimum Project Warranty: Refer to section 01 78 36.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
   1. Warranty Period: Two (2) years from Date of Substantial Completion.
   2. Insulating Glass: Warranted to be free from defects (excluding breakage) for a period of ten (10) years.

1.05 QUALITY ASSURANCE

A. The architectural aluminum supplier shall have a quality system registered to one of the ISO 9000 series of standards. The quality system shall be certified by a Registrar approved by the Accreditation Board (RAB) or another, international approval authority.
   1. The certificate shall be current and in good standing with the Registrar which issued it.
   2. The supplier shall furnish, upon request, a copy or copies of the current certificate.

PART 2 - PRODUCTS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Kawneer Company, Inc.
   2. EFCO Corporation
   3. Arcadia, Inc.
   4. US Aluminum
   5. Substitutions: Refer to Section 01 62 00.

B. Finish/Color: AA-M12C22A41, AAMA 611, Architectural Class I Anodic Coating (Color #14 Clear)

C. Product(s)

Window(s) will match Kawneer's 1600 Series window wall with 8225 TL top hinged vent units, or Architect approved equal by approved manufacturer. All parts and pieces shall be of one manufacturer.

2.02 MATERIALS

A. Aluminum for Windows and Components.
1. Extruded aluminum profiles shall be 6063-T5 alloy and temper (ASTM B221 G.S. 10A-T5).
2. The frame and ventilator depth shall be not less than 2–1.4" (57.2).
3. All frame and ventilator members shall have minimum wall thickness of .090" (2.3) and shall provide the structural strength sufficient to meet the specified performance requirements.
4. All references to dimensions for wall thicknesses and other cross-sectional dimensions of window members are nominal and in compliance with ANSI H35.2-1990.
5. All glass pockets shall be wept to provide positive drainage.

B. Mullions and Cover Plates: Shall be extruded aluminum of 6063-T5 alloy and temper of profile and dimensions indicated on drawings. Mullions shall provide structural properties to resist wind pressure required by performance criteria and standards.

2.03 ACCESSORIES

A. Fasteners: Where exposed, shall be 300 Series, Stainless Steel.
B. Perimeter Anchors: Aluminum. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
C. Exterior Panning and Interior Trims: Extruded aluminum, 6063-T5 alloy and temper, extruded to profiles and details indicated. Seal exterior joints with manufacturer’s standard sealant to assure water-tight joints.
D. Aluminum limit arm: 1 per outswinging window.
E. Handles: Cam type, white bronze alloy: US25D finish. Bronze Craft, or approved equal. Coordinate with required strikes, keepers, spring catches, and shade hardware.
F. Hinges: Stainless Steel 4 bar hinges; provide with “restrictor blocks.” Anderberg, Bronze Craft, or approved equal.
G. Remote Operations: Provide pole/hook assembly; aluminum with rubber end (7'-0" long). Bronze Craft, or approved equal.
H. Catches: Spring type at transom hopper vents. Bronze Craft, or approved equal.

2.04 GLASS AND GLAZING

A. General: Glass thickness and type shall be in accordance with manufacturer’s recommendations for prescribed design pressure. Factory glazing shall be in accordance with manufacturer’s standard requirements.
1. Glazing materials shall be compatible with aluminum and those sealants and sealing materials used in composite structure which have direct contact with the gasket.
2. Standard exterior and interior glazing gaskets shall be a dry glazed elastomer in accordance with ASTM C509-91.
3. Glazing beads shall be extruded aluminum and shall be a minimum thickness of 0.062" (1.575mm).

B. Glass Materials:

1. Insulating Glass: ASTM E 774.
   a. Glass Thickness 1"consisting of ¼" exterior, ½" spacer, ¼" interior.

PART 3 - EXECUTION

3.01 ACCEPTABLE INSTALLERS

A. Installer to have a minimum of five (5) years installation experience in project of similar type and size.

3.02 MANUFACTURER’S INSTRUCTIONS/RECOMMENDATIONS

A. Compliance: Comply with manufacturer’s product installation data and recommendations for installation requirements of window units, hardware, and other components in accordance with manufacturer’s warranty provisions.

3.03 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer’s instructions. Verify openings are sized to receive window units and sill plate is level in accordance with manufacturer’s acceptable tolerances.

1. Field Measurements: Verify field measurements for window installation.

3.04 PREPARATION

A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.

3.05 INSTALLATION

A. General: Install window units plumb, level, and true to line, without warp or rack of frames or sash with manufacturer’s prescribed tolerances. Provide support and anchor in place.
1. **Dissimilar Materials:** Provide separation of aluminum materials and other corrodbile surfaces from sources of corrosion or electrolytic action contact points by complying with AAMA 101, Appendix, titled "Dissimilar Materials."

2. **Weather Tight Construction:** Install sill members and other members in a bed of sealant or with joint filler or gaskets, to provide weathertight construction. Coordinate installation with wall flashings and other components of construction.
   a. Refer to Division 7 Joint Protection for installation requirements.

**B. Related Products Installation Requirements:**

1. **Insulation:** Refer to Division 7 Thermal Insulation Section 07 21 00.
2. **Sealants:** Refer to Division 7 Joint Protection Section 07 90 00.
3. **Glass:** Refer to Division 8 Glass Glazing Section 08 81 00.

**3.06 FIELD QUALITY CONTROL**

A. **Site Tests (Post Installation Testing):** Conduct project site tests for air infiltration and water penetration with manufacturer’s representative present. Architect shall select windows to be tested. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.

1. **Testing:** Testing shall be performed by a qualified independent testing agency. Refer to Division 1 Testing Section for payment of testing and testing requirements. Testing Standard shall be per AAMA 502 including reference to ASTM E 783 for Air Infiltration Test and ASTM E 1105 for Water Penetration Test.
   
   a. **Air Infiltration Tests:** Conduct in accordance with ASTM E 783. Tests shall be conducted at a minimum uniform static test pressure of 1.57 psf or a specified, but not to exceed 6.24 psf. The maximum allowable rates of air leakage for field testing shall not exceed 1.5 times the project specifications.

   b. **Water Penetration Tests:** Water penetration tests shall be conducted at a static test pressure of 8 psf for Architectural (AW), 6.00 psf for Heavy Commercial (HC) and 3.00 psf for Commercial (C).

**3.07 ADJUSTING AND CLEANING**

A. **Adjusting:** Adjust operating window components to provide a tight fit at contact points and at weatherstripping for smooth operation and a weathertight closure.

B. **Cleaning:** Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance. Remove construction debris from project site and legally dispose of debris.
C. Protection: Protect installed product's finish surfaces from damage during construction. Protect aluminum windows from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants. Remove and replace damaged aluminum windows at no extra cost.

END OF SECTION
SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary
   Conditions of Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes items known commercially as finish or door hardware that are required
   for swing, sliding, and folding doors, except special types of unique hardware specified in the
   same sections as the doors and door frames on which they are installed.

B. This Section includes the following, but is not necessarily limited to:

   1. Door Hardware, including electric hardware.
   2. Low-energy door operators plus sensors and actuators.
   3. Thresholds, gasketing and weather-stripping.
   4. Door silencers or mutes.

C. Related Sections: The following sections are noted as containing requirements that relate to
   this Section, but may not be limited to this listing.

   1. Division 8: Section - Steel Doors and Frames.
   2. Division 8: Section - Wood Doors.

1.03 REFERENCES (USE DATE OF STANDARD IN EFFECT AS OF BID DATE.)

A. 2013 California Building Code, CCR, Title 24.

B. BHMA – Builders' Hardware Manufacturers Association

C. DHI – Door and Hardware Institute


   1. NFPA 80 - Fire Doors and Other Opening Protectives
   2. NFPA 105 - Smoke and Draft Control Door Assemblies

E. UL - Underwriters Laboratories.

   1. UL 10C - Fire Tests of Door Assemblies
   2. UL 305 - Panic Hardware

F. WHI - Warnock Hersey Incorporated

G. SDI - Steel Door Institute
1.04 SUBMITTALS & SUBSTITUTIONS

A. General: Submit in accordance with Conditions of the Contract and Division 1 Specification sections.

B. Submit product data (catalog cuts) including manufacturers' technical product information for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

C. Submit six (6) copies of schedule organized vertically into "Hardware Sets" with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:

1. Include a Cover Sheet with:
   a. Job Name, location, telephone number.
   b. Architects name, location and telephone number.
   c. Contractors name, location, telephone number and job number.
   d. Suppliers name, location, telephone number and job number.
   e. Hardware consultant's name, location and telephone number.

2. Job Index information included:
   a. Numerical door number index including; door number, hardware heading number and page number.
   b. Complete keying information (referred to DHI hand-book "Keying Systems and Nomenclature"). Provision should be made in the schedule to provide keying information when available; if it is not available at the time the preliminary schedule is submitted.
   c. Manufacturers' names and abbreviations for all materials.
   d. Explanation of abbreviations, symbols, and codes used in the schedule.
   e. Mounting locations for hardware.
   f. Clarification statements or questions.
   g. Catalog cuts and manufacturer's technical data and instructions.

3. Vertical schedule format sample:

<table>
<thead>
<tr>
<th>Heading Number 1 (Hardware group or set number – HW -1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 1 Single Door #1 - Exterior from Corridor 101</td>
</tr>
<tr>
<td>(b) 90°</td>
</tr>
<tr>
<td>(c) RH</td>
</tr>
<tr>
<td>(d) 3' 0&quot;x7' 0&quot; x 1-3/4&quot; x (e) 20 Minute</td>
</tr>
<tr>
<td>(f) WD x HM</td>
</tr>
<tr>
<td>(g) 1 (h) (i) ea</td>
</tr>
<tr>
<td>(j) Hinges - (k) 5BB1HW 4.5 x 4.5 NRP (l) ½ TMS</td>
</tr>
<tr>
<td>(m) 626</td>
</tr>
<tr>
<td>(n) IVE</td>
</tr>
<tr>
<td>2 6AA 1 ea</td>
</tr>
<tr>
<td>Lockset - ND50PD x RHO x RH x 10-025 x JTMS 626</td>
</tr>
<tr>
<td>SCH</td>
</tr>
</tbody>
</table>

(a) - Single or pair with opening number and location. (b) - Degree of opening (c) - Hand of door(s) (d) - Door and frame dimensions and door thickness. (e) - Label requirements if any. (f) - Door by frame material. (g) - (Optional) Hardware item line #. (h) - Keyset Symbol. (i) - Quantity. (j) - Product description. (k) - Product Number. (l) - Fastenings and other pertinent information. (m) - Hardware finish codes per ANSI A156.18. (n) - Manufacture abbreviation.
D. Make substitution requests in accordance with Division 1. Substitution requests must be made prior to bid date. Include product data and indicate benefit to the project. Furnish samples of any proposed substitution.

E. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner’s final instructions on keying of locks has been fulfilled.

F. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

G. Furnish as-built/as-installed schedule with close-out documents, including keying schedule and transcript, wiring/riser diagrams, manufacturers’ installation and adjustment and maintenance information.

H. Fire Door Assembly Testing: Submit a written record of each fire door assembly to the Owner to be made available to the Authority Having Jurisdiction (AHJ) for future building inspections.

1.05 QUALITY ASSURANCE

A. Obtain each type of hardware (latch and lock sets, hinges, closers, exit devices, etc.) from a single manufacturer.

B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.

1. Responsible for detailing, scheduling and ordering of finish hardware.
2. Meet with Owner to finalize keying requirements and to obtain final instructions in writing.
3. Stock parts for products supplied and are capable of repairing and replacing hardware items found defective within warranty periods.

C. Hardware Installer: Company specializing in the installation of commercial door hardware with five years documented experience.

D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not.

1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".

E. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.
1.06 DELIVERY, STORAGE AND HANDLING

A. Coordinate delivery of packaged hardware items to the appropriate locations (shop or field) for installation.

B. Hardware items shall be individually packaged in manufacturers’ original containers, complete with proper fasteners. Clearly mark packages on outside to indicate contents and locations in hardware schedule and in work.

C. Provide locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, etc.

D. Contractor to inventory door hardware jointly with representatives of hardware supplier and hardware installer until each all are satisfied that count is correct.

1.07 WARRANTY

A. Provide warranties of respective manufacturers’ regular terms of sale from day of final acceptance as follows:

1. Locksets: Three (3) years.
2. Closers: Thirty (30).
3. Exit devices: Three (3) years.
4. All other hardware: Two (2) years.

1.08 MAINTENANCE

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.

1.09 PRE-INSTALLATION CONFERENCE

A. Convene a pre-installation conference at least one week prior to beginning work of this section.

B. Attendance: Architect, Construction Manager, Contractor, Hardware Supplier, Installer, Key District Personnel, and Project Inspector.

C. Agenda: Review hardware schedule, products, installation procedures and coordination required with related work. Review District’s keying standards.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Acceptable Substitutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>Ives</td>
<td>Hager, Stanley, McKinney</td>
</tr>
<tr>
<td>Locks, Latches</td>
<td>Schlage</td>
<td>Or Approved Equal</td>
</tr>
<tr>
<td>Cylinders</td>
<td>Corbin-Russwin</td>
<td>District Standard</td>
</tr>
<tr>
<td>Item</td>
<td>Manufacturer</td>
<td>Specification</td>
</tr>
<tr>
<td>------------------------------</td>
<td>--------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Exit Devices</td>
<td>Von Duprin</td>
<td>Or Approved Equal</td>
</tr>
<tr>
<td>Closers</td>
<td>LCN</td>
<td>Or Approved Equal</td>
</tr>
<tr>
<td>Push, Pulls &amp; Protection Plates</td>
<td>Ives</td>
<td>Trimco, BBW, DCI</td>
</tr>
<tr>
<td>Flush Bolts</td>
<td>Ives</td>
<td>Trimco, BBW, DCI</td>
</tr>
<tr>
<td>Dust Proof Strikes</td>
<td>Ives</td>
<td>Trimco, BBW, DCI</td>
</tr>
<tr>
<td>Coordinators</td>
<td>Ives</td>
<td>Trimco, BBW, DCI</td>
</tr>
<tr>
<td>Stops</td>
<td>Ives</td>
<td>Trimco, BBW, DCI</td>
</tr>
<tr>
<td>Overhead Stops</td>
<td>Glynn-Johnson</td>
<td>Or Approved Equal</td>
</tr>
<tr>
<td>Thresholds</td>
<td>Zero</td>
<td>Pemko, National Guard</td>
</tr>
<tr>
<td>Seals &amp; Bottoms</td>
<td>Zero</td>
<td>Pemko, National Guard</td>
</tr>
</tbody>
</table>

### 2.02 MATERIALS

**A. Hinges:** Exterior out-swinging door butts shall be non-ferrous material and shall have stainless steel hinge pins. All doors to have non-rising pins.

1. Hinges shall be sized in accordance with the following:
   a. **Height:**
      1) Doors up to 42" wide: 4-1/2" inches.
      2) Doors 43" to 48" wide: 5 inches.
   b. **Width:** Sufficient to clear frame and trim when door swings 180 degrees.
   c. **Number of Hinges:** Furnish 3 hinges per leaf to 7'-5" in height. Add one for each additional 2 feet in height.

2. Furnish non-removable pins (NRP) at all exterior out-swing doors and interior key lock doors with reverse bevels.

**B. Heavy Duty Cylindrical Locks and Latches:** Schlage "ND" Series as scheduled with "Rhodes" design, fastened with through-bolts and threaded chassis hubs.

1. Locksets to comply with ANSI A156.2, Series 4000, Grade 1; tested to exceed 3,000,000 cycles. Locksets shall meet ANSI A117.1, Accessible Code.
2. **Chassis:** One piece modular assembly and multi-functional allowing function interchange without disassembly of lockset.
3. Spindle shall be deep-draw manufactured not stamped. Spindle and spring cage to be one-piece integrated assembly.
4. **Anti-rotation plate to be interlocking to the lock chassis.** Lock design utilizing bit-tabs are not acceptable.
5. **Lever Trim:** Accessible design, bi-directional, independent assemblies.
6. Locks shall be of such construction that when locked, the door may be opened from within by using lever and without the use of a key or special knowledge.
7. Thru-bolts to secure anti-rotation plate without sheer line. Fully threaded thru-bolts are not acceptable.
8. Spring cage to have double compression springs. Manufacturers utilizing torsion springs are not acceptable.
9. Latchbolt to be steel with minimum ½" throw deadlatch on keyed and exterior functions; ¾" throw anti-friction latchbolt on pairs of doors.
10. Strikes: ANSI curved lip, 1-1/4" x 4-7/8", with 1" deep dust box (K510-066). Lips shall be of sufficient length to clear trim and protect clothing.

C. Exit devices: Von Duprin as scheduled.

1. Provide certificate by independent testing laboratory that device has completed over 1,000,000 cycles and can still meet ANSI/BHMA A156.3 - 2001 standards.
2. All internal parts shall be of cold-rolled steel with zinc dichromate coating.
3. Mechanism case shall have an average thickness of .140".
4. Compression spring engineering.
5. Non-handed basic device design with center case interchangeable with all functions.
6. All devices shall have quiet return fluid dampeners.
7. All latchbolts shall be deadlocking with ¾" throw and have a self-lubricating coating to reduce friction and wear.
8. Device shall bear UL label for fire and or panic as may be required.
9. All surface strikes shall be roller type and utilize a plate underneath to prevent movement.
10. All Exit Devices to be sex-bolted to the doors.
11. Panic Hardware shall comply with CBC Section 11B.404.2.7 and shall be mounted between 34" and 44" above the finished floor surface.
   a. Provide exit devices UL certified to meet maximum 5 pound requirements according to the California Building Code section 11B-309.4, and UL listed for Panic Exterior Fire Exit Hardware.

D. Closers: LCN as scheduled. Place closers inside building, stairs, room, etc.

1. Door closer cylinders shall be of high strength cast iron construction with double heat treated pinion shaft to provide low wear operating capabilities of internal parts throughout the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory. A written certification showing successful completion of a minimum of 10,000,000 cycles must be provided.
2. All door closers shall be fully hydraulic and have full rack and pinion action with a shaft diameter of a minimum of 11/16 inch and piston diameter of 1 inch to ensure longevity and durability under all closer applications.
3. All parallel arm closers shall incorporate one piece solid forged steel arms with bronze bushings. 1-9/16" steel stud shoulder bolts, shall be incorporated in regular arms, hold-open arms, arms with hold open and stop built in. All other closers to have forged steel main arms for strength, durability, and aesthetics for versatility of trim accommodation, high strength and long life.
4. All parallel arm closers so detailed shall provide advanced backcheck for doors subject to severe abuse or extreme wind conditions. This advanced backcheck shall be located to begin cushioning the opening swing of the door at approximately 45 degrees. The intensity of the backcheck shall be fully adjustable by tamper resistant non-critical screw valve.
5. Closers shall be installed to permit doors to swing 180 degrees.
6. All closers shall utilize a stable fluid withstanding temperature range of 120 degrees F. to -30 degrees F. without requiring seasonal adjustment of closer speed to properly close the door.
7. Provide the manufacturers drop plates, brackets and spacers as required at narrow head rails and special frame conditions. NO wood plates or spacers will be allowed.
8. Maximum effort to operate closers shall not exceed 5 lbs., such pull or push effort being applied at right angles to hinged doors. Compensating devices or automatic door operators may be utilized to meet the above standards. When fire doors are required, the maximum effort to operate the closer may be increased but shall not exceed 15 lbs. when specifically approved by fire marshal. All closers shall be adjusted to operate with the minimum amount of opening force and still close and latch the door. 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. Per 11B-404.2.8.1, door shall take at least 5 seconds to move from an open position of 90 degrees to a position of 12 degrees from the latch jamb.

E. Flush Bolts & Dust Proof Strikes: Automatic Flush Bolts shall be of the low operating force design. Utilize the top bolt only model for interior doors where applicable and as permitted by testing procedures.

1. Manual flush bolts only permitted on storage or mechanical openings as scheduled.
2. Provide dust proof strikes at openings using bottom bolts.

F. Door Stops:

1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
2. Do not install floor stops more than four (4) inches from the face of the wall or partition (CBC Section 11B-307).
3. Overhead stops shall be made of stainless steel and non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.

G. Protection Plates: Fabricate either kick, armor, or mop plates with four beveled edges. Provide kick plates 10' high and 2' LDW. Sizes of armor and mop plates shall be listed in the Hardware Schedule. Furnish with machine or wood screws of bronze or stainless to match other hardware.

H. Thresholds: As Scheduled and per details.

1. Thresholds shall not exceed 1/2" in height, with a beveled surface of 1:2 maximum slope.
2. Set thresholds in a full bed of butyl-rubber or polysobutylene mastic sealant complying with requirements in Division 7 "Thermal and Moisture Protection".
3. Use 1/4" fasteners, red-head flat-head sleeve anchors (SS/FHSL).
4. Thresholds shall comply with CBC Section 11B-404.2.5.

I. Seals: Provide silicone gasket at all rated and exterior doors.

1. Fire-rated Doors, Resilient Seals: UL10C Classified complies with NFPA 80 & NFPA 252. Coordinate with selected door manufacturers' and selected frame manufacturers' requirements.
2. Fire-rated Doors, Intumescent Seals: Furnished by selected door manufacturer. Furnish fire-labeled opening assembly complete and in full compliance with UL10C Classified complies with NFPA 80 & NFPA 252. Where required, intumescent seals vary in requirement by door type and door manufacture -- careful coordination required.
J. Door Shoes & Door Top Caps: Provide door shoes at all exterior wood doors and top caps at all exterior out-swing doors.

K. Silencers: Furnish silencers for interior hollow metal frames, 3 for single doors, 2 for pairs of doors. Omit where sound or light seals occurs, or for fire-resistive-rated door assemblies.

2.03 KEYING

A. Furnish a masterkey system as directed by the owner or architect. Furnish Corbin Russwin interchangeable cores for use with Schlage ND Series locks as specified.

B. A detailed keying schedule is to be prepared by the owner and/or architect. Each keyed cylinder on every keyed lock is to be listed separately showing the door #, key group (in BHMA terminology), cylinder type, finish and location on the door.

C. Furnish all cylinder cores as Corbin Russwin to match the existing District key system.

2.04 FINISHES

A. Generally to be satin chrome US26D (626 on bronze and 652 on steel) unless otherwise noted.

B. Furnish push plates, pull plates and kick or armor plates in satin stainless steel US32D (630) unless otherwise noted.

C. Door closers shall be powder-coated to match other hardware, unless otherwise noted.

D. Aluminum items to be finished anodized aluminum except thresholds which can be furnished as standard mill finish.

2.05 FASTENERS

A. Screws for strikes, face plates and similar items shall be flat head, countersunk type, provide machine screws for metal and standard wood screws for wood.

B. Screws for butt hinges shall be flathead, countersunk, full-thread type.

C. Fastening of closer bases or closer shoes to doors shall be by means of sex bolts and spray painted to match closer finish.

D. Provide expansion anchors for attaching hardware items to concrete or masonry.

E. All exposed fasteners shall have a phillips head.

F. Finish of exposed screws to match surface finish of hardware or other adjacent work.

G. All Exit Devices and Lock Protectors shall be fastened to the door by the means of sex bolts or through bolts.
PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that doors and frames are square and plumb and ready to receive work and dimensions are as instructed by the manufacturer.

B. Beginning of installation means acceptance of existing conditions.

C. Fire-Rated Door Assembly Inspection: Upon completion of the installation, all fire door assemblies shall be inspected to confirm proper operation of the closing device and latching device and that only the manufacturer’s furnished fasteners are used for installation and that it meets all criteria of a fire door assembly per NFPA 80 (Standard for Fire Doors and Other Opening Protective) 2013 Edition. A written record shall be maintained and transmitted to the Owner to be made available to the Authority Having Jurisdiction (AHJ). The inspection of the swinging fire doors shall be performed by a certified FDAI (Fire Door Assembly Inspector) with knowledge and understanding of the operating components of the type of door being subjected to the inspection. The record shall list each fire door assembly throughout the project and include each door number, an itemized list of hardware set components at each door opening, and each door location in the facility.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer’s instructions and requirements of DHI.

B. Use the templates provided by hardware item manufacturer.

C. Mounting heights for hardware shall be as recommended by the Door and Hardware Institute. Operating hardware will to be located between 34" and 44" AFF.

D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

F. Set thresholds for exterior doors in full bed of butyl-rubber sealant.

G. If hand of door is changed during construction, make necessary changes in hardware at no additional cost.

3.03 ADJUST AND CLEAN

A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

B. Clean adjacent surface soiled by hardware installation.

C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy, return to that work area and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
D. Instruct Owner’s Personnel in proper adjustment and maintenance of hardware finishes, during the final adjustment of hardware.

E. Continued Maintenance Service: Approximately six months after the completion of the project, the Contractor accompanied by the Architectural Hardware Consultant, shall return to the project and re-adjust every item of hardware to restore proper functions of doors and hardware. Consult with and instruct Owner’s personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.04 HARDWARE LOCATIONS

A. Conform to CCR, Title 24, Part 2; and ADAAG; and the drawings for access-compliant positioning requirements for the disabled.

3.05 FIELD QUALITY CONTROL

A. Contractor is responsible for providing the services of an Architectural Hardware Consultant (AHC) or a proprietary product technician to inspect installation and certify that hardware and its installation have been furnished and installed in accordance with manufacturers’ instructions and as specified herein.

3.06 SCHEDULE

A. The items listed in the following schedule shall conform to the requirements of the foregoing specifications.

B. While the hardware schedule is intended to cover all doors, and other movable parts of the building, and establish type and standard of quality, the contractor is responsible for examining the Plans and Specifications and furnishing proper hardware for all openings whether listed or not. If there are any omissions in hardware groups in regard to regular doors they shall be called to the attention of the Architect prior to bid opening for instruction; otherwise, list will be considered Complete. No extras will be allowed for omissions.

C. The Door Schedule on the Drawings indicates which hardware set is used with each door.

Manufacturers Abbreviations (Mfr.)

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Hinges, Kick Plates, Door Stops & Silencers

Door Closers

Locks, Latches & Cylinders

Continuous Hinges

Exit Devices

Thresholds, Gasketing & Weather-stripping

HARDWARE SET: 01

DOORS 3, 4, 5 & 6

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5BB1 4.5 x 4.5 NRP | ND73JD-C06 RHO | 8000-6 57C1 KEYWAY

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Contra Costa Community College District
Diablo Valley College
PAC Restroom Renovation

Section 08 71 00 – Page 10 of 12
Door Hardware
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**HARDWARE SET: 02**

**DOORS 7 & 8**

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**HARDWARE SET: 04**

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END OF SECTION
SECTION 09 22 26

NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

1.2 Metal suspension system for the support of gypsum drywall in ceiling, a soffit installation for interior and exterior finishes.

1.3 RELATED SECTIONS
  A. Section 09 29 00 Gypsum Board
  B. Section 09 50 00 Acoustical Metal Ceilings
  C. Division 23 Heating Ventilating and Air Conditioning (HVAC)
  D. Division 26 Electrical

1.4 REFERENCES

   a. *ASTM A 1008 Standard specification for the Steel, Sheet, Cold Rolled Carbon, Structural, High Strength Low-Alloy and High Strength Low Alloy with Improved Formability
   c. ASTM C 635 Standard Specification for Metal Suspension Systems
   d. ASTM C 645-09 - Standard Specification for Nonstructural Steel Framing Members
   e. ASTM C 754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
   f. ASTM C841 Standard Specification for Installation of Interior Lathing and Furring
   g. ASTM C842 Standard Specification for Application of Interior Gypsum Plaster
   h. ASTM C 847 - Standard Specification for Metal Lath
   i. ASTM C926 Standard Specification for Application of Portland Cement-Based Plaster
   j. ASTM C 1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster (Plaster and Stucco Accessories)
   l. International Building Code
   m. ESR-1289: International Code Council Evaluation Service Report
   n. Miami Dade County, Florida Wind Uplift Compliant

   *American Society for Testing and Materials

1.5 SUBMITTALS

   A. Product Data: Submit manufacturer’s technical data for each type of Metal Framing system required.

   B. Samples: Metal Framing System, including main runner and 4 foot cross tees.
C. Shop Drawings: Layout and details of Metal Framing System. Show locations of items which are to be coordinated with, or supported by the metal suspension system.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.

B. Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, and manufacturer’s installation instructions.

C. Fire Resistance Characteristics: For fire-resistance-rated assemblies that incorporate Metal framing systems provide materials and construction identical to those tested in fire resistance assembly as indicated in the construction documents and or architectural plans in accordance with ASTM E119.

1.7 DELIVERY, STORAGE, AND HANDLING

1.8 Protect and store products in manufacturer's unopened packaging until ready for installation.

1.9 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

1. Acceptable Manufacturer: Armstrong World Industries Lancaster PA

1. Suspensions System Components

2. Armstrong Drywall Suspension Systems all main beams and cross tees shall be commercial quality hot-dipped galvanized steel

   a. Main Beams: manufactured main beam—1-1/2” knurled face with ScrewStop™ reverse hem by 1-11/16 inches high by 144 inches long with factory punched cross tee routs and hanger wire holes and SuperLock™ main beam clip for a strong secure connection and fast accurate alignment. Heavy-duty performance per ASTM C635.

      i. Main Beams
          1. HD8906 – 12’

   b. Cross Tee: manufactured cross tee – 1-1/2” knurled face with ScrewStop™ reverse hem by 1-1/2 inches high by (50), (48), (36), (26), (24), (14) inches long with factory punched cross tee routs and hanger wire holes and XL stake on clip for a strong secure connection.
i. Cross tee
   1. XL8965 - 6’
   2. XL8945P - 4’
   3. XL8926 - 2’

  c. Wall Molding: manufactured knurled face angle molding. Locking Angle molding pre-engineered locking tabs punched 8” on center - 1-1/4 inch by 1-1/4 inch by 144 inches in length.

   i. Wall Angle items
      1. KAM10 – Knurled Angle - 1-1/4” X 120”
      2. KAM12 - 1-1/4” X 144”
      3. KAM151020E - 1-1/2” X 120” - 22 Gauge
      4. KAM151020 - 1-1/2” X 120” - 20 Gauge
      5. KAM21025 - 1-1/2” X 120” - 25 Gauge
      6. KAM21020EQ - 1-1/2” X 120” - 22 Gauge
      7. KAM21020 - 1-1/2” X 120” - 20 Gauge

   d. Channel Molding: manufactured Unhemmed Channel Molding nominal 3/4 inch by 1-9/16 inch by 1-1/4 inch by 120 inches in length.

   i. Channel Molding items: 7838 – 120” & 7858 – 144”

  e. Axiom One Piece Drywall Bottom Trim: available 2.5”, 4” and 6”

  f. Hanger wire: a Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least time three times the design load, but not less than 12-gauge.

  g. Accessories:

     i. **Drywall Angle Clips (DWAC)** 30, 45, 60 and 90 degree are used to create positive and secure angles for drywall and ceiling installations on either main beams or cross tees.

     ii. **Main Beam Adapter Clip (MBAC)** Attaches to the web of acoustical suspension system allows for larger screwing surface metal thickness meets ASTM requirements.

     iii. **DW58LT** Transition clip for 5/8” drywall with locking tabs facilitates transition from drywall to acoustical ceiling one sided hold down clip eliminates the need for drywall bead.

---

**PART 3 EXECUTION**

3.1 **EXAMINATION**

   A. Prior to installation, inspect previous work of all other trades. Verify that all work is complete and accurate to the point where this installation may properly proceed in strict accordance with framing shop drawings.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Installation: In accordance with all approved plans, details, and manufacturer’s installation guidelines located in the Armstrong Drywall Grid System Hanging and Framing Flat Ceilings CS-3539.

(1) Install seismic components if required by the building code. Seismic components to be specified on the architectural plans by the project engineer or design team.

END OF SECTION
DIVISION: 09 00 00—FINISHES
SECTION: 09 22 26—SUSPENSION SYSTEMS

REPORT HOLDER:

WORTHINGTON ARMSTRONG VENTURE (WAVE)

101 LINDENWOOD DRIVE, SUITE 350
MALVERN, PENNSYLVANIA 19355

EVALUATION SUBJECT:

FIRE-RESISTANCE-RATED AND NONFIRE-RESISTANCE-RATED
SUSPENDED CEILING SYSTEMS

“2014 Recipient of Prestigious Western States Seismic Policy Council
(WSSPC) Award in Excellence”

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DIVISION: 09 00 00—FINISHES
Section: 09 22 26—Suspension Systems

REPORT HOLDER:
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101 LINDENWOOD DRIVE, SUITE 350
MALVERN, PENNSYLVANIA 19355
(610) 722-1218
www.armstrong.com
jikelly@armstrong.com

EVALUATION SUBJECT:
FIRE-RESISTANCE-RATED AND NONFIRE-RESISTANCE-RATED SUSPENDED CEILING SYSTEMS

ADDITIONAL LISTEE:
ARMSTRONG WORLD INDUSTRIES
POST OFFICE BOX 3001
LANCASTER, PENNSYLVANIA 17604

1.0 EVALUATION SCOPE
Compliance with the following code:
- 2013 Abu Dhabi International Building Code (ADIBC)\footnote{The ADIBC is based on the 2006 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.}

Properties evaluated:
- Exterior and interior finish
- Fire-resistance
- Structural

2.0 USES
The suspended ceiling systems described in this report are suspended or direct-hung, concealed framing, ceiling assemblies used in fire-resistance-rated and nonfire-resistance-rated construction for both exterior and interior applications.

3.0 DESCRIPTION
3.1 General:
The 8900 series ceiling system is designed for screw-attached wood panels (complying with DOC PS 1 or PS 2) of nonfire-resistance-rated or screw-attached gypsum wallboard (complying with ASTM C36 or ASTM C1398) ceiling panels of fire-resistance-rated, interior roof and/or floor-ceiling assemblies.

The XL 7936 series ceiling system is designed for interior or exterior nonfire-resistance-rated roof-ceiling and/or floor-ceiling assemblies. For exterior ceilings without weather-exposed surfaces, as defined in IBC Section 2502, the system is designed for screw-attached gypsum sheathing (complying with ASTM C79 or ASTM C1936). For exterior weather-exposed surfaces, the system is designed for screw-attached metal lath (complying with ASTM C847) with three coats of cement (Type I or II portland cement complying with ASTM C150) plaster finish.

3.2 Components:
3.2.1 Main Runners: Main runners used in both the 8900 series ceiling systems and XL 7936 series ceiling systems are the 8900 (Drywall Stucco and Plaster System) series main runners. All main runners are classified as heavy-duty in accordance with ASTM C635. The main runners have an inverted T-shape and double web. The double web section is rotary-stitched together with a knurled lower flange for screw penetration, and is reverse-folded over for screw retention along the entire length of the bottom flange. The runners are cold-formed from ASTM A663, CS Type B steel, and have a hot dipped, galvanized G-40 coating for interior ceilings or a G-90 coating for exterior ceilings. Table 1 and Figure 1 specify the dimensions, lengths and allowable transverse loads.

The HD 8906, HD8906IIIC and HD890610 main runners for fire-resistance-rated systems have an added end-coupling for temperature expansion relief, and additional routs for added cross-runner spacing to accommodate field assembly of NEMA Type F lighting in nonfire-rated installations.

The SP-135 main runners for stucco systems are non-fire-resistance-rated systems. SP-135 main runner rout spacing is designed for cross-runner spacing of 13\(\frac{\text{1}}{2}\) inches (343 mm) on center to accommodate stucco lathing.

The main runner has lengths and routing that allow the ceiling framing system to be assembled in the field without field-cutting or screw fastening.

3.2.2 Cross Runners: Cross runners include the XL 7836 (Stucco System) series and the 8900 (Drywall Stucco and Plaster System) series.

The XL 7936 (Stucco System) cross runners have an inverted T-shaped double web. The cross runners are
cold-formed from 0.018-inch-thick (No. 26 MSG) steel that conforms to ASTM A653, CS Type B, and have a hot-dipped galvanized G-40 coating for interior ceilings or a G-90 coating for exterior ceiling. The double web section is rotary-stitched together with a knurled lower flange for screw penetration, and a reverse-folded over for screw retention along the entire length of the bottom flange.

The 8900 (Drywall Stucco and Plaster System) series cross runners have an inverted T-shape and a double web. The cross runners are cold-formed from 0.018-inch-thick (No. 26 MSG) and 0.015-inch-thick steel that conforms to ASTM A653, CS Type B, and have a hot-dipped galvanized G-40 coating for interior ceilings or a G-90 coating for exterior ceilings. The double web section is rotary-stitched together with a knurled lower flange for screw penetration, and a reverse-folded hem for screw retention along the entire length of the bottom flange. Table 2 and Figure 1 specify dimensions, lengths, and allowable transverse loads.

The XL 8947, XL 8947P, XL 8925 and XL 7918 cross runners are used to accommodate NEMA Type F lighting fixtures. These cross runners have factory-knurled reverse hems at the lower flange to receive screws.

The 8900 (Drywall Stucco and Plaster System) series includes cross runners for both fire-resistance-rated and nonfire-resistance-rated drywall ceiling assemblies. XL 8965, XL 8947, XL 8947P, XL 8945, XL 8945P, XL 8341, XL 8925, XL 8926 and XL 7918 cross tees are used in fire-resistance-rated drywall assemblies, while XL 8947, XL 8947P, XL 8926, XL 8925 and XL 7916 cross tees are used in nonfire-resistance-rated assemblies. The cross tees have additional routs to accommodate a full flange opening for NEMA Type F lighting fixtures. The additional routs allow field assembly of the gypsum board ceiling framing without cutting or fastening.

3.2.3 Hanger Wire: Hanger wire for suspended ceilings other than plaster, and any fixtures, must comply with IBC Section 2506.2.1. Hanger wires for plaster ceiling framing systems must comply with ASTM C1063 for use under the IBC. For exterior applications, corrosion-resistant hanger wires, fasteners and accessories must be used.

3.2.4 Accessories: Each system has accessory items that include support angles and corner caps. Steel for accessory items complies with ASTM A568 designation 1008 or 1010, and has a G40, or G90 galvanization coating designation in accordance with ASTM A653.

3.3 The 8900 (Drywall System) Series Two-hour Fire-resistance-rated Suspended Ceiling System:

The 8900 series concealed grid system is part of a two-hour, fire-resistance-rated roof-ceiling or floor-ceiling assembly. The rating applies to restrained and unrestrained assemblies as described in IBC Section 703.2. Figure 2 shows assembly details. General requirements in IBC Section 711 must be observed.

4.0 INSTALLATION

4.1 General:

The suspended ceiling system must be installed in accordance with this report and the manufacturer's published installation instructions. Except for installations with plaster ceilings, the suspended ceiling system must be installed in accordance with 2012 and 2009 IBC Section 808.1.1.1 (2006 IBC Section 803.9.1.1) for systems exceeding 4 psf and less than 10 psf, as applicable. The minimum tension and compression capacity of framing member connections is 180 pounds (800 N). For plaster ceilings, the suspended ceiling system must be installed in accordance with IBC Sections 2510 and 2512.

4.2 Main Runners:

Main runners must be installed and leveled to within 1/16 inch in 10 feet (6.4 mm in 3048 mm), with the supporting wire taut. Vertical suspension hanger wire must be installed within 6 inches (152 mm) of the main runner fire expansion relief. The design loads for main runners must be less than or equal to the capacities allowed in Table 1 of this report. Supports for the main runners that consist of vertical hangers, perimeter hangers, and lateral force bracing must be installed in accordance with the applicable code.

4.3 Cross Runners:

Main runners, or other cross runners, must support cross runners to within 1/32 inch (0.80 mm) of the required center-to-center spacing. This tolerance must be noncumulative beyond 12 feet (3658 mm). Intersecting runners must be installed to form a right angle to the supporting members.

The maximum design loads for cross runners must be less than or equal to the capacities allowed in Table 1 of this report. A cross runner that supports another cross member must have a minimum uniformly distributed load capacity of 12 pounds per linear foot (175 N/m).

4.4 Seismic Design:

4.4.1 Seismic Design Requirements under the 2012 IBC: Suspended ceilings constructed of lath and plaster or gypsum boards, screw or nail attached to suspended members that are laterally braced to the structure above, are exempt from the provisions found in Section 13.5.6 of ASCE 7-10 as referenced in IBC Section 1613, and must be designed and installed to support the lateral loads determined in accordance with Section 13.3 of ASCE 7-10.

4.4.2 Seismic Design Requirements under the 2009 and 2006 IBC: Seismic design and installation details of the ceiling system must be in accordance with Section 13.5.6 of ASCE 7-05 as referenced in IBC Section 1613. Suspended Ceilings constructed of lath and plaster or gypsum boards, screw or nail attached to suspended members that support a ceiling on one level extending from wall to wall, are exempt from the lateral load design requirements of CISC 3-4.

4.5 Partitions:

The partitions must be laterally supported as required by Section 13.5.8 of ASCE 7 as referenced in IBC Section 1613.

4.6 Gypsum Wallboard Attachment:

Gypsum wallboard must be installed and fastened to the ceiling framing system in accordance with IBC Section 2508.

4.7 Plaster Attachment:

Metal plaster bases must be installed in accordance with ASTM C1063. To attach the lath, minimum 1-inch-long, No. 8, Type S, oval head screws per ASTM C1002 must be used. These screws must secure the metal lath to the runners and perimeter members at 6 inches (305 mm) on center in accordance with IBC Section 2510.

4.8 Special Inspection:

Suspended ceilings in Seismic Design Categories D, E or F must be subjected to periodic special inspection during anchorage of suspended ceilings in accordance with the requirements of IBC Section 2506.2.1 and Section...
5.0 CONDITIONS OF USE

The suspended ceiling systems described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The ceiling suspension main and cross runners are fabricated and installed in accordance with this report and the manufacturer's published installation instructions. In the event of a conflict between the manufacturer's installation instructions and this report, this report governs.

5.2 Design loads and spans of main and cross runners must comply with Tables 1 and 2 of this report.

5.3 Suspended ceiling systems must be designed to resist the lateral loads determined in accordance with Section 13.3 of ASCE 7-10 for recognition under the 2012 IBC (and in accordance with ASCE 7-05, Section 13.5.6, for recognition under the 2009 and 2006 IBC). The documents must be prepared by a registered design professional where required by statutes of the jurisdiction in which the project is to be constructed.

5.4 For Seismic Design Categories C, D, E or F, a quality assurance plan complying with ASCE 7, Section 11A, must be submitted to the code official.

5.5 Periodic special inspections must be provided in accordance with Section 4.8 of this report and ASCE 7-10 (for 2012 IBC) and ASCE 7-05 (for 2009 and 2006 IBC), Section 11A.1.3.9, Item 2 of ASCE 7, Section 13.5.6.2.2, and Item h of ASCE 7-05. A statement of special inspection must be provided as required in 2012 IBC Section 1704.3 (2009 and 2006 IBC Section 1705.3, Item 4.3).

5.6 The ceiling framing systems must not be used to provide lateral support for walls or partitions, except as provided for in ASCE 7, Section 13.5.8.1.

5.7 The ceiling systems must be braced to resist seismic forces as determined from Section 1613 of the IBC.

5.8 The supporting construction of the ceiling system has not been evaluated and is outside the scope of this evaluation report. The code official must approve the roof or floor construction supporting the suspended ceiling system.

5.9 The ceiling systems are limited to ceilings not considered accessible in accordance with Item 28 of 2012 IBC Table 1607.1 (Item 32 of 2009 and 2006 IBC Table 1607.1).

5.10 For exterior ceiling installations, the ceiling systems must be designed for wind loads.

5.11 Light fixtures must be positively attached to the suspended ceiling system with connectors having a minimum capacity, in any direction, of 100 percent of the lighting fixture weight. Lighting fixtures may also be attached to the grid with clips complying with the ICC-ES Acceptance Criteria for Attachment Devices for Recessed Light Fixtures (Luminaires) in Suspended Ceiling Systems (AC184).

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with ICC-ES Acceptance Criteria for Suspended Ceiling Framing Systems (AC368), dated February 2012.

6.2 Reports of fire-resistance tests in accordance with ASTM E119 (UL 263).

7.0 IDENTIFICATION

Cartons of all products are identified with the name and address of Armstrong World Industries, Inc., the evaluation report number (ESR-1289) and the word "WAVE."
### TABLE 1—DIMENSIONS AND ALLOWABLE LOADS FOR MAIN RUNNERS

<table>
<thead>
<tr>
<th>CATALOG NUMBER</th>
<th>TYPE</th>
<th>LENGTH (inches)</th>
<th>BASE-METAL THICKNESS (inch)</th>
<th>MAXIMUM SPAN (feet)</th>
<th>ALLOWABLE LOADS</th>
</tr>
</thead>
<tbody>
<tr>
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<td>HD8906 IIC</td>
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<td>O</td>
<td>135</td>
<td>0.018</td>
<td>4</td>
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</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 p! = 14.59 N/m, 1 lbf = 4.448 N.

1Runner web is stitched.

### TABLE 2—DIMENSIONS AND ALLOWABLE LOADS FOR CROSS RUNNERS

<table>
<thead>
<tr>
<th>CATALOG NUMBER</th>
<th>TYPE</th>
<th>LENGTH (inches)</th>
<th>BASE-METAL THICKNESS (inch)</th>
<th>MAXIMUM SPAN (feet)</th>
<th>ALLOWABLE LOADS</th>
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</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 p! = 14.59 N/m, 1 lbf = 4.448 N.
TYPE A

TYPE B

TYPE O

TYPE P

FIGURE 1
FIGURE 2—SERIES 8900 TWO-HOUR-FIRE-RESISTANCE-RATED ASSEMBLY

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 4.88 kg/m², 1 gallon = 3.8 L, 1 sq. ft. = 0.0929 m², 1 psi = 6.89 kPa, 1 lbm = 0.45 kg, 1 sq. in. = 645.16 mm².

1. **Roof Covering**: Roof covering consisting of hot-mopped or cold-application materials compatible with insulation(s) described in Item 2 that provide Class A, B or C coverings.

2. **Roof Insulation—Mineral and Fiber Boards**: The boards must comply with ASTM C612, Type IA or IB. Nominal 1-inch-thick minimum, 24-inch-by-48-inch or larger. To be applied in six layers as follows:
   A. May be loosely laid on top of gypsum sheathing (Item 4).
   B. May be fastened to steel roof deck (through gypsum sheathing) with mechanical fasteners (Item 7).
   C. May be bonded to gypsum sheathing with adhesive.
   D. Individual layers of mineral and fiber boards above the mechanical fasteners, if used, may be bonded to the bottom layer and to each other with adhesive or hot asphalt.

First layer to be installed perpendicular to gypsum sheathing direction, with end joints staggered 2 feet in adjacent rows. Each layer of boards must be offset, in both directions, from layer below a minimum of 12 inches in order to lap all joints.

3. **Sheathing Material (Optional)**: Vinyl film or paper scrim vapor barrier, applied with adhesive to the gypsum sheathing. Adjacent sheets overlapped 2 inches.

4. **Gypsum Sheathing**: Water-resistant core gypsum sheathing complying with ASTM C79. Supplied in sheets nominally 2 by 4 feet to 4 by 12 feet, by nominal 3/8 inch thick. Minimum weight is 2.0 psf. Applied perpendicular to the steel roof deck direction, with or without adhesive or mechanical fasteners through the insulation. End joints to occur over crests of steel roof deck, with end joints staggered 1 foot or more in adjacent rows.

5. **Steel Roof Deck**: Minimum 1/2-inch-deep, nominal 36-inch-wide fluted units, minimum 0.029-inch-thick (No. 22 gage) galvanized steel. Welded to supports with 3/16-inch puddle welds, through welding washers. Side lap joints of adjacent units are welded or secured together with No. 8 by 3/4-inch-long, self-drilling, self-tapping steel screws midway between steel joists.

6. **Adhesive (Optional)**: Applied to the crest of the steel roof deck in 1/2-inch-wide ribs at a rate of 0.4 gallon per 100 square feet (approximately 6 inches on center). Applied in 1/2-inch-wide ribs at 0.4 gallon per 100 square feet between the vapor barrier and the gypsum sheathing, and between the sheathing and the first layer of roof insulation.

7. **Mechanical Fasteners (Optional)**: (Not shown) Insulation clips with discs may be used to secure roof insulation to the steel roof deck (through gypsum sheathing). Clips are 3/8 inches long, having a shank diameter of 0.203 inch. Clips designed so that their tips "lock" against the underside of the steel roof deck. Steel discs are 21/8 inches in diameter, and 0.030 inch thick. Fastener spacing is per manufacturer's specifications.

8. **Hot Asphalt or Coal Tar Pitch (Optional)**: (Not shown) May be applied between layers of roof insulation when applied at a rate not exceeding 25 lbs./100 sq. ft.

9. **Steel Joists**: Type 8H3 or 10K1, minimum size; spaced 48 inches on center, welded to end supports. NOTE: Design load must stress 8H3 joists to maximum bending stress of 22,000 psi.

10. **Bridging**: Minimum 1/2-inch-diameter steel rods are welded to top and bottom chords of each joist.
11. **Cold-rolled Channels:** Minimum 0.060-inch-thick (No. 16 gage) cold-rolled steel channels, 1\(\frac{1}{2}\) inches deep with \(\frac{5}{16}\)-inch flanges. Two channels are tied together back-to-back with 16SWG galvanized steel wire and are then wire-tied to top of joist lower chord with minimum 16 SWG galvanized steel wire, spaced as required to provide attachment provision for ceiling hanger wires between steel joists.

12. **Hanger Wire:** Number 12 SWG galvanized steel wire, twist-tied to bottom chord of joists or cold-rolled steel channels. Hanger wires are spaced 48 inches on center along main runners (at every other main runner/cross tee intersection). Hanger wires also to occur at all four corners of light fixtures, at midpoint of cross tees adjacent to light fixtures and air-duct outlets, and adjacent to each main runner splice.

13. **Air Duct:** Number 22 MSG (minimum) galvanized steel. Total area of duct opening not to exceed 225 square inches per 100 square feet of ceiling area. Total area of individual duct openings is not to exceed 225 square inches. Maximum opening dimension is 18 inches. Inside and outside faces of duct throat must be protected with \(\frac{1}{16}\)-inch-thick ceramic fiber paper, laminated to the metal. Duct supported by \(\frac{1}{16}\)-inch-deep, No. 16 MSG cold-rolled steel channels spaced not over 48 inches on center, suspended by No. 12 SWG galvanized steel wire.

14. **Damper:** Number 16 MSG minimum galvanized steel, sized to overlap duct opening 2 inches, minimum. Protected on both sides with \(\frac{1}{16}\)-inch-thick ceramic fiber paper, laminated to the metal and held open with a fusible link.

15. **Fixtures, Recessed Light:** Fluorescent-lamp-type steel housing, 2-by-4-foot size. Fixtures must be spaced so their total area does not exceed 24 square feet per each 100 square feet of ceiling area, and wired in conformance with the National Electrical Code.

16. **Fixture Protection—Gypsum Wallboard:** Same as Item 18. Cut to form a five-sided enclosure, trapezoidal in cross section, at least 1\(\frac{3}{4}\) inches higher than the light fixture housing. The fixture protection consists of a 23\(\frac{3}{4}\)-inch-by-49-inch top piece, two 47\(\frac{1}{4}\)-inch-long side pieces and two 23\(\frac{3}{4}\)-inch-long end pieces. The top edge of each fixture protection side piece may be notched 1 inch deep by 10 inches long near its midpoint.

17. **Steel Framing Members—Armstrong World Industries, Inc.:** Type 8900 Drywall stucco and plaster system main runners are nominally 12 feet long, and are spaced 48 inches on center. Ends of main runners at walls to rest on wall angle, without attachment, with \(\frac{1}{2}\)- to \(\frac{1}{4}\)-inch end clearance. Primary cross tees (1\(\frac{1}{2}\) inches wide across flange) or cross channels, nominally 4 feet long, are installed perpendicular to main runners and spaced 24 inches on center. Additional primary cross tees or cross channels are required at each wallboard and joint, 8 inches from, and on each side of, the wallboard end joint, and 8 inches from each side of light fixtures. Secondary cross tees (\(\frac{1}{8}\)-inch wide across flange), nominally 4 feet long, are installed at sides of light fixtures.

18. **Wallboard, Gypsum:** Five-eights-inch-thick, Type X, 4-foot-wide gypsum wallboard is installed with the long dimension perpendicular to cross tees, with side joints centered underneath main runners. Wallboard is fastened to each cross tee with 1-inch-long Type S screws, located \(\frac{1}{4}\) inch from end joints and \(\frac{3}{4}\) inch from side joints, and spaced 12 inches on center. End joints of adjacent wallboard sheets must be staggered not less than 4 feet on center. Wallboard is fastened to leg of wall angle with wallboard screws spaced 12 inches on center.

19. **Metal Trim Molding:** Number 25 MSG galvanized steel, measuring \(\frac{5}{16}\) inch deep, with \(\frac{1}{8}\)- and 1-inch-long legs. Placed over and against wallboard edges around light fixtures, with the 1-inch leg facing down and fastened to the cross tees and main runners with \(\frac{1}{16}\)-inch-long screws. Spacing of screws approximately 8 inches on center along 4-foot side, and 10 inches on center along 2-foot side, of light fixtures.

20. **Screw, Wallboard:** Number 6, Type S, 1- and \(\frac{1}{2}\)-inch-long, self-drilling and self-tapping screws.

21. **Finishing System:** (Not shown) Paper tape embedded in joint compound over joints, and covered with additional compound with edges feathered out. Wallboard screw heads covered with two layers of compound.

22. **Wall Angle:** (Not shown) Number 24 MSG painted steel with \(\frac{1}{8}\)-inch legs. Nailed to walls around perimeter of ceiling to support steel framing member ends and to permit screw attachment of the gypsum wallboard.
PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide gypsum board construction at walls and ceilings as shown, as specified and as needed for a complete and proper installation.

1.02 SUBMITTALS

A. Manufacturer's information for materials, installation and application.

B. Samples: Of components and accessories, upon request.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements

1. Fire-Resistance Ratings:

a. Comply with fire-resistance ratings as indicated and required by governing authorities and codes.

b. Provide materials, accessories, and application procedures which have been listed by a nationally recognized testing agency or tested according to ASTM E119 for type of construction shown.

B. Design Requirements:

1. Installation Tolerances:

a. Gypsum board surfaces to be painted shall have no measurable variation in any 2'-0" direction and a maximum variation of 1/4" in 10'-0" when a straightedge is laid on the surface in any direction.

b. Shim work as required to comply with specified tolerances.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM):


B. Gypsum Association (GA):

1. GA216, Recommended Specifications for the Application and Finishing of Gypsum Board.

2. GA-214-M-97 Recommended levels of Gypsum Board Finish.
1.05 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and stack flat.

B. Stack gypsum board so that long lengths are not over short lengths.

C. Gypsum board shall not be stored or stacked on floors in excess of forty pounds (40 lbs.) per square foot equivalent loading.

1.06 ENVIRONMENTAL CONDITIONS

A. Environmental Requirements:
   
   1. Temperature: During cold weather, in areas receiving gypsum board installation, maintain temperature range between fifty-five degrees (55°) and seventy degrees (70°) F for twenty four (24) hours before, during, and after gypsum board and joint treatment application.

   2. Ventilation:
      
      a. Provide ventilation during and following adhesives and joint-treatment applications.

      b. Use temporary air circulators in enclosed areas lacking natural ventilation.

      c. Under slow drying conditions allow additional drying time between coats of joint treatment.

      d. Protect installed materials from drafts during hot, dry weather.

B. Protection: Protect adjacent surfaces against damage and stains.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. United States Gypsum Co., USG Corp.

B. Georgia-Pacific Corp.

C. National Gypsum Co.

D. Substitutions: Refer to Section 01630.
2.02 MATERIALS

A. Gypsum Board: Comply with ASTM C840; maximum permissible lengths; ends square cut, tapered edges on boards to be finished.

1. Typical: ASTM C1396, Type X, fire rated gypsum board, impact resistant unless otherwise indicated.

2. 1/4" gypsum board where indicated.

3. First Layer at Double Layer Applications: ASTM C1396 or ASTM C442, Type X, fire rated gypsum backing board.

4. Tile and FRP Substrate: GP ‘Denshield’ Tileguard, or equal. 5/8” thick. Grade/rating as required by wall assembly. **WR Gypsum board is not acceptable.**

B. Gypsum Board Accessories: Comply with ASTM C840.

1. Provide protective coated steel corner beads and edge trim; type designed to be concealed in finished construction by tape and joint compound.

2. Corner Beads: Manufacturer's standard metal beads.

3. Vent Screeds: Types as indicated.


5. Reinforcing Tape, Joint Compound, Adhesive, Water, Fasteners: Types recommended by system manufacturer and conforming to ASTM C475.
   a. Typical Joint Compound: Chemical hardening type for bedding and filling, ready-mixed or powder vinyl type for topping.

   a. Back control joints with 4 mil thick polyethylene air seal.

7. Reveals: Extruded aluminum special trim pieces in manufacturer's standard or custom shapes to conform to configurations and dimensions indicated.
   a. Manufactures:
      1) Fry Reglet Corp./Drywall Moldings.
      2) MM Systems Corp./Drywall Moldings.
      3) Gordon Inc./Final Forms I Drywall Trims.
      4) Substitutions: Refer to Section 01630.

8. Metal suspension systems:
   a. USG DGL Drywall Suspension System.
   b. National Gypsum Company
   c. Or equal.
9. Screws: Type W Bugle head screws for wood studs or Type S Bugle head screws for metal studs, meeting ASTM 1002 or C954. Length as required according to all applicable codes and standard installation procedures. Nails will not be considered an acceptable alternate.

C. Acoustical Accessories:

1. Resilient Channels: Provide resilient channels where indicated and where required to provide required sound transmission classifications.
   
a. Fasteners and Anchorages: As recommended by gypsum board system manufacturer for maximum STC and NRC ratings.

2. Acoustical Insulation: Preformed mineral fiber, ASTM C665, Type I; friction fit type without integral vapor barrier; as required to meet STC ratings indicated, or of thickness indicated.

3. Acoustical Sealant: ASTM C919, type recommended for use in conjunction with gypsum board.
   
a. Type: Paintable, non-shrinking and non-cracking where exposed, nondrying, nonskinning, nonstaining, and nonbleeding where concealed.

4. Electrical Box Pads: Provide at outlet, switch and telephone boxes in walls with acoustical insulation.
   
a. Manufacturers for Non-Fire Rated Partitions:
      
1) Harry A. Lowry & Associates (800.772.2521)/Lowry’s Electrical Box Pads.
2) Tremco Sheet Caulking (650.572.1656).
3) Fire rated partition material manufacturers.
4) Substitutions: Refer to Section 01630.

b. Manufacturers for Fire Rated Partitions:

1) Hevi-Duty Nelson (800.331.7325)/Fire Rated FSP Firestop Putty Pads.
2) Specified Technologies, Inc. (800.992.1180)/Fire Putty Pads.
3) Substitutions: Refer to Section 01630 – Product options and Substitutions.

D. Textures:

1. Classroom and corridor walls and soffits: light orange peel.

2. Storage, utility, janitor: light knock-down.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Check framing for accurate spacing and alignment.

B. Verify that spacing of installed framing does not exceed maximum allowable for thickness of gypsum board to be used.

C. Do not proceed with installation of gypsum board until deficiencies are corrected and surfaces to receive gypsum board are acceptable.

D. Protrusions of framing, twisted framing members, or unaligned members shall be repaired before installation of gypsum board is started.

E. Clean partition cavities prior to installation of gypsum board.

3.02 APPLICATION OF GYPSUM BOARD

A. General: Work shall comply with applicable requirements of specified reference standards, except where more stringent requirements are specified; by local codes; or by manufacturer or gypsum board.

1. Neatly fit and stagger end joints.

2. Make joints occur on different studs at opposite sides of partition.

3. Cut and fit neatly around outlets and switches.

4. Installation techniques shall result in plumb and straight surfaces with no waves or buckles, free of unevenness at joints.

5. Brush cut edges and penetrations of water-resistant gypsum board with water resistant tile adhesive.

6. Nailing is not permitted for either walls or ceilings in any location. No exceptions will be made.

B. Ceilings:

1. Apply with long dimension at right angles to horizontal supports. Screw to all bearings at 8" o.c. perimeter and 12" o.c. field.

2. Provide solid bearing at end joints.

3. All joints loosely butted; No screws less than 3/8" from edges and ends at boards.
C. Partitions:

1. General: Apply with long dimensions at vertical to supports and with all abutting edges over supports. Screw to each bearing at 8” o.c. perimeter and 12” o.c. field.

   a. Apply full lengths between floor and ceiling.

   b. Start application at corner of room or space.

   c. Stagger joints to occur on different framing members on opposite sides of partitions.

   d. Do not place butt ends against tapered edges.

   e. Cut, fit neatly around all outlets, switches, and other penetrating items.

   f. Install gypsum board within ¼” of penetrating ducts, pipes, conduit, outlet boxes, and other penetrating items.

D. Fastening:

1. Attach gypsum board with fasteners as specified according to manufacturer’s latest specifications.

2. Space fasteners in accordance with more stringent of GA-216 recommendations or UL standards.

3. Drive screws with power screwdriver recommended by gypsum board manufacturer.

4. Do not hammer-drive screws.

5. Do not break through paper surface of gypsum board.

6. Set fastener heads slightly below surface of gypsum board.

7. Stagger fasteners opposite each other on adjacent ends or edges.

8. Omit fasteners at edges where metal edge trim will be installed.

E. Double-Layer Application:

1. Apply base layer vertically, offsetting vertical joints at least one (1) stud space between layers.

2. Fasten to supports in accordance with more stringent of manufacturer’s instructions, GA-216 recommendations or UL standards.

3. Precut and fit face layer by laminating to base layer with adhesive.
4. Provide temporary support for face layer, by fasteners or shoring, until adhesive is dry.
   a. Provide alternate permanent support by attaching face layer to base layer with screws in accordance with manufacturer's instructions.

F. Metal Trim and Moldings:

1. Apply trim at exterior corners and at interior corners where gypsum board intersects metal or other dissimilar materials.

2. Install in longest lengths practicable.

3. Run trim and moldings straight and square with planes.

4. Edges: Apply applicable shape metal edge trim at exposed edges of gypsum board and where otherwise shown.
   a. Gypsum Board Abutting Other Materials: Install edge trim with 1/4" clearance to allow for caulking.

5. External Corners: Apply metal corner beads at external corners and where otherwise shown in single lengths.

G. Perimeters, penetration, and openings in sound-rated partitions shall be installed and sealed in accordance with requirements specified in Section 07 90 00 – Sealants & Caulking

3.04 TAPING AND FINISHING

A. Provide level #4 finish per GA-214-M-97 for all exposed areas

B. Apply finishing compound and tape in accordance with manufacturer's directions.
   1. Do not apply tape and joint compound over joints containing acoustical sealant until the sealant has completely cured.

C. Center tape over joints and embed in uniform layer of joint compound of sufficient width and depth to provide form and complete bond.
   1. Apply skim coat while embedding tape.
   2. At water-resistant gypsum board, fill fastener heads, penetrations, and joints with water-resistant compound.

D. Treat angles with reinforcing tape folded to conform to adjacent surfaces and straight, true angles.

E. Provide minimum twenty four (24) hours drying time between applications of compounds.

F. Apply coat of finishing compound over joint compound and tape.
1. Spread evenly and feather out beyond edge of board.

2. After first finishing coat is thoroughly dry, cover with second coat with edges feathered out slightly beyond the preceding coat.

3. Apply third coat if required to visually conceal gypsum board joints.

G. Give dimples at fastener heads and marred spots on surface of gypsum board one coat joint compound and two coats finishing compound, applied in same manner as for joints specified above.

H. Conceal flanges of metal reinforcement with minimum two coats compound.

1. Extend compound 8" to 10" each side of metal nosing.

I. After each application of joint or finishing compound has dried, lightly sand joints.

1. Leave gypsum board and treated areas uniformly smooth and ready for painting or other decoration.

J. Where gypsum board is covered with a wainscot or wall covering, apply one (1) coat of topping compound over joint compound, sand smooth and prime.

K. Where acoustical tile is glued to gypsum board apply one coat topping compound over joint compound, sand smooth and prime.

3.06 PROTECTION OF FINISHED WORK

A. Provide proper procedures for protection of completed units from damage or deterioration until final acceptance of the Project.

3.07 DIVISION OF THE STATE ARCHITECT

A. Interpretive Regulation (IR25-3) Drywall Ceiling Suspension

B. Materials: Materials are to comply with applicable UBC Standards. Gypsum board is either ½ inch or 5/8 inch in thickness.

C. Design: For lateral load, refer to CBC, Section 1632A. The weight of the suspended ceiling shall not be less than four (4) pounds per square foot for design purposes.

D. Details of Construction.

1. General: Gypboard ceilings should not support building components other than air conditioning/heating grills or light fixtures. All such components shall be supported either directly from main runners, or by supplemental framing which is supported by main runners. No vertical loads other than gypsum board dead load shall be applied to cross-furring.

2. Vertical Support System: There are many possible variations of hanger and main runner
sizes and spacings listed in the CBC, Table No. 25A-A, and all of the combinations are acceptable. However, the main runners that are most frequently used are 1-1/2 inch cold rolled channels, 0.475 lbs/ft. This is acceptable provided the following requirements are met:

a. Vertical hanger wires are #9 gage and galvanized soft-annealed steel.

b. Cross-furring may be 7/8 inch, 25 gage galvanized hat sections at 24 inches o.c. maximum.

c. If main runners are spaced at 4'-0" o.c., hanger wires shall be spaced at 3'-0" o.c. maximum.

d. If main runners are spaced at 3'-6" o.c., hanger wires shall be spaced at 3'-6" o.c. maximum.

e. If main runners are spaced at 3'-0" o.c., hanger wires shall be spaced at 4'-0" o.c. maximum.

f. To use a main runner spacing of 4'-0 o.c. with a hanger spacing of 4'-0" o.c., main runners must be 1-1/2 inch hot rolled channels weighing 1.12 lbs/ft. Also, #8 gage galvanized hanger wires would be required.

3. The following requirements apply to all wire hangers/runner combinations:

a. Hangers should be saddle-tied around main runners to develop the full strength of the hangers.

b. Cross-furring should be saddle-tied to the main runners with one strand of #16 gage, or two strands of #18 gage tie wire.

c. Main runners should be spliced by lapping and interlocking flanges 12 inches minimum and tying near each end with double loops of #16 gage wire.

d. Cross-furring should be spliced by lapping and interlocking the pieces eight (8) inches minimum and tying near each end with double loops of #16 gage wire.

4. Fasten hangers wire with not less than three (3) tight turns. Fasten bracing wires with four (4) tight turns. Make all tight turns within a distance of 1-1/2 inches. Hanger or bracing wire anchors to the structure should be installed in such a manner that the direction of the anchor aligns as closely as possible with the direction of the wire.

Note: Wire turns made by machine where both strands have been deformed or bent in wrapping can waive the 1-1/12 inch requirement, but the number of turns should be maintained, and be as tight as possible.

Separate all ceiling hanger and bracing wires at least six (6) inches from all unbraced ducts, pipes, conduit, etc.

When drilled-in concrete anchors or shot-in anchors are used in reinforced
concrete for hanger wires, 1 out of 10 must be field tested for 200 lbs. in tension. When drilled-in concrete anchors are used for bracing wires, 1 out of 2 must be field tested for 440 lbs. in tension. Shot-in anchors in concrete are not permitted for bracing wires. If any shot-in or drilled-in anchor fails, see Section 1923A.3.5, Title 24.

Note: Drilled in or shot-in anchors require special DSA approval when used in prestressed concrete.

Provide trapeze or other supplementary support members at obstructions to typical hanger spacing. Provide additional hangers, struts or braces as required at all ceiling breaks, soffits, or discontinuous areas. Hanger wires that are more than 1 in 6 out of plumb are to have counter-sloping wires.

E. Support and anchorage of light fixtures and mechanical services.

1. All recessed or drop-in light fixtures, as well as ceiling mounted mechanical air terminals and services, shall be supported directly by main runners or by supplemental framing which is supported by main runners and positively attached with screws or other approved connectors.

2. Surface mounted fixtures shall be attached to a main runner with a positive clamping device made of material with a minimum of 14 gauge. Rotational spring clamps do not comply.

F. Lateral System.

1. Wire Brace System: Provide bracing assemblies, per Figure 1 of IR 25-2, as determined by calculations, with the following limitations:

a. For school buildings, place bracing assemblies at a spacing not more than 12 ft. by 12 ft. on center.

b. For Essential Services Buildings, place bracing assemblies not more than 8 ft. by 12 ft. on center.

c. Provide bracing assemblies at not more than six (6) feet from each perimeter wall and at the edge of vertical ceiling offsets.

d. The slope of bracing wires shall not exceed 45 degrees from the plane of the ceiling and shall be taut. Splices in bracing wires are not to be permitted without special DSA approval.

e. Ceiling grids members may be attached to not more than two (2) adjacent walls. Ceiling grid members shall be at least ½ inch free of other walls. If walls run diagonally to ceiling grid runners, one end of main and cross runners should be free, and a minimum of ½ inch clear of wall.

f. Suspended ceiling systems with an area of 144 square feet or less, and fire rated
ceiling systems with an area of 96 square feet or less, surrounded by walls which connect directly to the structure above, do not require bracing assemblies when attached to at least two adjacent walls.

2. Alternate System: Design as a diaphragm, similar to plywood diaphragm concept, subject to acceptance by the DSA Regional Office.

3. Diaphragm Ratios:
   Horizontal 2:1 maximum
   Vertical 1:1 maximum

4. A maximum diaphragm shear equal to 50 lbs./ft. is allowed with 1 inch or 1-1/4 inch Hi-lo Type S, or S-12, bugle head screws at 12 inches o.c. at all gypsum board edges (3/8 inch screw edge distance) and at all intermediate supports. A wall constructed similarly can resist the same shear force provided the gypsum board is on the same side of the studs as the ceiling is, and a positive connection between the ceiling and the wall is detailed. The gypsum board diaphragms are to resist lateral loads due to their own weight and/or the ceiling diaphragms(s) only.

5. Details are required providing for lateral load transfer from the gypsum board to shear walls, or other lateral load resisting elements, on all four sides of the diaphragm.

END OF SECTION
SECTION 09 30 00

TILE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior floor and base tile installed over waterproofing/crack-isolation/anti-fracture membrane using thinset method with epoxy grouted joints.

B. Exterior floor tile installed using full mortar bed method with cementitious grouted joints.


1.2 RELATED SECTIONS

A. Section 03336 - Architectural Concrete - Building: Concrete topping slabs with embedded radiant heat tubing.

B. Section 03350 - Concrete Finishing: Troweling and finishing of concrete floor slabs to receive waterproofing membranes.

C. Section 05512 – Metal Stairs with Precast Concrete Treads: Precast concrete treads, risers and intermediate landings to receive thinset floor tile.

D. Section 07140 - Fluid Applied Waterproofing: Waterproofing below mortar beds at exterior tile.

E. Section 07900 – Joint Sealers: Sealants and backing material other than specified in this section.

F. Section 09110 - Non-Load Bearing Metal Framing: Metal stud framing and backing.

G. Section 09250 - Gypsum Board: Gypsum board to receive thinset wall tile outside toilets.

H. Section 09251 – Cementitious Backing Board: Cementitious backing units to receive ceramic wall tile within toilets.

I. Section 10163 – Stainless Steel Toilet Compartments: Toilet partitions and urinal screens secured to framing through tile finish.

J. Section 10800 - Toilet and Bath Accessories: Toilet accessories secured to framing through tile finish.
K. Division 15 - Mechanical: Floor drains.

1.3 REFERENCES

A. American National Standards Institute:

1. ANSI A108.1B – Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement Mortar.

2. ANSI A108.4 – Ceramic Tile Installed with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive.

3. ANSI A108.5 - Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.

4. ANSI A108.6 - Ceramic Tile Installed with Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy.

5. ANSI A118.3 - Chemical-Resistant, Water Cleanable, Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Adhesive.

6. ANSI A118.4 - Latex-Portland Cement Mortar.

7. ANSI A118.7 - Polymer Modified Tile Grouts for Tile Installation.

8. ANSI A118.10 – Load Bearing, Bonded Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.

9. ANSI A118.12 – Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.

B. ASTM International:

1. ASTM A185 – Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

2. ASTM C144 – Specification for Aggregate for Masonry Mortar.


5. ASTM C482 - Test Method for Bond Strength of Ceramic Tile to Portland Cement.


10. ASTM C1028 - Test Method for Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynameter Pull-Meter Method.

11. ASTM F1869 - Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

C. EN 101 - Method for Determination of Scratch Hardness of Surface According to MOHS.


E. TCNA 137.1 - Specifications for Ceramic Tile.

1.4 SUBMITTALS

A. Product Data: Submit data and installation instructions for membranes, bond coats, mortars, grouts, grout releases and grout release removers, sealants and grout sealers.

B. Samples:

1. Submit samples of each type and color of tile specified.

2. Submit samples, minimum 3 inches long, of grout in each color selected.

3. Submit samples illustrating full range of sealant colors available for Architect's selection.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit maintenance procedures for epoxy grouted tile installations.
1.6 QUALITY ASSURANCE


B. Tile: Conform to TCNA 137.1.

1.7 FIELD SAMPLES

A. Provide 1 field sample, 24 inches by 24 inches in size, for each type and color of tile selected. Construct sample in place with selected colored grout.

B. Locate where directed by Architect.

C. Rebuild samples not meeting specified requirements as directed by Architect.

D. Accepted samples will establish minimum standard of quality and workmanship for ceramic tile work.

E. Retain and protect accepted field samples in undisturbed condition during work of this section.

F. Accepted samples may remain as part of Work.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products in accordance with manufacturer’s instructions and recommendations.

B. Arrange deliveries of products in accordance with lead times and construction schedules. Order products with long lead times in timely fashion to ensure delivery that avoids conflict with sequence of construction and allows continuity of work.

C. Deliver products and store products in their original unbroken cartons.

D. Store tile in dry covered area.

1.9 EXTRA STOCK

A. Provide 1 carton of each type and color of tile used.

B. Wrap and label identifying manufacturer, size, color, project name and areas installed.

C. Deliver to Owner; obtain receipt.
PART 2 PRODUCTS

2.1 TILE MATERIALS

A. CT1: Unglazed porcelain floor tile; coefficient of friction not less than 0.60 when tested in accordance with ASTM C1028.
   1. Size: 33 percent 4 x 36 inch, 33 percent 6 x 36 inch and 33 percent 9 x 36 inch.
   2. Color: TBD

B. CT1A: Unglazed porcelain base tile; bull nosed along one long edge.
   1. Size: 3-1/2 x 35-1/2 inch.
   2. Color: TBD

C. CT2: Glazed ceramic wall tile composed of 50 percent pre-consumer waste from drilling aggregate, 20 percent post-consumer cullet from ground windshields and other glass and 30 percent new material; trim for thinset application.
   1. Size: 8-1/2 x 2-1/2 inches.
   2. Color: TBD

D. CT3: Unglazed porcelain floor tile; coefficient of friction not less than 0.60 when tested in accordance with ASTM C1028.
   1. Size: 6 x 36 inch.
   2. Color: TBD

E. CT4: Unglazed quarry floor tile; smooth surface; coefficient of friction not less than 0.70 dry and 0.60 wet when tested in accordance with ASTM C1028; trim for thinset application.
   1. Size: 4 x 8 x 1/2 inch.
   2. Color: TBD

R. CT5: Concrete Tile – Concreteworks; Ds90 SMOKE – H-12M, 24" Hx 48" WX 1/2" (MAX.) CUT TO SIZE– Use TOUCHSTONE T-2000, two component epoxy adhesive stone tile.
2.2 SETTING AND GROUTING MATERIALS

A. Mortar: Latex Portland cement mortar for thick cement mortar beds consisting of factory prepared blend of selected raw materials, Portland cement and graded aggregates mixed with latex admixture; suitable for interior and exterior exposures; Laticrete 226 Thick Bed Mortar mixed with Laticrete 3701 Mortar Admixture or equal product substituted under provisions of Division 1.

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Absorption</td>
<td>ANSI A118.6 4.4</td>
<td>&lt;5%</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>ANSI A118.4 6.1</td>
<td>5500 to 6500 psi</td>
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<tr>
<td>TCNA Service Rating</td>
<td>ASTM C627</td>
<td>Extra Heavy</td>
</tr>
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</table>

B. Tile Bond Coats:

1. To Metal Substrate: EN12004, R2 Classification; 2 component epoxy adhesive in factory-proportioned kit consisting of epoxy resin, hardener and chemically resistant silica filler; water cleanable; non-staining, high bond strength; maximum chemical resistance; Greenguard certified; recommended by manufacturer for adhering tile to steel, plywood and cement backer board; Laticrete Latapoxy® 300 Adhesive or equal product substituted under provisions of Division 1.

2. To Other Substrates: ANSI A118.4; factory pre-blended polymer fortified dry set mortar in powdered form for mixing with water; containing antimicrobial protection; gray color; Laticrete International, Inc. Laticrete® 254 Platinum or equal product substituted under provisions of Division 1.

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Result</th>
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</thead>
<tbody>
<tr>
<td>28 Day Cure Shear Strength</td>
<td>ANSI A118.4 5.2.4</td>
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<tr>
<td>Shear Bond Water Immersion</td>
<td>ANSI A118.4 5.2.3</td>
<td>150 to 300 psi</td>
</tr>
</tbody>
</table>
C. Tile Grouts:

1. Epoxy Grout: ANSI A118.3; multi-component epoxy type consisting of liquid resin, liquid hardener and colored powder; non-sag formula suitable for floors and walls; containing anti-microbial protection; water cleanable; chemically resistant; stain resistant; Greenguard Indoor Air Quality Certified®; Laticrete International, Inc. Laticrete® Spectralock® Pro Grout or equal product substituted under provisions of Division 1.

   a. Properties:

<table>
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<tr>
<th>Property</th>
<th>Test Method</th>
<th>Result</th>
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<tbody>
<tr>
<td>Shrinkage</td>
<td>ANSI A118.3 E5.3</td>
<td>&lt;0.25%</td>
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<tr>
<td>Vertical Joint Sag</td>
<td>ANSI A118.3 E5.4</td>
<td>Passes</td>
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<tr>
<td>Bond Strength</td>
<td>ANSI A118.3 E5.5</td>
<td>1,000 psi</td>
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<tr>
<td>Compressive Strength</td>
<td>ANSI A118.3 E5.6</td>
<td>3,500 psi</td>
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<tr>
<td>Tensile Strength</td>
<td>ANSI A118.3 E5.7</td>
<td>1,100 psi</td>
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<tr>
<td>Thermal Shock</td>
<td>ANSI A118.3 E5.8</td>
<td>510 psi</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>ANSI A118.3</td>
<td>&lt;0.50%</td>
</tr>
</tbody>
</table>

   b. Colors: To be determined.

2. Cementitious Grouts:

   a. For Joints 1/8 Inch Wide and Wider: ANSI A118.7; polymer modified cement dry grout recommended by manufacturer for heavy duty use in interior and exterior environments; sanded; Laticrete International, Inc. Laticrete® 1500 Sanded Grout fortified with Laticrete® 1776 Grout Enhancer or equal products substituted under provisions of Division 1.

   1) Properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Result</th>
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</thead>
<tbody>
<tr>
<td>Linear Shrinkage</td>
<td>ANSI A118.7</td>
<td>&lt;0.2%</td>
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<tr>
<td>Compressive Strength</td>
<td>ANSI A118.7</td>
<td>3,000 psi</td>
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<tr>
<td>Water Absorption</td>
<td>ANSI A118.7</td>
<td>7%</td>
</tr>
<tr>
<td>CNA Service Rating</td>
<td>ASTM C627</td>
<td>Extra heavy</td>
</tr>
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</table>

   2) Colors: To be determined.
b. For Joints Less Than 1/8 Inch Wide: ANSI A118.7; polymer modified cement dry grout recommended by manufacturer for use in interior and exterior environments; unsanded; Laticrete International, Inc. Laticrete® 1600 Unsanded Grout fortified with Laticrete® 1776 Grout Enhancer or equal products substituted under provisions of Division 1.

1) Properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Shrinkage</td>
<td>ANSI A118.6</td>
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<tr>
<td>Flexural Strength</td>
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<td>400 psi</td>
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</tbody>
</table>

2) Colors: To be determined.

2.3 ACCESSORIES

A. Interior Floor Waterproofing/Crack Isolation/Anti-Fracture Membrane: ANSI A118.10 and A118.12; cold-applied single-component self-curing liquid rubber polymer that cures to flexible seamless waterproofing membrane without use of fabric reinforcing in field, coves and corners and that provides anti-fracture protection of up to 1/8 inch over shrinkage and other non-structural cracks; load bearing; non-flammable; contains antimicrobial protection; contains no solvents; 0.020 to 0.030 inch thick when cured; IAPMO approved; Greenguard Indoor Air Quality Certified®; Laticrete International, Inc. Laticrete® Hydro Ban™ or equal product substituted under provisions of Division 1.

1. Properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-Day Hydrostatic Test</td>
<td>ANSI A118.10</td>
<td>Passes</td>
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<tr>
<td>7-Day Tensile Strength</td>
<td>ANSI A118.10</td>
<td>265 to 300 psi</td>
</tr>
<tr>
<td>7-Day Water Immersion</td>
<td>ANSI A118.10</td>
<td>95 to 120 psi</td>
</tr>
<tr>
<td>7-Day Shear Bond</td>
<td>ANSI A118.10</td>
<td>200 to 275 psi</td>
</tr>
<tr>
<td>28-Day Shear Strength</td>
<td>ANSI A118.10</td>
<td>214 to 243 psi</td>
</tr>
<tr>
<td>System Crack Resistance Test</td>
<td>ANSI A118.12 5.4</td>
<td>Passes</td>
</tr>
</tbody>
</table>

2. Accessory Materials:

Membrane Reinforcing Fabric.

b. Sealant: ASTM C920, Type S, Grade NS, Uses M and G; single component silicone; non-sag formula; neutral cure; Laticrete International, Inc. Laticrete® LataSiltm.

B. Reinforcing:

1. Floor Reinforcing: ASTM A185; 16 gauge welded wire mesh; 2 x 2 inch grid; galvanized.

2. Wall: Expanded metal lath; diamond mesh; self-furring; minimum 3.4 lbs/sq yd; galvanized.

C. Restroom Base Cove: Coved shape profile fabricated from Type 304 stainless steel with brushed finish on exposed surfaces; coved section with 23/32 inch radius forms visible surface; 7/16 inch offset between cove and anchoring legs to receive wall and floor tile; anchoring legs with trapezoid shaped perforations to secure profile in wall and floor mortar bond coats; supplied with inside corners, outside corners, connectors and end caps; Schuler Systems L.P. Schluter® - DILEX-EHK U11/011 or equal product substituted under provisions of Division 1.

D. Exterior Edge Trim: Color coated aluminum T-shaped edging profile for balconies and terraces; 3-1/8 inch wide anchoring leg with trapezoid shaped perforations to secure profile in mortar bed; 1-9/16 inch tall vertical section with 1-1/16 inch tall drip lip with 3/4 inch offset for 2-5/8 inch total visible surface height; matching inside corners, outside corners and connector pieces; Schuler Systems L.P. Schluter® - BARA-RK in color SB "Black Brown" or equal product substituted under provisions of Division 1.

E. Expansion Joints:

1. Backing Material: Closed cell polyurethane foam; 2.7 pcf; approximately 20 percent thicker than width of expansion joint.

2. Sealants:
   a. Between Floor and Walls and at Door Frames: ASTM C920, Type S, Grade NS, Uses M and G; single component silicone; non-sag formula; neutral cure; colors to match grout.
   b. In Traffic Areas: ASTM C920, Type M, Grade P, Use T; 2-part polyurethane; Shore A hardness of 35; color to match grout.

F. Grout Release: Removable; biodegradable; odor free; formulated to prevent grout penetration or staining of unglazed quarry tile; TEC Specialty Products, Inc. #TA-264 Grout Release or equal product substituted under provisions of Division 1.

G. Grout Release Remover: Concentrated ammoniated stripper; water-based formula; non-
flammable; liquid form; TEC Specialty Products, Inc. #TA-258 Floor Finish Stripper or
equal product substituted under provisions of Division 1.

H. Grout Cleaner: Type recommended by grout manufacturer to remove grout haze
from face of tile; Laticrete International, Inc. Laticrete® Cleaning Additive.

2.4 MORTAR AND GROUT MIXES

A. Mix and proportion factory packaged bond coats and grout materials in accordance
with manufacturer’s instructions.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine condition of substrates to determine acceptability for installation. Verify that
substrates are acceptable for product installation in accordance with manufacturers’
instructions and recommendations.

8. Verify that surfaces to receive tile and waterproofing/anti-fracture membrane are level,
plumb, and with maximum variation in backing surface not to exceed 1/4 inch in 10'-0"
from required plane with not more than 1/16 inch in 1 foot variation in high spots.

C. Verify that studs supporting gypsum board and cementitious backing board to receive
thinset tile are plumb, aligned and properly placed. Verify that metal studs are
minimum 20 gauge with minimum 3-5/8 inch web depth and are spaced at 16 inches
c or maximum.

D. Verify that spaces between cementitious backer boards and adjacent slabs and curbs
to receive waterproofing/anti-fracture membrane have been filled with latex-Portland
cement mortar.

E. Verify that joints in gypsum board and cementitious backing board to receive thinset
tile have been treated with tape and bedding coat of joint compound with no finish
coats. Verify that fasteners heads have been treated with 1 coat of joint compound.

F. Verify that concrete slabs to receive waterproofing/anti-fracture membrane are
structurally sound, clean, free of dirt, grease, paint, laitance, efflorescence, concrete
sealers and curing compounds and have been steel troweled and fine broom finished.

G. Verify that moisture vapor emission rate of concrete subfloors and mortar beds to receive
waterproofing/anti-fracture membrane does not exceed 5.0 pounds per 1,000 sq ft in
24 hrs or that recommended by membrane manufacturer by conducting calcium chloride
tests in accordance with ASTM F1869 and test manufacturer’s instructions.

1. Conduct minimum 1 calcium chloride test for every 1,000 square feet of flooring or
portion thereof, around perimeter, at columns and where moisture is present.
2. Prepare diagram of area or room showing location and results of each test.

3. If test results indicate moisture emission in excess of specified rate, do not proceed with membrane installation until corrective action has been completed. Consult membrane manufacturer regarding use of vapor reduction membrane or other available corrective actions.

H. Verify that concrete slabs to receive waterproofing/anti-fracture membranes slope to drains.

I. Verify that deflection of concrete slabs to receive waterproofing/anti-fracture membranes and thinset tile under live, dead and impact loads does not exceed L/360.

J. Ensure surfaces are clean and well cured.

K. Do not begin installing tile until deficiencies are corrected.

3.2 INSTALLATION - MORTAR BEDS

A. Install factory blended mortars in accordance with referenced TCNA methods and with manufacturer's instructions and recommendations.

1. Ensure surfaces to receive mortar are between 40°F and 90°F.

2. Ensure surfaces to receive mortar are structurally sound, clean and free from dirt, oil, grease, laitance, paint, concrete sealers and curing compounds.

3. Ensure construction and expansion joints in substrate surfaces are continued through mortar beds.

B. Install reinforced mortar bed for exterior floor tile over drainage composite and fluid applied waterproof membrane in accordance with TCNA F121.

1. Place mortar over drainage composite to approximately 1/2 depth of mortar bed.

2. Place reinforcing over mortar; ensure reinforcing remains at mid-depth of mortar bed.

3. Place balance of mortar bed; spread and compact well. Apply mortar bed to uniform thickness not less than 1-1/4 inches and not more than 2 inches.

4. Incorporate exterior edge trim into mortar bed in accordance with manufacturer's instructions where indicated on Drawings.

B. Install reinforced mortar bed for exterior wall tile over fluid applied waterproof membrane in accordance with TCNA W201.

1. Install reinforcing over waterproofing membrane; cut lath at expansion joints.
2. Trowel apply scratch coat to cover reinforcing but not exceeding 1/2 inch thickness; scratch mortar before it hardens.

3. After scratch coat mortar hardens; trowel apply mortar bed over scratch coat so that combined thickness of scratch coat and mortar bed is not less than 3/4 inch. Float with steel trowel and straight edges to form plumb and true mortar surface.

C Allow mortar beds to cure minimum 24 hours prior to installing tile.

3.3 INSTALLATION - MEMBRANES

A. Interior Floor Waterproofing/Crack Isolation/Anti-Fracture Membrane: Apply waterproofing/crack isolation/anti-fracture membrane in accordance with manufacturer’s instructions and recommendations.

1. Dampen hot and dry surfaces; sweep off excess water.

2. Pretreat cracks, joints, coves, corners, seams, drains and penetrations. Allow pre-treated areas to dry to touch prior to applying waterproofing/anti-fracture membrane.
   a. Cracks and Joints: Apply liberal coat of membrane liquid with brush or trowel to fill non-structural joints and cracks; apply liberal coat of membrane liquid approximately 8 inches wide with brush or roller over substrate cracks, cold joints and control joints.
   b. Coves and Floor/Wall Transitions: Apply liberal coat of membrane liquid with brush or trowel to fill cove joints and floor/wall transitions less than 1/8 inch; apply liberal coat of membrane liquid approximately 8 inches wide with brush or roller over substrate coves and floor/wall transitions.
   c. Drains: Apply liberal coat of membrane liquid around and over bottom half of drain clamping ring; cover with second coat of membrane liquid. Allow membrane liquid to dry; apply bead of sealant where membrane liquid meets drain throat. Install top half of drain clamping ring.
   d. Other Penetrations: Pack gaps around pipes, electrical boxes and other penetrations with tile bond coat material. Apply liberal coat of membrane liquid around penetration opening; cover with second coat of membrane liquid. Extend membrane liquid applications on to penetration up to level of tile. When dry, seal membrane liquid flashing with sealant.

3. Brush or roller apply 2 coats of membrane liquid over substrate including pretreated areas; cover floor and extend minimum 6 inches up walls at toilets and 4 inches up walls at kitchens.

4. At expansion joints, apply liberal coat of membrane liquid approximately 8 inches wide; embed and loop 6 inch wide reinforcing fabric allowing liquid to bleed through fabric. Top coat with second coat of membrane liquid.
5. Allow topcoat to dry to touch. Examine surface for pinholes, voids, thin spots and other defects. Seal defects with additional application of membrane liquid.

6. Allow membrane to fully cure prior to testing. Protect membrane from damage during curing process.

7. Flood completed membrane to test for leaks.
   a. Dam installation area. Flood to minimum depth of 2 inches with clean water. After 2 hours, inspect for leaks.
   b. If leaking is found, remove water and repair leaking areas. Repeat flood test. Repair damage to building due to leaks.
   c. When area is proven watertight, drain water and remove dam.

8. Do not permit traffic over unprotected or uncovered membrane.

3.4 INSTALLATION - TILE

A. Floor Tile and Base Tile:

1. Interior Floor Tile Over Concrete: Install interior floor tile over concrete over waterproofing/crack-isolation/anti-fracture membrane over concrete slabs-on-grade and raised concrete slabs with latex Portland cement bond coat in accordance with TCNA F122 and ANSI A108.5

2. Interior Floor Tile Over Concrete Topping Slabs with Embedded Radiant Heating Tubing: Install interior floor tile over waterproofing/crack-isolation/anti-fracture membrane over concrete topping slabs with latex Portland cement bond coat in accordance with TCNA RH110 and ANSI A108.5.

3. Exterior Floor Tile: Install exterior floor tile over cured reinforced mortar bed over drainage composite on fluid applied waterproofing with latex Portland cement bond coat in accordance with TCNA F121 and ANSI A108.1B.

B. Wall and Base Tile:

1. Interior Wall Tile Within Toilets: Install interior wall tile over cementitious backer board over water resistive barrier on metal studs with latex-Portland cement mortar bond coat in accordance with TCNA W244C and ANSI A108.5.

2. Interior Wall Tile in Other Locations: Install interior wall and base tile over gypsum board on metal studs with latex-Portland cement mortar bond coat in accordance with TCNA W243 and ANSI A108.5.

3. Exterior Wall Tile: Install exterior wall tile over cured reinforced mortar bed over fluid applied waterproofing on concrete wall with latex-Portland cement mortar
bond coat in accordance with TCNA W201 and ANSI A108.5.

4. **Exterior Wall Cap Tile:** Install exterior wall cap tile over metal cap flashing with epoxy cement bond coat in accordance with TCA F116 and ANSI A108.4.

C. **Install expansion joints in accordance with TCA EJ171:**

1. Where tile abuts restraining surfaces such as curbs, columns, pipes and door frames.

2. To perimeter walls in rooms and spaces larger than 16 feet on a side.

3. At 16 foot maximum spacing where expanse of interior or exterior tile exceed 12 feet in either direction.

D. **Place tile in accordance with patterns indicated on Drawings.** Carefully plant tile layouts, ensure pattern is uninterrupted from one surface to next and through doorways.

E. **Neatly cut tile around fixtures; accurately form corners, base, intersections and returns.**

F. **Form tile joints to widths recommended by manufacturer unless otherwise directed.**

1. Ensure tile joints are uniform in width, subject to normal variance in tolerance allowed in tile size.

2. Ensure joints are watertight, without voids, cracks, excess mortar or grout.

G. **Form internal wall angles square, external angles and exposed edges bullnosed unless otherwise directed.** Provide coved base at wall-floor intersection unless otherwise specified or directed.

F. **Sound tile after setting, remove and replace hollow sounding units.**

3.5 **GROUTING**

A. **Apply grout release to unglazed tile in accordance with ANSI A108.6 and manufacturer’s instructions and recommendations prior to applying grout.**

1. Protect adjacent surfaces not designated to receive grout release.

2. Rake out high ridges of mortar from grout joints.

3. Apply thin coat grout release to tile using sponge brush, short napped roller or paint pad; cover tiles thoroughly and allow to dry.

4. Apply second coat grout release at right angles to first coat; allow to dry.

5. Ensure grout is applied within 12 hours after second coat is thoroughly dry.
B. Epoxy Grout: Mix and apply epoxy grout to interior floor and wall tile in accordance with manufacturer's instructions and recommendations.

1. Remove excess mortar and construction debris from tile joints.

2. Wipe face of tile with slightly dampened sponge to remove dirt and dust. Ensure no standing water remains in joints.

3. Verify that colored powder packages bear same batch number.

4. Mix epoxy grout components. Stir contents of hardener and resin bags; blend entire contents of hardener and resin bags together. Add colored powder and mix to smooth trowelable consistency; do not over mix.

5. Remove mixed grout from mixing container and place in small piles on floor to be grouted; place grout for walls and bases on mortar boards on floor.

6. Pack joints full of grout using stiff rubber float; ensure no voids are left during application.

7. Allow grout to settle and firm slightly then use rubber float at 90 degree angle to remove as much excess material as possible before initial cleaning. Avoid gouging joints while removing as much epoxy from tile surface as possible.

8. Initial Cleaning: Begin initial cleaning to remove grout haze approximately 15 minutes after grouting an area to ensure grout joints begin to firm; do not allow grout to set on face of tile.
   a. Use grout cleaning solution with white nylon scrub pad. Wipe tile and grout surface in light circular motion to loosen grout residue and smooth out joints. Rinse scrub pad and change solution frequently.
   b. Drag damp clean sponge diagonally over scrubbed surface to remove grout. Rinse sponge and change solution frequently.

9. Final Cleaning: Begin final cleaning to remove grout haze approximately 90 minutes after initial cleaning to ensure no grout haze or other contaminates remain on surface of tile.
   a. Use grout cleaning solution and clean white nylon scrub pad. Wipe tile surface in light circular motion; avoid contact with grout. Rinse scrub pad and change cleaning solution frequently.
   b. Drag damp clean sponge diagonally over scrubbed tile surface to remove grout haze. Rinse sponge and change solution frequently.
c. Allow application to dry and examine for areas where residual haze remains. If haze is present, immediately repeat final cleaning procedures until no haze remains.

C. Cementitious Grout: Apply cementitious grout to exterior floor tile in accordance with ANSI A108.10 and manufacturer's instructions.

1. Dampen surface with water.

2. Spread grout with sharp firm rubber grout float forcing maximum grout into joints. Use diagonal strokes to pack joints; fill joints smooth without voids, pinholes or low spots.

3. Before grout sets, tool joints to depth of bevel.

4. Upon completion of grouting, sponge and wash tile thoroughly removing excess grout.
   a. Remove excess grout from face of tile with edge of grout float; hold float at 90 degree angle and pull diagonally across joints.
   b. Remove remaining grout with damp sponge or towel; work diagonally to joints. Allow to dry.
   c. When grout joints are firm, polish surface with coarse nylon pad or coarse cloth and minimal water taking care not to damage soft glazed tile or polished stone.

5. Cure grout in accordance with manufacturer's instructions.

D. As soon as possible after grout has sufficiently cured, remove remaining grout release residue using grout release remover in accordance with manufacturer's instructions and recommendations.

1. Mix grout release remover with water in accordance with manufacturer's recommendations.

2. Apply grout release remover solution liberally over small area. Allow solution to soak until grout release film becomes white; do not allow solution to dry.

3. Scrub treated area with nylon stripping pad until grout release film is removed; rinse surface with clean water.

4. Examine surface for residual traces of grout release film; repeat procedure if necessary to remove remaining traces.
3.7 CLEANING

A. Remove excess mortar, grout and sealer from tile and adjacent surfaces.

B. Clean soiled surfaces.

3.8 PROTECTION

A. Prohibit traffic from grouted floor finish for 48 hours after installation.

END OF SECTION
SECTION 09 50 00

Acoustical Metal Ceilings

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes
   1. Acoustical metal ceiling panels
   2. Exposed grid suspension system
   3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
   4. Perimeter Trim

B. Related Sections:
   1. Section 09 22 26 Non-Structural Metal Framing
   2. Section 09 29 00 - Gypsum Board
   3. Section 09 50 00 - Acoustical Metal Ceilings
   4. Divisions 23 - HVAC Air Distribution
   5. Division 26 - Electrical

C. Alternates
   1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been approved by Addenda, the specified products shall be provided without additional compensation.

   2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.
1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
   2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
   3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
   4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
   5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
   6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
   9. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
   11. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
   12. ASTM E 1264 Classification for Acoustical Ceiling Products

B. International Building Code

C. ASHRAE Standard 62 1 2004 Ventilation for Acceptable Indoor Air Quality

D. NFPA 70 National Electrical Code

E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures


1. ESR 1308 - Armstrong Suspension Systems

H. International Association of Plumbing and Mechanical Officials - Seismic Engineer Report
   1. 0244 - Armstrong Single Span Suspension System

I. California Department of Public Health CDPH/EHLB Emission Standard Method Version 1.1 2010

J. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

1.4 SYSTEM DESCRIPTION

   Continuous/Exterior Soffit

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.

B. Samples: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with, or supported by the ceilings.

D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.

E. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.
1.6 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
   a. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.

C. Acoustic Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

D. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.8 PROJECT CONDITIONS

A. Space Enclosure: Standard Ceilings: Do not install interior ceilings until space is enclosed and weatherproof; wet work in place is completed and nominally dry; work above ceilings is complete; and ambient conditions of temperature and humidity are continuously maintained at values near those intended for final occupancy. Building areas to receive ceilings shall be free of construction dust and debris.
1.9 LEED

A. Armstrong Metal Ceilings qualify for the following credits:

a. Category - Material & Resources
   i. MR Credit 2.1, 2.2 - Construction Waste Management Divert 50% or 75% from disposal
   ii. MR Credit 4.1, 4.2 - Recycled Content
   iii. MR Credit 5.1, 5.2 - Regional Materials (dependent on location)
      1. LEED NC - 10% Extracted, Processed & Manufactured Regionally
         LEED CI - 20% Manufactured Regionally

b. Category - Indoor Environmental Quality
   i. EQ Credit 4.1 to 4.6 - Low-Emitting Materials

c. Category - Innovation and Design Process
   i. ID Credit - Acoustic Performance

1.10 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

   1. Acoustical Panels: Sagging and warping
   2. Grid System: Rusting and manufacturer’s defects

B. Warranty Period:

   1. Acoustical Metal panels: One (1) year from date of substantial completion
   2. Grid: One (1) year from date of substantial completion

C. The Warranty shall not deprive the Owner of other rights the Owner 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 the requirements of the Contract Documents.

1.11 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Acoustical Metal Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.

2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Metal Ceiling Panels:
   1. Armstrong World Industries, Inc.

B. Suspension Systems:
   1. Armstrong World Industries, Inc.

C. Aluminum Custom Trims:
   1. Armstrong World Industries, Inc.

2.2.1 ACOUSTICAL CEILING UNITS

A. Acoustical Panels Type AMP
   1. Acoustical Panels Type AMP-1:
      a. Surface Texture: Smooth
      b. Composition: Metal
      c. Color: TBD
      d. Size: 4IN x 96IN
e. Edge Profile: Linear
f. Perforation Option: Unperforated
g. Noise Reduction Coefficient (NRC):
h. Ceiling Attenuation Class (CAC):
i. Sabin: N/A
j. Articulation Class (AC):
k. Flame Spread: ASTM E 1264; Class A (FM)
l. Light Reflectance White Panel:
m. Dimensional Stability: Standard
n. Recycle Content: Post-Consumer - 0% Pre-Consumer Waste - 25%
o. Acceptable Product: MetalWorks Linear, 5490 as manufactured by Armstrong World Industries

2. Infill Metal Panel Accessories:
   a. 5495 - 4" Panel Splice
   b. 5497 - Standard Carrier
   c. 5572 - Standard Carrier Molding
   d. 5576 - Pressure Spring
   e. 5581 - 4" Panel End Cap
PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer’s printed recommendations. (Exception: HumiGuard Max Ceilings)

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.3 INSTALLATION

A. Follow manufacturer installation instructions

B. Install suspension system and panels in accordance with the manufacturer’s instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.

C. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

D. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.

E. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

F. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.
3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION
Durable, metal panels offer a variety of flexible acoustical and interior/exterior solutions.

**KEY SELECTION ATTRIBUTES**
- Nominal 4", 6", 8", and 12" wide panels, including nominal 1" reveal
- Install in the ceiling, on the wall
- Create 90° angled or curved ceiling-to-wall transitions
- Available for exterior applications, tested to meet wind uplift Classes 30, 60, and 90
- Acoustical options with microperforated panels
- Fast and easy installation

**COLORS**
Due to printing limitations, shade may vary from actual product.


**PERFORATION OPTIONS**
(1/2 scale shown)

| M1 (Unperforated) | M2 (Microperforated) |

**INSTALLATION DETAILS**

**Wall**
- Kicker
- Serpentine® Main Beam
- Flex Carrier
- Guide Bar (Furring Strip)

**Linear Transitions**
- Ceiling to Wall

**Linear Attaching to Wall**
- Standard Installation 8" Planks

**Seismic Installation Perpendicular to Main Carrier Unattached Wall**
- 12" MetalWorks Linear Plank
- 6497 Standard Carrier
- XL8945P Drywall Cross Tee
- HD8906 Drywall Main Beam
- BERG2 Loose Screw

See more photos at: armstrong.com/photogallery
SEARCH: metalworks linear
### VISUAL SELECTION

<table>
<thead>
<tr>
<th>Item Number*</th>
<th>Description</th>
<th>Dimensions Nominal L x W x H (Inches)</th>
<th>Colors</th>
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* When specifying or ordering, include the appropriate 2-, 3-, 4-, or 5-letter color suffix (e.g., 5490M/4W, 5490M1W, 5490M2X, 5490M1EX). The suffix is based on the color of the panel. For full color shades, see pages 100-101.

† When specifying or ordering, include the appropriate 4- or 5-letter color suffix (e.g., 5572ZI). The suffix is based on the color of the panel. For full color shades, see pages 100-101.

### PERFORMANCE

Dots represent high level of performance.

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<th>Light Reflect</th>
<th>Wash</th>
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<td>Flex Carrier Molding</td>
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* When specifying or ordering, include the appropriate 4- or 5-letter color suffix (e.g., 5572ZI). The suffix is based on the color of the panel. For full color shades, see pages 100-101.

### SUSPENSION SYSTEM

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<td>5499</td>
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<td>4 x 1-1/2 x 5/8&quot;</td>
<td>50</td>
</tr>
<tr>
<td>7166</td>
<td>6&quot; Carrier Splice</td>
<td>6 x 1-1/2 x 7/8&quot;</td>
<td>50</td>
</tr>
<tr>
<td>5580</td>
<td>Carrier Hanger</td>
<td>2-1/4 x 3 x 1&quot;</td>
<td>20</td>
</tr>
<tr>
<td>6351</td>
<td>Speed Clip</td>
<td>1/4 x 1/2 x 1/8&quot;</td>
<td>Bulk</td>
</tr>
<tr>
<td>5494</td>
<td>Contrast Filler Strip Black</td>
<td>96 x 1/4 x 1/4&quot;</td>
<td>16</td>
</tr>
</tbody>
</table>

### PHYSICAL DATA

**Material:** Electro-galvanized Steel – thickness 0.028"
**Surface Finish:** Available in White, Silver Grey, Gun Metal Grey, and Effects Wood Looks powder-coated, post-production finishes. Panels are finished on both sides for exterior applications. Custom colors also available. Contact TechLine for custom color matching requests at 1 877 ARMSTRONG.

**Edge Detail:** Square with extended flange. To create contrast visual, flange is covered with 1-1/4" Black Contrast Filler Strip Item 5494.

**Fire Performance:** Tested per ASTM E84 and CAN/ULC S102. Flame Spread Index 25 or less. Smoke Developed Index 50 or less.

**ASTM E1264 Classification:** Fire Class – Class A
**Perforated – Type XX, Pattern G**

**Seismic Restraint:** MetalWorks Linear panels have been engineered, tested, and approved for application in all seismic areas when installed per Armstrong installation instructions.

**Wind Uplift Performance:** 4", 6", and 8" panels tested for wind uplift Classes 30, 60, and 90. Specific installation recommendations to meet these wind classes are available. There is no acoustical fleece on exterior panels. For more information, contact TechLine at 1 877 ARMSTRONG.

**Warranty:** Details at armstrong.com/warranty

**Weight:** 440, 5492 – 1.51 lbs/SF, 16 pcs/ctn or 128 LF/ctn; 43 SF/ctn (5491, 5493 – 1.51 lbs/SF, 10 pcs/ctn or 80 LF/ctn; 53 SF/ctn (5570, 5571 – 1.51 lbs/SF, 6 pcs/ctn or 48 LF/ctn; 48 SF/ctn 7160, 7161 – 1.51 lbs/SF, 12 pcs/ctn or 96 LF/ctn; 48 SF/ctn

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SECTION 09 77 14

WOOD VENEER WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes:
   1. Wall panels and installation components.

B. Related Sections:
   1. Section 01350, Special Environmental Requirements
   2. Section 09 20 00 (09200) – Plaster and Gypsum Board
   3. Division 26 (16) Sections - Electrical Work

C. Alternates
   1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products which have not been approved by Addenda, the specified products shall be provided without additional compensation.
   2. Submittals which do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); panel design, size, composition, color, and finish; installation system component profiles and sizes; compliance with the referenced standards.

1.3 REFERENCES

A. Test Methods:
   1. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of wall panel required.

B. Samples: Minimum 3 inch x 6 inch samples of specified wall panel.

C. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.
D. Shop Drawings: Submit shop drawings showing how panels are to be laid out on the walls, details of trim members and width of panels. Width of panels and location of vertical seams are critical.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and installation components by a single manufacturer.

B. Fire Performance Characteristics: Identify wall components with appropriate markings of applicable testing and inspecting organization.
   1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.
      a. Flame Spread: 25 or less
      b. Smoke Developed: 50 or less
   2. HPVA (Hardwood Plywood and Veneer Association) certification and audit program per ASTM E-84 tunnel test.

C. Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.

D. Coordination of Work: Coordinate wall work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver wall panels to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. The wood veneer panels should not be stored in spaces where the temperature or humidity conditions vary greatly from the temperatures and conditions that will be normal in the occupied space. The temperature should be between 50 degrees F and 86 degrees F and relative humidity should not fall below 25 percent or exceed 55 percent.

C. Before installing wall panels, permit them to reach room temperature and a stabilized moisture content.

D. Handle wall panels carefully to avoid chipping edges or damaged units in any way.

1.7 PROJECT CONDITIONS

A. Space Enclosure:

Wood veneer wall panel materials should be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation.

The wood veneer panels should not be stored or installed in spaces where the temperature or humidity conditions vary greatly from the temperatures and conditions that will be normal in the occupied space.

As interior finish products, the wood veneer panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.
1.8 WARRANTY

A. Wall Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:
   1. Wall Panels: Manufacturer’s defects

B. Warranty Period:
   1. Wall panels: One (1) year from date of substantial completion.

C. The Warranty shall not deprive the Owner of other rights the Owner 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 the requirements of the Contract Documents.

1.9 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
   1. Wall Panels: Furnish quantity of full-size units equal to 5.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Wall Panels:
   1. Armstrong World Industries, Inc.  

2.2 WALL PANELS

A. Wall Panels: Type AWP-1:
   1. Surface Texture: Smooth
   2. Surface Type: Wood
   3. Finish: Natural Variations Light Cherry
   4. Thickness: ¾”
   5. Width: 23-3/4”
   6. Panel Heights: 47”, 95”, 107” & 119”
   7. Acoustical Fleece: Black
   8. Reveal: ¾” minimum for expansion & contractaion
   9. Perforation Type 1: W1 Unperforated
   10. Perforation Type 2: W5 Perforated
   11. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton, W1 NRC N/A / W5 NRC 0.45 w/Acoustical Fleece
   12. Flame Spread: ASTM E84; Class A.
   13. Recycled Content: 92%
   14. Dimensional Stability: Standard – space must be enclosed with HVAC systems operating and with appropriate humidity levels maintained between 25%RH-55%RH at all times.
   15. Acceptable Product: WoodWorks Channeled Wall System, #__________ (once you’ve finalized on panel size I can provide you with an item #’s to use here), as manufactured by Armstrong World Industries.

B. Accessories:
   1. Z-Clips
   2. #8 x 5/8” Modified Truss Head Sharp Point Screws
   3. Natural Variations 1” Edge Banding for Cut Panels
PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer’s printed recommendations.

3.2 PREPARATION

A. Measure each wall area and establish layout of acoustical units to balance border widths at opposite edges of each wall. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

A. Install wall panels by attaching the panels to an existing wall in accordance with the manufacturer’s installation instructions, Woodworks Channeled Wall LA-297532, and in accordance with the authorities having jurisdiction.
   a. See "Instillation Using Z-Clips"

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

END OF SECTION
SECTION 09 91 00
PAINTING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish and install all paint and similar finishes, where shown on the drawings and as necessary to complete the work, including but not limited to:

1. Interior and exterior of new construction.

2. Exposed duct work on the roofs.

3. Exposed exterior galvanized metals.

4. All other work as shown and indicated on the drawings.

B. Related Work: Shop priming of ferrous metal items is included under various Specification Sections.

C. Surfaces Not to Be Painted:

1. Factory-prefinished items as specified in various sections.

2. Prefinished wall, ceiling, and floor coverings.

3. Painting specified elsewhere and included in respective Sections, including but not necessarily limited to, shop priming.


5. Surfaces concealed in walls and above ceilings except as specifically indicated otherwise.

6. Ducts, piping, conduit, and equipment concealed in walls and ceilings, unless specifically indicated otherwise.

1.02 SUBMITTALS

A. Product Data:

1. Submit a complete list of materials proposed for use, together with manufacturer's specifications.

2. Paint materials and products shall be subject to the Architect's acceptance.
B. Substitutions:

1. See Section 01 25 00 – Product Options & Substitutions. Further, submit in quintuplicate a schedule listing the specified items in the first column and the proposed substitution items in the second column.

C. Colors:

1. **As selected by the Architect.**

   a. **Hand Samples of Selected Colors and Finishes for Initial Selection:** Submit (4) four samples of each color (samples to be stepped in a clearly visible manner, defining each separate coat, including block fillers and tinted primers) on substrate for Architect’s review of color, sheen, and texture only on 8.5 inch x 11 inch heavy cardboard (unless requested on actual substrate by Architect at no extra cost) with manufacturer’s product number, color, sheen, and texture clearly identified on each sample. For transparent and stained finished, prepare (4) samples of each finish on 8.5 inch x 11 inch material, species, and quality of wood to be used in the Work. Contractor to resubmit painted brush-outs of all colors as needed at no extra cost until acceptable sheen, color and texture is selected by the Architect.

   b. **Field Samples for Verification:** Prepare samples of colors and finishes for approval by the Architect sufficiently in advance of the work to allow time for deliberation, on an area minimum 4 feet x 4 feet to permit evaluation by the Architect. Contractor to provide minimum 4 feet x 4 feet painted brush-out (samples to be stepped in a clearly visible manner, defining each separate coat, including block fillers and tinted primers) of all exterior paint colors on intended materials under ideal lighting conditions in a location approved by Architect. For linear material elements (i.e. metal rails, gutters, flashing, coping, etc.), a 4 feet long section of the material’s natural width is acceptable to serve as a field sample mock-up. Clearly label and identify each sample as to color, location and application. Brush-outs may occur either on existing conditions, final exterior materials of new construction, or mock-ups as needed to verify colors in a timely manner to meet the project schedule. Contractor to provide as many painted brush-outs of all colors as needed at no extra cost until the final colors are selected by the Architect.

1.03 QUALITY ASSURANCE

A. Include on label of containers:

1. Manufacturer’s name.

2. Type of paint.

3. Manufacturer’s stock number.

5. Instructions for reducing, where applicable.

B. Regulatory Requirements: Comply with Bay Area Air Quality Control Management District (BAAQMD) regulations for Volatile Organic Contents (VOC's).

C. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealed containers with labels legible and intact.

B. Storage of Materials:
   1. Store only acceptable Project materials on Project site.
   2. Store in a suitable location.
   3. Restrict storage to paint materials and related equipment.
   4. Comply with health and fire regulations.

1.05 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be stored and applied.
   2. Do not apply finish in areas where dust is being generated.

B. Protection: Cover or otherwise protect finished work of other trades and surfaces not being painted concurrently or not be painted.

1.06 WARRANTY

A. Color and Life of Film:
   1. At the end of two (2) years, colors of surfaces shall have remained free from serious fading, and variations (if any) shall be uniform.

   2. Materials shall have their original adherence at end of two (2) years, and there shall be no evidence of blistering, running, peeling, scaling, chalking, streaking, or stains at end of this period.
1.07 EXTRA STOCK

A. Extra Materials:

1. At completion of the Work, deliver to Owner extra stock of paint of one (2) gallons of each color used in each coating material used.

2. Stock shall be in tightly sealed and clearly labeled containers.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Product numbers specified are as manufactured by Kelly Moore Paint Company, unless otherwise indicated. Equivalent products manufactured by ICI or Pittsburgh are acceptable.

B. Materials selected for coating system of each type of surface shall be the product of a single manufacturer.

C. Thinner: As recommended by each manufacturer for his respective product.

2.02 COLORS

A. The Architect will prepare a color schedule with samples for guidance of painter and reserves the right to select, allocate, and vary colors on different surfaces throughout building.

1. Submit/provide samples of selected colors as specified in Article 1.02.

2.03 MIXING AND TINTING

A. All primers, undercoats, and/or sealers used for interior surfaces and exterior walls are to be tinted pink to verify adequate coverage.

B. Deliver paints and stains ready mixed to jobsite.

C. Accomplish job mixing and job tinting only when acceptable to the Architect.

D. Mix only in mixing pails placed in suitable sized nonferrous or oxide-resistant metal pans.

E. Use tinting colors recommended by manufacturer for specific type of finish.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence, or quality of work and which cannot be put into acceptable condition through preparatory work.

B. Proceed with preparation or coating application when conditions are suitable.

C. Contractor will provide ventilation for any fumes that might adversely affect other workmen or people in the vicinity of coating application.

D. Contractor will also provide advance notice to other workmen or building occupants of exposure to fumes that might cause irritation.

3.02 PREPARATION

A. According to Kelly-Moore Paint Company specifications.

B. General Surface Preparation:

1. All surfaces must be cured, cleaned, sound, dry and free from dust, dirt, wax, oil, grease, mildew, efflorescence or other contaminants that might adversely affect the appearance and performance of the primer or finish coat.

2. All voids, cracks and holes should be filled with a suitable patching compound to reflect the texture and appearance of the surrounding substrate.

3. All hardware or built-in items should be fitted and removed or protected during painting.

4. Fill cracks and steel dents in steel door frames and doors with fender putty.

5. At existing window sash, remove all loose putty and replace and repair to obtain a smooth even surface without any voids or cracks.

C. Ferrous Metal:

1. Iron and steel preparation may require the removal of millscale and/or rust by sandblasting or sanding.

2. Exposed metal must be primed immediately to prevent rusting with 1710 Kel-Guard Red Oxide Primer or 1711 Kel-Guard White Rust Inhibitive Primer.

3. All shop-primed items are to be fully re-primed in the field.

D. Galvanized Metal and Aluminum:
1. Galvanized and aluminum surfaces must receive an etching wash prior to painting. A test area with the complete paint system is suggested to assure proper adhesion.

E. Wood and Hardboard:

1. Prime millwork and tops and bottoms of doors at mill or immediately upon arrival at the job site. After fitting, immediately prime all door edges and face.

2. Remove all stains, marks and dirt from surfaces to receive a semi-transparent stain finish.

3. Seal all tannic acid, water and asphalt stains with one or more coats of Kelly-Moore 255 Stain Resistant Primer.

4. Back prime all wood prior to installation against metal, concrete, stucco, plaster or brick with one coat of primer specified for exposed surfaces.

F. Concrete Surfaces:

1. All concrete surfaces should cure for a minimum of thirty (30) calendar days prior to coating.

2. Surfaces that are highly glazed or where bond breaker or form oil are present must be cleaned and etched to provide a suitable surface.

3. Surfaces with efflorescence, lime salts or other highly alkaline conditions must be cleaned and neutralized.

4. Cracks, holes or other surface imperfections should be filled with a suitable patching material to match the textural profile of the surface.

G. Plaster or Stucco:

1. Surfaces should cure for a minimum of thirty (30) calendar days before coating.

2. Neutralize surfaces with efflorescence or high alkalinity.

3. Rake out and fill all cracks, holes or other imperfections and fill with a suitable patching material to match the textural profile of the surface.

H. Gypsum Wallboard:

1. All wallboard joints, nail heads, and metal corners will be taped, topped and sanded ready to receive paint according to specifications.

2. To receive the most uniform texture appearance, seal the wall with Kelly-Moore PVA Sealer and allow to dry prior to texturing.
I. Performance:

1. All work to be performed by qualified craftsmen skilled in the application of the materials specified.

2. All materials to be mixed, thinned and applied in strict accordance with the manufacturer's printed instructions.

3. All materials to be applied evenly with no runs, sags or skips.

4. All work to be performed in acceptable weather conditions.

5. Proper ventilation to be provided to aid drying and prevent an accumulation of odors or vapors.

3.03 APPLICATION

A. According to paint manufacturer's specifications and recommendations. Kelly Moore Paint Company specifications shall be referred to as governing document in the event that clarification is needed for surface preparation, materials, application or any other matter connected with painting work.

B. Condition of surfaces to be painted shall be approved by the Inspector before the first coat is applied. Each coat of paint material to be inspected and approved by the Inspector before succeeding coat is applied. Request inspections by the Project Inspector. If succeeding coat or coats are applied without the approval of the Project Inspector, no credit will be given that work and it shall be redone.

C. Prime and back-prime all millwork and trim to be painted or stained immediately upon delivery to the site.

D. Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer. No concrete to be painted until moisture reading is less than fifteen percent (15) to eighteen percent (18%).

E. Application:

1. Apply paint with suitable brushes, rollers, or spraying equipment.

2. Apply stain in accordance with manufacturer's recommendations.

3. Rate of application shall not exceed that recommended by paint manufacturer for surface involved.

F. Comply with recommendation of product manufacturer for drying time between succeeding coats.

G. Finish coats shall be smooth and free from brush arks, streaks, laps or pileup of paints, and skipped or missed areas.
H. Leave all parts of moldings and ornaments clean and true to details with no undue amount of paint in corners and depressions.

I. Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.

J. Refinish whole wall where portion of finish is not acceptable.

K. Adjust natural finishes as necessary to obtain identical appearance on veneers and solid stock.

L. Hardware, hardware accessories, plates, lighting fixtures, and similar items in place shall be removed prior to painting and replaced upon completion of each space. Paint mark on above listed items will not be accepted.

M. Equipment adjacent to walls shall be disconnected, using workmen skilled in appropriate trades, and moved to permit wall surfaces to be painted.

   1. Following completion of painting, they shall be expertly replaced and reconnected.

N. Do not paint over fusible links, UL labels, or sprinkler heads.

O. Exposed Plumbing and Mechanical Items: Items without factory finish such as conduits, pipes, access panels, and items of similar nature shall be finished to match adjacent wall and ceiling surfaces, unless otherwise directed.

P. Paint duct interiors exposed to view through grilles and diffusers with flat black.

Q. Field touch-up all structural and miscellaneous steel.

R. Paint all exposed sheet metal.

S. If adequate coverage of any surface is not attained with the number of coats specified, apply additional coat or coats to cover.

3.04 CLEANING

A. Touch up and restore finish where damaged.

B. Remove spilled, splashed, or spattered paint from surfaces.

C. Do not mar surface finish of item being cleaned.

D. Leave storage space clean and in condition required for equivalent spaces in Project.

3.05 PAINT SYSTEMS

A. General

   1. Number of coats scheduled is minimum.
a. Additional coats shall be applied at no additional cost if necessary to completely hide base material, produce uniform color, and provide satisfactory finish result.

2. This specification shall serve as a guide and is meant to establish procedure and quality.

3. Acceptance of Final Colors: Final coat of paint for both exterior and interior shall not be applied until colors have been accepted by the Architect.

B. Unless otherwise noted, all items listed below are Kelly-Moore Paint Company products. The products listed below are intended to establish the quality of paint products for this project.

1. **Exterior Concrete, Portland Cement Plaster, Stucco:**
   
   1. Acrylic Latex:
      
      a. 1 coat 247 ACRY-SHIELD 100% Acrylic Exterior Masonry Primer
      b. 2 coats 1245 ACRY-SHIELD 100% Acrylic Exterior Low Sheen Finish
   
   2. Acrylic Latex, Accent Colors:
      
      a. 1 coat 247 ACRY-SHIELD 100% Acrylic Exterior Masonry Primer
      b. 2 coats 1135 KEL-COLOR Acrylic Low Sheen Accent Base
   
   3. Elastomeric Coating:
      
      a. 1 coat 247 ACRY-SHIELD 100% Acrylic Exterior Masonry Primer
      
      b. 2 coats 1128 KEL-SEAL TERPOLYMER 100% Acrylic Elastomeric Coating, Smooth or
      
      c. 2 coats 1129 KEL-SEAL TERPOLYMER 100% Acrylic Elastomeric Coating, Textured

2. **Exterior Concrete Block:**

   1. Block Filler: 1 coat 521 FILL & PRIME Acrylic Block Filler.

   2. Acrylic Latex Flat:
      
      a. 2 coats 1240 ACRY-SHIELD 100% Acrylic Exterior Flat Finish

   3. Acrylic Latex Accent Colors:
      
      a. 2 coats 1170 KEL-COLOR Acrylic Flat Accent Base

   4. Elastomeric Coating:
3. **Exterior Rough Lumber, Plywood Siding:**
   1. 100-percent Acrylic-Flat:
      a. 2 coats 1240 ACRY-SHIELD 100% Acrylic Exterior Flat Finish

4. **Exterior Wood Trim, Doors (Doors, Door Bottom), Fascia:**
   1. 100-percent Acrylic:
      a. 1 coat 255 ACRY-SHIELD 100% Acrylic Exterior Wood Primer
      b. 2 coats 1685 DURA-POXY + 100% Acrylic Semi-Gloss Enamel
   2. 100-percent Acrylic Accent Colors:
      a. 1 coat 255 ACRY-SHIELD 100% Acrylic Exterior Wood Primer
      b. 2 coats 1370 KEL-COLOR 100% Acrylic Semi-Gloss Accent Base

5. **Exterior Galvanized Steel:**
   Preparation: Treat with Eco-prime.
   First Coat: KM 1725 - Kel-Guard Acrylic Metal Primer
   Second and
   Third Coats: KM 1680 – Dura-Poxy Acrylic Gloss Enamel

6. **Exterior Metal other than Galvanized Steel:**
   First Coat: KM 1710 – Alkyd Kel-Guard Red Oxide Primer
   Second and
   Third Coats: KM 1680 – Dura-Poxy Acrylic Gloss Enamel

7. **Rust-Inhibiting Primer and Spot Painting for Ferrous Metal:**
   First Coat: KM 1710 - Kel-Guard Red Oxide Primer or
               KM 1711 - Kel-Guard White Rust Inhibitive Primer

8. **Interior Painted Wood Doors:**
   First Coat: KM 975 - Flo-Cote Enamel Undercoat
   Second and
9. **Steel Doors, Doors and Window Frames:**

First Coat: Shop coat of rust inhibitive primer applied by door frame manufacturer. Field touch up as required.

Second and Third Coats: KM 1680 – Dura-Poxy Acrylic Gloss Enamel

10. **Painted Interior Wood Trim:**

First Coat: KM 975 - Flo-Cote Enamel Undercoat

Second and Third Coats: KM 1685 - Dura-Poxy Semi-Gloss Acrylic Enamel

11. **Interior Wood Trim, Railing, Base - Stained, Clear Finish:**

Stain: 1 Coat Varathane Stain

Sealer: 1 Coat 2083 Wood Craft Sanding Sealer

Finish: 2 Coats 2090 Kel-Thane II Satin/Semi-Gloss Clear Stain

12. **Gypsum Board Smooth Finish:**

First Coat: KM 971 - Acry-Plex Hi-Hide Vinyl Wall Sealer.

Second and Third Coats: KM 1500 - Enviro-Cote flat wall enamel.

13. **Gypsum Board Textured Finish:**

First Coat: KM 971 - Acry-Plex Hi-Hide Vinyl Wall Sealer

Second and Third Coats: KM 1500 - Enviro-Cote wall enamel, sheen to be determined by Architect.

14. **Pipes, Grilles, and other Interior Metal:**

First Coat: KM 1710 - Kel-Guard Red Oxide Primer for ferrous metal

KM 1725 - Kel-Guard Acrylic Metal Primer for galvanized metal and non-ferrous metal. If shop primed, omit first coat.

Second and Third Coats: KM 1520 – Enviro-Cote Semi-gloss Acrylic Enamel
15. **Duct Interiors (Exposed to View) and Framing Behind Eave Vents:**

Heavy-duty plastic enamel, low luster – color to be determined by Architect.

16. **Miscellaneous:**

Finish surfaces to be painted and not covered in the categories above, if any, according to the recommendations of the paint manufacturer as approved by the Architect.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Floor-mounted overhead-braced stainless steel toilet partitions. Wall hung stainless steel urinal screens.
B. Attachment and door hardware.

1.2 RELATED SECTIONS

A. Section 09110 – Non-Load Bearing Metal Framing: In-wall and in-ceiling framing for partition panel supports.
B. Section 09300 - Tile: Wall and floor tile systems.
C. Section 10800 - Toilet and Bath Accessories: Size and location details for factory installed reinforcing for toilet accessories.
D. Division 15 - Mechanical: Plumbing fixtures.

REFERENCES

E. ASTM A 666 – Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.

1.3 DESIGN REQUIREMENTS

A. Sustainable Design Requirements:

1. Steel and aluminum used in work of this section are intended to:
   a. Contribute to meeting requirements for recycled content outlined in LEED®-NC3.0 for Credit MR4.
   b. Reduce quantity of indoor air contaminants that are harmful to comfort and
well-being of installers and occupants and are not to contain urea-formaldehyde resins outlined in LEED™-NC3.0 Credit EQ4.4.

2. Adhesives used in work of this section are intended to reduce quantity of indoor air contaminants that are harmful to comfort and well-being of installers and occupants and are to be formulated to be within VOC content limits outlined in LEED™_NC3.0 Credit EQ4.1.

1.5 SUBMITTALS

A. Shop Drawings: Indicate partition and screen layout with dimensions, elevations, panel and door sizes, door swings, materials and panel thicknesses, reinforcing fittings, hardware fastenings, anchorage and mounting details, size and location factory reinforcing, finishes and requirements of related work.

B. Product Data: Submit data for components, hardware and accessories.

C. Samples:

1. Panel Finish: Submit samples, minimum 3 x 6 inch in size, illustrating material, embossed pattern, color and finish.

2. Hardware: Provide samples of each type of hardware.

E. LEED Documentation:

1. Steel: Submit letter or product data from manufacturer indicating recycled content. Designate percentage of post-consumer and post-industrial recycled content.

2. Aluminum: Submit letter or product data from manufacturer indicating recycled content. Designate percentage of post-consumer and post-industrial recycled content.

3. Stainless Steel Toilet Compartments: Submit letter or product data from manufacturer stating that no materials used in this product contain added urea-formaldehyde resins.

4. Adhesives: Submit letter or product data from manufacturer stating that adhesives used in work of this section do not exceed VOC content limits established in South Coast Air Quality Management District Rule #1168.

5. Submit hard copies of completed Online Documentation required for LEED™ MR Credit 4, EQ Credit 4.1 and EQ Credit 4.2.
1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture of stainless steel toilet compartments with minimum 5 years documented experience.

B. Installer: Company specializing in installation of stainless steel toilet compartments with minimum 3 years documented experience and factory trained and approved by manufacturer.

1.7 REGULATORY REQUIREMENTS

A. Accessibility for Persons with Disabilities: Comply with requirements of CBC Section 11158.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site, store, handle and protect in accordance with manufacturer’s instructions and recommendations.

B. Deliver items in manufacturer’s original unopened protective packaging.

C. Discharge materials carefully and store on clean concrete surface or raised platform in secure dry area. Do not dump onto ground.

D. Store materials in original protective packaging to prevent soiling, physical damage or wetting.

E. Handle so as to prevent damage to finished surfaces.

1.9 FIELD MEASUREMENTS

A. Verify field measurements are as shown on shop drawings.

1.10 COORDINATION

A. Coordinate work with placement of support framing and anchors specified under Section 09110 – Non-Load Bearing Metal Framing. Provide information required for proper placement of blocking and structural support.

B. Coordinate work with installation of plumbing fixtures specified in Division 15-Mechanical.
1.11  WARRANTY

A.  Manufacturer's Warranty: Provide manufacturer's limited warranty for stainless steel panels, doors and pilasters which corrode or discolor within 5 years from date of Substantial Completion. Cover cost of replacement materials for materials found defective within warranty period.

PART 2  PRODUCTS

2.1  MANUFACTURERS

A.  Global Steel Products Corporation:


B.  Manufacturers Offering Acceptable Equivalent Products:

   1.  Accurate Partitions Corporation.

   2.  Hadrian Manufacturing, Inc.


2.2  MATERIALS

A.  Stainless Steel Sheet: ASTM A666, Type 304; stretcher leveled.

B.  Extruded Aluminum: ASTM B221, 6063 alloy, TS temper.

2.3  ACCESSORIES

A.  Headrail: Extruded aluminum; tubular construction with anti-grip top.

B.  Pilaster Shoes: Stainless steel; minimum 3 inches high; internal cross section forming to pilaster.

C.  Mounting Brackets:

2. Pilaster-to-Floor: Inverted stirrup mounting foot with cadmium plated jack bolt; L-brackets mechanically fastened each end of mounting foot and equipped with spring clips.

D. Fasteners:

1. Mounting Brackets to Walls: Sheet metal screws with full thread and tamper resistant heads; length sufficient to penetrate framing minimum 3/8 inch; chrome-plated steel.

2. Mounting Brackets to Floors: Sleeve type expansion anchors; length sufficient for minimum 1-1/2 inch embedment into concrete; corrosion resistant steel.

3. Mounting Brackets to Panels and Pilasters: Internally threaded through-bolt fasteners consisting of barrel nuts and machine screws with tamper resistant heads; chrome-plated steel.

4. Hinges and Strike/Keeper to Pilasters: Internally threaded through-bolt fasteners consisting of barrel nuts and machine screws with tamper resistant heads; chrome-plated steel.

5. Other Hardware: Sheet metal screws with full thread and tamper-resistant heads; chrome-plated steel.

E. Adhesive: Non-toxic with volatile organic contents not exceeding VOC content limits established in South Coast Air Quality Management District Rule #1168.

2.4 HARDWARE

A. Hinges: Chrome plated die-case Zamac cam-action hinges; cams adjustable to allow door to rest at any position within 270 degree range.

1. Upper Hinge: Recessed and interlocked in door with nylon pin within plane of door.

2. Lower Hinge: Recessed in door; includes mating box and pintle nylon cams which provide bearing surface.

B. Latch: Chrome plated die-case Zamac concealed mortise style configured for emergency access.

1. Compartments with Grab Bars: Paddle handle providing access without grasping or twisting; manufacturer's ADA paddle handle.

2. Other Compartments: Manufacturer's standard handle.

C. Keeper/Strike: Chrome plated die-case Zamac; 1 piece with rubber bumper.
D. Door Pulls: U-shape wire type; chrome plated.

E. Combination Coat Hook/Door Stop: Chrome plated Zamac hook with rubber bumper tip.

2.5 FABRICATION

A. Fabricate partition doors, panels and pilasters and urinal screen panels with 22 gauge embossed stainless steel sheets formed and bonded under pressure with adhesive to full face honeycomb core.

1. Panels: 1 inch thick; partition panel sized to suit cubicle depths indicated on Drawings; urinal screen panel sized as indicated on Drawings.

2. Pilasters: 1-1/4 inch thick; widths to suit cubicle widths and spacing; height as required for 83 inch overall partition height.

3. Doors: 1 inch thick; sizes to suit access requirements.

B. Seal door and panel edges with 22 gauge stainless steel interlocking moldings welded to face sheets and each other at corners to form rigid frame around component. Grind welds smooth.

C. Seal pilaster edges with 22 gauge stainless steel interlocking moldings. Weld inverted stirrup with leveling jack bolt to base of pilaster.

D. Provide internal reinforcement in areas of attached hardware, fittings, grab bars and toilet accessories. Mark locations of reinforcement for partition mounted grab bars and toilet accessories.

2.6 FINISHES

A. Stainless Steel Sheet:

1. Door, Panel and Pilaster Faces: Embossed pattern to match Global "Diamond Finish."

2. Other Locations: #4 brushed finish.

B. Extruded Aluminum: Clear anodized with stain finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine installed work of other trades to determine acceptability for installation. Verify that
such work is complete to point where work of this section may begin and is acceptable for product installation in accordance with manufacturer's instructions and recommendations.

B. Verify that plumbing fixtures are correctly located and correctly spaced.

C. Verify correct location of built-in framing, anchorage, and bracing. Verify that walls are plumb.

D. Verify that doors are correctly located.

E. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install toilet partitions and urinal screens in accordance with manufacturer’s instructions and final reviewed shop drawings.

B. Install partition and screen components secure, straight, plumb, level, square and aligned.

C. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.

D. Attach mounting brackets securely to wall framing and floor slabs. Wet drill ceramic tile prior to installing fasteners.

1. Securely mounting brackets to wall framing using threaded fasteners.

2. Secure mounting brackets to floor slabs with expansion anchors. Adjust for floor variations with leveling bolt integral with pilaster anchoring shoe; conceal floor fastenings at toilet partitions with stainless steel pilaster shoe trim.

E. Attach panels and pilasters to brackets with tamper resistant metal screws. Locate headrail joints at pilaster center lines.

F. Level, plumb and tighten installation. Align tops of panels. Secure pilaster shoe trims in position.

G. Install doors using specified hardware. Equip each door with hinge, latch, keeper/strike and combination coat hook/door stop. In addition, equip each outswinging door with 1 additional combination coat hook/door stop and equip each door to compartments having grab bars with back-to-back door pulls.

1. Install strike/keeper on each pilaster in alignment with latch. Locate strike/keepers and latches at midpoints of doors between 30 and 44 inches above floor.
2. Install combination coat hook/door stops on interior faces of each door.
   a. Locate combination coat hook/door stops 48 inches above floor on doors to
      compartments having grab bars.
   b. Locate combination coat hook/door stops 3 inches below tops of doors to
      other compartments.

3. Equip each door to compartments having grab bars with door pull on both sides.
   Locate pulls immediately below latches.

4. Install additional combination coat hook/door stops on exterior faces of each
   outswinging door. Locate 3 inches below tops of doors.

H. Set tops of doors parallel with line of finished ceiling when doors are in closed position.

I. Align tops and bottoms of doors with tops and bottoms of panels.

3.3 ERECTION TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

B. Maximum Variation From Plumb: 1/8 inch.

3.4 ADJUSTING

A. Adjust and align partition hardware to uniform clearance at vertical edges of doors not
   exceeding 3/16 inch.

B. Adjust partition hinges to locate in-swing doors in partial open position when unlatched.
   Adjust hinges of outswinging doors to return doors to closed position.

C. Field repair of scratches and damaged components will not be permitted. Replace
   damaged and scratched materials with new materials.

3.5 CLEANING

A. Remove protective maskings. Clean surfaces.

END OF SECTION
SECTION 10 26 00

WALL PROTECTION

PART 1 - GENERAL

1.01 SUMMARY
   A. Section includes corner guards.
   B. Related Sections:

      1. Section 06 10 00 – Rough Carpentry
      2. Section 06 20 00 – Finish Carpentry
      3. Division 9

1.02 PERFORMANCE REQUIREMENTS
   A. Corner Guards: Resist lateral impact force of 200 lbs at any point without damage or permanent set.

1.03 SUBMITTALS
   A. Division 1 Section 01340 - Submittals
   B. Product Data: Submit physical dimensions, features, details, and rough-in measurements.
   C. Samples: Submit two sections of corner guard 24 inches long, illustrating component design, configuration, color and finish.
   D. Manufacturer's Installation Instructions: Submit procedures, perimeter conditions requiring special attention.

1.04 QUALITY ASSURANCE
   A. Perform Work in accordance with best practice.

1.05 FIELD MEASUREMENTS
   A. Verify field measurements prior to fabrication.

1.06 COORDINATION
   A. Coordinate Work with wall or partition sections for installation of concealed blocking or anchor devices.

PART 2 - PRODUCTS

2.01 WALL AND CORNER GUARDS
   A. Manufacturers:
1. Pawling Corp. Model CG 51, Korogard, or equal.

2.02 COMPONENTS
A. Corner Guard - Surface Mounted:
   2. Wing projection: 2 inches.
   3. Length: One piece.
   4. Preformed end caps.
B. Mounting Brackets and Attachment Hardware: Appropriate to component and substrate.
C. Exposed fasteners to be stainless steel tamper proof.

2.03 FABRICATION
A. Fabricate components with tight joints, corners and seams.
B. Pre-drill holes for attachment.
C. Form end trim closure by capping and finishing smooth.

2.04 FACTORY FINISHING
A. Corner Guard: Type 304 stainless steel with No. 4 finish.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Section 01 31 13 - Coordination: Coordination and project conditions.
B. Verify rough-in for components are correctly sized and located.

3.02 INSTALLATION
A. Position corner guard from top of wall base and flush with finished ceiling.
B. Coordinate installation of wall coverings with corner guard.
C. Seal to adjacent finishes.

3.03 ERECTION TOLERANCES
A. Section 01 45 16 – Quality Control: Tolerances.
B. Maximum variation from plumb: 1/8 inch in 8 feet.

3.04 LOCATION
A. Refer to interior elevations for location of wall corner guards.

3.5 CLEANING
A. Remove protective film and clean surfaces.

END OF SECTION
SECTION 10 28 00
TOILET ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Toilet and bath accessories.
2. Warm-air dryers.
3. Underlavatory guards.

B. Related Sections include the following:

1. Division 10 Section "Toilet Compartments" for compartments and screens.

1.03 SUBMITTALS

A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Samples: For each accessory item to verify design, operation, and finish requirements.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

D. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

E. Design Calculations: Computations demonstrating design and/or test data to Architect for review and/or submittal to the Division of the State Architect. Design calculations shall be proposed and signed by a registered professional engineer to comply with the requirements of the 2001 C.B.C., Section 1115B.8.3 regarding structural strength of grab bars, fasteners and mounting devices to be secured to the toilet partitions.
1.04 QUALITY ASSURANCE

A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.

B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.

   1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.
   2. Do not modify aesthetic effects, as judged solely by Architect, except with Architect's approval. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.05 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.06 WARRANTY

A. General Warranty: Special warranty 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. Manufacturer's written 2 year warranty against defects in materials and workmanship on all accessories.

B. Hand Dryers:

   1. Minimum Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:

   1. Toilet and Bath Accessories:
2. High Flow Warm-Air Dryers:
   a. American Dryer.
   b. Bobrick.
   c. Excel Dryer.
   d. Pinnacle Dryer Corporation.
   e. World Dryer.

3. Underlavatory Guards:
   a. Brocar Products, Inc.
   b. Truebro, Inc.

B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Toilet and Bath Accessory Schedule at the end of Part 3.

2.02 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.

C. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60.

E. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.


G. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.


I. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.
2.03 FABRICATION

A. General: One, maximum 1-1/2-inch diameter, unobtrusive stamped manufacturer logo, as approved by Architect, is permitted on exposed face of accessories. On interior surface not exposed to view or back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.

B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

C. Recessed Toilet Accessories: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.

D. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.

   1. Provide galvanized steel backing sheet, not less than 0.034 inch and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

E. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:

   1. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
   2. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

F. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner’s representative.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.
D. Toilet Tissue Dispensers: Supplied by District Vendor and installed by Contractor. 3 inch maximum profile from wall surface in accessible stalls, typical.

3.02 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.03 TOILET AND BATH ACCESSORY SCHEDULE

A. Accessible Toilet Tissue Dispenser (Bobrick B-4388): or approved equal, recessed multi-roll toilet tissue dispenser, type 304 22-gauge stainless steel, all welded construction, exposed surfaces shall have satin finish (at accessible stalls only).

B. Toilet Tissue Dispenser (Bobrick B-2888) or approved equal, stainless steel, multi-roll (surface-mounted).

C. Combination Waste Receptacle: (Bobrick No. B-3944) Where this designation is indicated, provide stainless-steel waste receptacle complying with the following:

1. Provide one of the following:
2. Fabricated for nominal 4 inch wall depth and with continuous seamless 1 inch wall flange. Provide towel compartment in upper portion of unit, designed to dispense not less than 600 C-fold or 800 multi-fold towels, double panel door with continuous piano hinge and tumbler lock. Waste receptacle in lower portion of unit provided with reusable heavy duty vinyl liner, minimum 12 gallon capacity, secured in place with tumbler lock.

D. Soap Dispenser (Bobrick No. B-2111): Supplied by District and installed by Contractor.

E. Grab Bars Bobrick, or approved equal (At accessible stalls only). Heavy duty, 18 gauge, 304 stainless steel tubing, welded 11 gauge flanges, concealed mounting. Safety grip finish, no peening.

1. Bobrick B - 6806 x 48", or approved equal.
2. Bobrick B - 6806 x 36", or approved equal.

F. Sanitary Napkin Disposal Unit (Bobrick No. B-270): Where this designation is indicated, provide stainless-steel sanitary napkin disposal unit complying with the following:

1. Products: Provide one of the following:
2. Surface Mounted Type: With seamless exposed walls; self-closing top cover; locking bottom panel with stainless-steel, continuous hinge; and removable, reusable receptacle.
G. Seat-Cover Dispenser (Bobrick No. B-221): Where this designation is indicated, provide seat-cover dispenser complying with the following:

1. Surface-Mounted Type: Stainless-steel unit with concealed opening at bottom for filling; minimum 250-seat-cover capacity.

H. Mirror Unit: Where this designation is indicated, provide mirror unit complying with the following:

1. Stainless-Steel, Channel-Framed Mirror (Bobrick No. B-290): Fabricate frame from stainless-steel channels in manufacturer's standard satin or bright finish with square corners mitered to hairline joints and mechanically interlocked.
   a. Size: 24 inches by 42 inches.

2. Fixed Tilt Frame Mirror (Bobrick No. B-293): Fabricate frame of 22 gauge, stainless steel with all joints mitered, welded and ground smooth. Frame tilt shall extend 4 inches from wall at top tapering to 1 inch at bottom.
   a. Size: 24 inches by 42 inches.

I. Mop and Broom Holder (Bobrick No. B-239-34): Where this designation is indicated, provide mop and broom holder complying with the following:

1. Products: Provide one of the following.
   2. Mop and Broom Holder with Utility Shelf: 34-inch long unit fabricated of minimum nominal 0.05-inch thick stainless steel with shelf; support brackets for wall mounting; four hooks for wiping rags; three spring-loaded, rubber hat, cam-type, mop/broom holders mounted on front of shelf.

J. Warm-Air Dryer: Where this designation is indicated, provide warm-air dryer complying with the following:

High Flow Warm-Air Dryer:

1. Products: Provide one of the following:
   a. American Dryer, Inc; Extreme Air GXT- MR (recessed)
   b. Excel Dryer, Inc. Xlerator w/ Recess Kit

K. Underlavatory Guard: Where this designation is indicated, provide underlavatory guard complying with the following:

1. Insulating Piping Coverings: White, antimicrobial, molded-vinyl covering for supply and drain piping assemblies intended for use at accessible lavatories to prevent direct contact with and burns from piping. Provide components as required for applications indicated with flip tops at valves that allow service access without removing coverings.

END OF SECTION
Features
- Vitreous china.
- Elongated bowl.
- Siphon jet.
- Wall-mount.
- 1-1/2" top spud.
- 1.28 gpf (4.8 lpf) or 1.6 gpf (6 lpf) depending on flushometer specified.
- 10-1/2" (267 mm) x 9" (229 mm) water area.
- 26-1/2" (673 mm) x 16-1/2" (419 mm) x 13-1/4" (337 mm).

Recommended Accessories
K-4731-C Commercial Heavy-duty Toilet Seat
K-4731-SC Commercial Heavy-duty Toilet Seat
K-4731-GC Commercial Heavy-duty Toilet Seat
K-10673 WAVE DC 0.5 GPF Urinal Flushometer
K-10956 Tripoint™ DC 1.28 GPF WC Flushometer
K-13517 Manual 1.28 GPF WC Flushometer
K-10674 Wave DC 1.6 GPF WC Flushometer
K-10957 Tripoint™ DC 1.6 GPF WC Flushometer
K-13516 Manual 1.6 GPF WC Flushometer

Components
Additional included component/s: Spud.

ADA | CSA B651

Codes/Standards
ASME A112.19.2/CSA B45.1
EPA WaterSense®
California Energy Commission (CEC)
ADA
ICC/ANSI A117.1
CSA B651

KOHLER® One-Year Limited Warranty
See website for detailed warranty information.

Available Color/Finishes
Color codes intended for reference only.

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TOTO.

TET3LA

EcoPower® High-Efficiency Toilet Flush Valve, 1.28 gpf

FEATURES

- 1.28 GPF
- Self-powered hydroelectric flush valve system
- No minimum daily usage requirement
- 4" x 4" stainless steel coverplate with brushed satin finish and solid bronze valve body
- Self-cleaning piston valve with 360° filter screen
- Neutral rough-in and adjustable tail piece connection
- Manual flush override
- Smart sensor with self-adjusting detection range
- 6-second detection time to prevent ghost flushing
- Concealed flush valve with 1" angle stop and 1-1/2" vacuum breaker set
- ADA compliant

MODELS

□ TET3LA31#SS (Back spud wall)
  - TET3LA#SS (1.28 gpf flush valve)
  - VB13RB-31 (1-1/2" vacuum breaker tube, 1" angle stop)

□ TET3LA32#SS (Top Spud)
  - TET3LA#SS (1.28 gpf flush valve)
  - VB13RB-32 (1-1/2" vacuum breaker tube, 1" angle stop)

□ TET3LA33#SS (Back spud floor)
  - TET3LA#SS (1.28 gpf flush valve)
  - VB13RB-33 (1-1/2" vacuum breaker tube, 1" angle stop)

COLORS/FINISHES

- #SS Stainless Steel

OPTIONAL ACCESSORIES

- Z-4000-J - Adapter for ground joint angle stops

CODES/STANDARDS

- Meets or exceeds ASSE 1037, CSA B125.3
- Certifications: IAPMO(cUPC), EPA WaterSense, ASSE, State of Massachusetts, and others
- Code Compliance: UPC, IPC, NSPC, NPC Canada, and others
- Complies with CA Title 20 regulations and CalGreen when used with a 1.28 gpf water closet
- ADA compliant

PRODUCT SPECIFICATION

TOTO® Model No. ________
Product shall be 1.28 GPF. Product shall be an automatic infrared sensor-activated, toilet flush valve. Product shall use hydropower, EcoPower flush valve system. Product shall have 4" x 4" cover plate with brushed stainless steel finish and solid bronze valve body. Product shall have smart sensor with self-adjusting detection range. Product shall have neutral rough-in and adjustable tail piece connection. Product shall have manual flush override. Product shall have 6-second detection time to prevent ghost flushing. Product shall have piston with debris screen and solenoid with self-cleaning mechanism. Product shall be ADA compliant.
Features
- Made from premium materials that withstand high-volume usage
- Constructed of vitreous china
- 21-1/4"L x 18-1/8"W
- Wall-mount installation
- Faucet not included
- Includes wall hanger
- Drilled for concealed arm carrier

Recommended Accessories
K-8998 P-Trap

Components
Additional included component/s: Hanger (2 Required).

ADA  CSA B651  OBC

Codes/Standards
ASME A112.19.2/CSA B45.1
ADA
ICC/ANSI A117.1
CSA B651
OBC

See website for detailed warranty information.

Available Color/Finishes
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Features
- 0.5 gal/min (1.9 l/min) flow rate.
- Factory set 30 second max. continual run cycle.
- Vandal-resistant aerator.
- 24" (610 mm) flexible supply hoses for easy installation.
- 5-3/4" (146 mm) spout reach.
- Less drain.

Material
- Brass construction.

Technology
- Includes 30-year Hybrid Energy Cell.
- Electronic Insight™ Sensor Technology for accurate and consistent activation.

Installation
- Single-hole mounting.
- Above-counter valve for easy installation and maintenance.

Optional Accessories
1160595 .35 gpm Aerator, Medium  
1075455 Medium Spray 0.5 gpm (1.9 l/min)  
1139284 Medium Aerrated 1.0 gpm (3.8 l/min)  
1139285 Medium Laminar 1.0 gpm (3.8 l/min)  
1097180 Medium Aerrated 1.5 gpm (5.7 l/min)  
1104546 Medium Laminar 1.5 gpm (5.7 l/min)  
79441 Sealing Washer  
13478-A  
13479-A  
13478-B  
13479-B

Codes/Standards
- ASME A112.18.1/CSA B125.1  
- NSF 372  
- All applicable US Federal and State material regulations  
- ADA  
- ICC/ANSI A117.1  
- CSA B651  
- OBC

KOHLER® One-Year Limited Warranty
See website for detailed warranty information.

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<tr>
<td>○○</td>
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Features

- Vitreous china.
- Washout flushing action.
- 3/4" top spud.
- 14-1/8" (359 mm) extended rim.
- 0.125 gpf (0.47 lpf) to 1.0 gpf (3.8 lpf).
- WaterSense® compliant when used with WaterSense flushometer.
- Will replace K-4960-ET urinal.
- 26-7/8" (683 mm) x 18" (457 mm) x 14-1/8" (359 mm)

Recommended Accessories

K-10668 WAVE DC 1/8 GPF Urinal Flushometer
K-10949 Tripoint™ DC 1/8 GPF Urinal Flushometer
K-13520 Manual 1/8 GPF Urinal Flushometer
K-10675 WAVE DC 0.5 GPF Urinal Flushometer
K-10958 Tripoint™ DC 0.5 GPF Urinal Flushometer
K-13519 Manual 0.5 GPF Urinal Flushometer
K-10676 WAVE DC 1.0 GPF Wshdwon Flushometer
K-10960 Tripoint™ DC 1.0 GPF Wshdwon Flushometer
K-13518 Manual 1.0 GPF Wshdwon Flushometer

Components

Additional included component/s: 3/4" inlet spud, 2" outlet spud, Strainer, and Hangers (2).

Bardon™ 1/8th GPF
High Efficiency Urinal (HEU)
K-4904-ET

Codes/Standards

ASME A112.19.2/CSA B45.1
EPA WaterSense®
ADA
ICC/ANSI A117.1

KOHLER® One-Year Limited Warranty
See website for detailed warranty information.
TEU1UA
EcoPower® Ultra High-Efficiency Urinal Flush Valve 0.125 gpf

FEATURES
- 0.125 GPF
- Self-powered hydroelectric flush valve system
- No minimum daily usage requirement
- Durable chrome plated body with tamper-proof screws and solid bronze valve body
- Neutral rough-in and adjustable tail piece connection
- True mechanical flush override
- Smart sensor with self-adjusting detection range
- 6-second detection time to prevent ghost flushing
- ADA compliant

MODELS
- TEU1UA12#CP
  - TEU1UA#CP (0.125 gpf flush valve)
  - VB9CP-12 (3/4" vacuum breaker tube, 3/4" angle stop)

COLORS/FINISHES
- #CP Polished Chrome

OPTIONAL ACCESSORIES
- Z-4000-J - Adapter for ground joint angle stops

CODES/STANDARDS
- Meets or exceeds ASSE 1037, CSA B125.3
- Certifications: IAPMO(cUPC), EPA WaterSense, ASSE, State of Massachusetts, and others
- Code Compliance: UPC, IPC, NSPC, NPC Canada, and others
- Complies with CA Title 20 regulations and CalGreen when used with a 0.125 gpf wall mount urinal
- ADA compliant

PRODUCT SPECIFICATION
TOTO® Model No.____________
Product shall be 0.125 GPF. Product shall be an automatic infrared sensor-activated, urinal flush valve. Product shall use hydropower, EcoPower flush valve system. Product shall have durable chrome plated body with tamper-proof screws and solid bronze valve body. Product shall have neutral rough-in and adjustable tail piece connection. Product shall have smart sensor with self-adjusting detection range. Product shall have true mechanical flush override. Product shall have 6-second detection time to prevent ghost flushing. Product shall have solenoid with self-cleaning mechanism. Product shall be ADA compliant.
FEATURES & BENEFITS

CONSTRUCTION
Unit is made of 18 gauge Type 304 stainless steel with a satin finish that resists stains and corrosion, and has soft, rounded corners. Unit features stainless steel satin finish back panel, vandal-resistant bottom plate, and 1-1/4" integral trap.

INTEGRATED TRAP
Brass 1-1/4" IPS trap is internally mounted for easy installation and access.

QUALITY CONTROL
Both fountains are pre-built and fully water and pressure tested to ensure proper functionality.

BACK PANEL
Stainless steel back panel helps to protect the wall from inadvertent splashing, and its decorative satin finish increases location visibility and completes the fountain's attractive appearance.

BARRIER-FREE
Barrier-free capabilities combined with its ease of use allows for a number of installation location possibilities.

BUBBLER HEAD
Polished chrome-plated brass bubbler head with integral basin shank for added strength. Shielded, angled stream opening provides a steady, sanitary source of drinking water at .45 gpm.

PUSH BUTTON VALVE
The push-button activated valve assembly allows for front access stream adjustment as well as cartridge and strainer access. The valve works at an operating pressure range of 30 to 90 psig (2.1 to 6.2 bar).

SPECIFICATIONS

Model 1119 "Hi-Lo" wall mounted barrier-free drinking fountain shall include dual 18 gauge Type 304 Stainless Steel satin finish basins, push-button operated stainless steel valves with front-accessible cartridge and flow adjustment, 100% lead-free waterways, polished chrome-plated brass vandal-resistant bubbler heads, polished chrome-plated brass vandal-resistant waste strainers, vandal-resistant bottom plates, stainless steel satin finish back panel, high and low fountain mounting levels, and 1-1/4" IPS traps.

APPLICATIONS

Perfect for either public or private indoor/outdoor settings, Model 1119 is a great fit in areas where aesthetics are important to the overall appeal of the architecture. This series is precisely mounted, making it a nice addition to any surrounding. Beautiful satin finish helps to maintain the fountain's overall appeal so it always remains looking as new as it did when it was installed. Specifically, this type of wall mounted drinking fountain may be placed in settings such as schools and other locations in and around office buildings where the temperature remains above freezing. Model meets all current Federal Regulations for the disabled including those in the Americans with Disabilities Act. Hawks manufactures drinking fountains and electric water coolers to be lead-free by all known definitions including NSF/ANSI Standard 61, Section 9, NSF/ANSI 372, California Proposition 65, and the Federal Safe Drinking Water Act. Product is compliant to California Health and Safety Code 116875 (AB 1953-2006).

OPTIONS

- Fountain Skirt: Model SK1, satin finish stainless steel cane touch skirt for installation on high unit in some applications that may need to comply with ADA protruding objects guidelines.
- Water Filter: Model 6426, 12" x 2" (30.5 x 5.1 cm), in-line lead removal element that reduces lead from incoming water supply.
- Mounting Plate: Model 6700.4 "Hi-Lo" universal mounting plate for most dual bubbler fountains. Priced Separately
- Support Frame: Model 6800 universal in-wall mounting support for use with most fountains.

For more information, visit www.hawsco.com or call (888) 640-4297.
SECTION 22 00 00

PLUMBING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The bidding requirements and contract forms, including General Conditions and Supplemental General Conditions, all Division 01 Sections and Section 23 0500 - General Mechanical apply to all work herein.

1.2 DESCRIPTION

A. This Specification establishes the required standards for all labor, materials, equipment, and workmanship in connection with the furnishing, fabrication, and installation of "Plumbing" systems. Plumbing includes, but is not necessarily limited to, the following items of work:

1. A complete system of soil, waste, vent and sanitary sewer piping and structures, including provisions for mechanical equipment drainage; and connection of same to existing soil, waste, vent and sanitary sewers, located approximately as indicated on the Drawings.

2. Cold water distribution system, complete, from points of contact with site domestic water systems (located approximately as indicated on the Drawings) to all plumbing fixtures, mechanical equipment, building specialties, and Owner supplied equipment scheduled for service on the Drawings.

3. Hot water distribution system, complete, from serving water heaters and/or points of contact with site domestic hot water, to all plumbing fixtures, mechanical equipment, building specialties, and Owner supplied equipment scheduled for service on the Drawings.

4. Natural gas piping system, complete from utility company meters (located as indicated on the Drawings) and terminating in stopcocks adjacent to all natural gas fired equipment, as noted on the Drawings. All gas-fired equipment shall be equipped with a gas pressure regulator as hereinafter specified.

5. All plumbing fixtures and trim as scheduled on the Drawings, inclusive of setting of fixtures and connections to drainage and water supply systems.

6. Rough in and connection of all fixtures and equipment furnished by the Owner and/or Tenant.
7. Final connection of water and natural gas to equipment furnished under other Sections.

8. Condensate drainage piping and connections from points of attachment to equipment to indirect waste locations, as noted on the Drawings.

9. Flashing of all plumbing pipe penetrations through exterior walls, roofs, and foundations.

10. Testing and adjusting of all piping systems and equipment herein specified.

11. Sterilization of domestic water systems.

12. Pipe wrapping and insulation.

B. Should any work or material not be included in the Drawings or Specifications but is nevertheless necessary for the proper execution of the stated scope therefore for full compliance with codes, laws, rules and regulations, the Contractor shall understand such work and material is required, and shall perform all such work and furnish such material as fully as if it were particularly delineated or described.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Sealants and Firestopping – Division 07 – Thermal and Moisture Protection.

B. Line voltage wiring: Division 26 - Electrical.

C. Water service, meter, and piping in connection with Landscape Irrigation System: Division 32, Landscaping and Irrigation Sections.

D. Final connection of water and gas to equipment furnished under other Sections of the Specifications.

E. Finish painting: See Section 09 9100 for painting requirements.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Conform to all applicable codes and standards as stated herein and as described in Division 01 of the Specifications, including the following:

1. American Gas Association (AGA)

2. American National Standards Institute (ANSI)

3. Adhesive and Sealant Council (ASC)

4. American Society of Mechanical Engineers (ASME)
5. American Society for Testing and Materials (ASTM)
6. American Society of Civil Engineers (ASCE)
7. California Building Code (CBC)
8. California Plumbing Code (CPC)
9. California Fire Code (CFC)
10. California Energy Conservation Code, Title 24
11. State of California Administrative Code (CAC) Titles 8, 17, and 24
12. California Electric Code (CEC)
13. National Electrical Manufacturers Association (NEMA)
15. Underwriters’ Laboratories (UL)
16. Comply with all ADA and California Title 24 requirements for disabled access.
17. City Fire Marshal requirements
18. Comply with the latest edition of all applicable standards, including AWWA, PDI, and OSHA
19. NSF/ANSI 61 Standard, Drinking Water System Components - Health Effects for fixture materials that will be in contact with potable water.
20. AB 1953, Amendments to Section 116875 of the Health and Safety Code relating to lead plumbing.

B. Minimum requirements: The requirements of these are the minimum that will be allowed unless such requirements are exceeded by applicable codes or regulations, in which the regulatory codes or regulation requirements shall govern.

1.5 SUBMITTALS

A. All submittals shall be submitted under the provisions of Section 01 33 00.

1. Product Data

   a. Cut sheets for each plumbing fixture. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports
and indicate materials and finishes, dimensions, construction details, and flow control rates for each fixture indicated.

b. Manufacturer’s product data, specifications, and installation instructions for plumbing piping, fittings, materials, and equipment

2. Shop Drawings

a. Prepare complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas. Shop drawings shall be prepared using AutoCAD 2012 or newer and shall be drawn at a minimum ¼” = 1’ - 0” scale. Sections, details, and diagrams shall be to required scales for specified areas.

b. Submit shop drawings to Architect for approval, prior to fabrication or installation of any work. Do not install equipment or piping until layout drawings have been approved. Any work installed without prior shop drawing approval shall be removed at the Contractor’s expense.

c. Complete and detailed shop drawings shall be maintained throughout the coordination and construction phase indicating all equipment and trades’ work clearly. All equipment including piping, etc. shall clearly identify both top and bottom elevations as well as distances from equipment to established building lines. Coordinate with other trades and field conditions and show dimensions and details including building construction and access for servicing.

d. Use of contract documents for shop drawings is not acceptable

e. Any work installed without prior shop drawing approval shall be removed at the Contractors expense.

1.6 AS-BUILT DRAWINGS

A. Comply with the requirements of Section 01 78 39 – PROJECT RECORD DOCUMENTS and the following.

1. A complete set of Contract Drawings shall be maintained at the work site, and all changes in the work shall be recorded on this set on a daily basis. In addition to changes made during course of work, show the following:

a. Exact location, type and function of concealed valves and controllers.

b. Exact size, elevations and location of underground and under floor piping.

B. Submit to Architect for final approval.
1.7 OPERATION & MAINTENANCE DATA (Closeout)

A. Comply with the requirements of Section 01 78 23 – OPERATION AND MAINTENANCE DATA and the following.

1. Installing contractor shall provide all operating and maintenance instructions provided by the manufacturer, describing proper operation and maintenance of any equipment and devices installed. Operating and maintenance instructions shall cover maintenance, adjustment, and operation of each piece of apparatus.

2. Contractor shall also provide a parts list of all equipment and component parts for all equipment under this Section. The equipment list shall include manufacturer’s name, model number, and local representative, service facilities and normal channel of supply for each item.

3. Data shall be bound in a hard cover 3-ring binder, with table of contents identifying items therein, and index tabs for each system. Neatly obscure or cross out inapplicable data from manufacturer’s literature. Include the following:
   a. Manufacturer’s brochures, ratings, certified shop drawings, lubrication charts and data, and parts list with part numbers. Mark each sheet with equipment identification number and actual installed condition or system and location of installation. Specifically identify which options are provided.
   b. Description of start-up and operating procedures for each system, including controls diagrams and description of operating sequences.
   c. Recommend preventative maintenance schedule and procedures.

B. Submit data to the Architect for approval. Final acceptance of the work will not be made until a satisfactory submission of this material is received and approved by the Architect.

1.8 COORDINATION

A. All work shall be coordinated with water, gas, sanitary sewer, and other services on the site. The locations of points of connection to the site services shall be confirmed prior to commencement of any and all work required under this Section of the Specifications.

B. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 PRODUCTS

2.1 GENERAL
A. Only specified materials shall be utilized in the work of this Section unless substitutions have been approved in accordance with the General Conditions and Division 01 Sections of the Specifications.

B. All materials shall be new and unused, of the best quality for the intended use, and shall be listed by the ASA, AGA, and UL as meeting their requirements and bearing their label wherever standards have been established and label services are regularly furnished by them.

C. Tracer wire shall be installed with all non-metallic piping below grade. Tracer wire shall be solid core copper, 14-gauge minimum, lain continuously along pipes. Wire shall be “ty-wrapped” to pipe at eight feet (8’ o.c.) on center. Tracer wire shall terminate in concrete access boxes at the beginning and terminal ends of the buried pipe.

D. Vent piping shall have vandal resistant mushroom vent caps.

2.2 PIPE, FITTINGS

A. Below Ground Sanitary Soil, Waste, Vent, and Storm Drainage Piping:

1. Lines 2” and larger shall be standard weight, no-hub cast iron soil pipe and fittings manufactured from gray cast iron with a tensile strength of not less than 21,000 psi, bituminous coated interior and exterior, conforming to the requirements of ASTM A888 and CISPI Standard 301. Each length of pipe shall be hydrostatically (water) tested by the manufacturer to verify compliance. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and listed by NSF international. All pipe and fittings shall be of the same manufacturer. Approved manufacturers: AB&I, Charlotte, or Tyler.

2. Joints:

a. Super-duty no-hub couplings shall have a shield constructed of type 304 stainless steel with a minimum thickness of 0.016” (28 gauge). The worm gear drive clamps shall have a hexagon head to accept a 3/8” socketed torque wrench. The clamps shall be tightened to a minimum of 80 in pounds. The gaskets shall be manufactured using neoprene rubber meeting the requirements of ASTM C-564. Couplings shall meet FM 1680 class 1. Smooth shielded couplings shall have a 304 stainless steel shield with a minimum thickness of 0.025” (24 gauge). Couplings 1-1/2” through 4” shall have four bands and 5” through 10” shall have six bands. The clamps shall be tightened between 115 and 125 inch pounds. Approved manufacturers: Husky SD4000, Clamp-All High Torq 125, or MG Couplings.

b. Couplings shall be installed in accordance with manufacturer’s installation instructions, local code requirements, and shall be tightened using a calibrated torque wrench.
B. Above Ground Soil, Waste, Drain, and Vent Pipe:

1. Lines 2" and larger shall be no-hub cast iron soil pipe and fittings manufactured from gray cast iron with a tensile strength of not less than 21,000 psi, bituminous coated interior and exterior, conforming to the requirements of ASTM A888 and CISPI Standard 301. Each length of pipe shall be hydrostatically (water) tested by the manufacturer to verify compliance. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and listed by NSF international. All pipe and fittings shall be of the same manufacturer. Approved manufacturers: AB&I, Charlotte, or Tyler.

2. Joints:
   a. Heavy duty no-hub couplings shall have a shield constructed of type 304 stainless steel with a minimum thickness of 0.010" (32 gauge). The worm gear drive clamps shall have a hexagon head to accept a 5/16" socketed torque wrench. The clamps shall be tightened to a minimum of 80 in pounds. The gaskets shall be manufactured using neoprene rubber meeting the requirements of ASTM C-564. Couplings shall meet FM 1680 class 1. Smooth shielded couplings shall have a 304 stainless steel shield with a minimum thickness of 0.016” (28 gauge). Couplings 1-1/2” through 4” shall have four bands and 5” through 10” shall have six bands. The clamps shall be tightened a minimum of 80 inch pounds. Approved manufacturers: Husky HD2000, Tyler Wide Body, or Clamp All 80.

   b. Couplings shall be installed in accordance with manufacturer's installation instructions, local code requirements, and shall be tightened using a calibrated drive click torque wrench.

3. Lines under 2" shall be galvanized steel pipe, with threaded cast iron drainage fittings.

4. At the option of this Contractor, all soil, waste, and vent piping above ground may be DWV copper, with wrought copper fittings, with “Stay-Safe 50” lead free solder and a suitable non-corrosive flux.

C. Natural Gas Piping:

1. Above ground piping shall be Schedule 40, black steel.

   a. All concealed pipe and all pipe 2½" and larger shall be welded. Fittings for welded pipe shall be seamless steel, weld neck. All welding shall be performed by a certified welder and inspected by a certified welding inspector.
b. All accessible pipe 2" and smaller shall be threaded. Fittings for threaded pipe shall be 150-lb. malleable iron, screwed and banded.

c. All exposed above grade piping shall be painted with rust resistant paint and lead-free primer.

D. Hot & Cold Water Piping:

1. All domestic hot and cold water piping 3" and smaller shall be Type L, hard temper, copper pipe with wrought copper or cast brass solder joint fittings or ProPress fittings. Pipe shall be NSF 61 Certified and bear the NSF Certification mark.

2. Pipes below grade inside buildings shall be soft drawn, Type K, soft drawn copper with no joints below slabs. Pipes shall be sleeved with 20-mil plastic sheathing.

3. All joints shall be made up with lead free solder with matching flux. Solder joints with 95-5 tin-antimony.

E. Condensate Drainage Pipe:

1. Condensate drainage piping shall be Mueller or approved equal.

   a. 2" and larger shall be type DWV copper tube, ASTM B306.

   b. 1 ½" and smaller shall be type M, hard temper copper, standard copper fittings.

2. Drainage fittings shall be ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings. 1 ½" & smaller, standard pressure fittings.

3. Solder shall be ASTM B 32, lead free with ASTM B 813, water-flushable flux

2.3 UNIONS

A. Steel pipe unions shall be malleable iron, 150 lb., ground joint, Grinnell Fig. 463.

B. Copper pipe unions shall be soldered joint,Nibco series 633 or 733, Mueller, or equal.

C. Dielectric unions shall be EPCO, Watts, or equal.

2.4 DIELECTRIC FITTINGS

A. Precision Plumbing Products, "Clear Flow" series, threaded dielectric fittings, sizes 19100P thru 19195P.

B. Dielectric fittings shall have zinc electroplated steel casing, and NSF/FDA listed lining. Fittings shall meet the requirements of ASTM standard F1545 for continuous use at
temperatures up to 225°F (- +5°F) and for pressures up to 300 psi, and shall achieve a dielectric waterway in all potable water and appropriate HVAC applications.

2.5 VALVES, SPECIALTIES

A. Ball Valves: Valves shall be rated 600 PSI non-shock CWP and have 2-pc. Lead-free dezincification-resistant body, end piece, stem and ball, TFE seats, full port, separate pack nut with adjustable stem packing and anti-blowout stems. Valves ends shall have full depth ANSI threads. Valves shall be 3rd party certified to Annex G of NSF/ANSI 61. Nibco T-685-80-LF, Watts LFB-6080, or KITZ 858.

B. Gate Valves: 3” and smaller shall be Nibco T134, Stockham B-120, or KITZ 42T; bronze body, union bonnet, rising stem, solid wedge, 150 lb. with wheel handle.

C. Gate Valves: Larger than 3” shall be Nibco F-617-0 or KITZ 72; iron body, bolted bonnet, outside screw and yoke, solid wedge, 125 lb. with wheel handle.

D. Lift Check Valves (vertical): Nibco T-480-Y-LF or KITZ 836; bronze body, inline lift type, Teflon seat, and discs, spring actuated, 125 lb.

E. Swing Check Valves (horizontal): Nibco T-413-Y-LF, Stockham B-345, or KITZ 822T; bronze body, Y-pattern swing-type, rated 200 PSI non-shock CWP. Body, bonnet, and disc hanger shall be of lead-free dezincification-resistant material and TFE seat disc. Valve ends shall be threaded type. Valves shall be 3rd party certified to Annex G of NSF/ANSI 61.

F. Gas Shut-off Valves:

1. At Building Service: Homestead Fig. 601, semi-steel, lubricated plug, lever handle, 200 lb. Install CALIFORNIA(KOSO) Series 300 seismic actuated shut off valve at meter (or entrance to building if not new construction). Brace per manufacturer's instructions.

2. At Connection to Equipment: Jomar T-203 gas ball valves, 1/4 -turn, hot forged brass, 2-piece design, standard port, appliance type with side tap/drain. Provide with AGA/csa certified stainless steel flex connection 12" max.

G. Gas Pressure Regulators: American Meter, Series 1813B. Regulators shall be sized for full gas capacity of equipment as scheduled on the Drawings. Inlet pressure shall be 3 psg. Outlet pressure shall be 7" water column. Regulators installed indoors shall have relief opening piped to outdoors. Size relief pipe in accordance with ANSI Z223.1 "National Fuel Gas Code".

H. Hose Bibbs

1. HB-#1: Interior Hose Bibbs shall be Chicago No. 293 with No. E-27 vacuum breaker, polished chrome plated, tee handle, adjustable threaded flange inlet, hose thread outlet. Provide a Chicago No. 1771 loose key stop at each hose bibb.
a. Provide (1) hose bibb in all toilet rooms equipped with a floor drain. Hose bibb shall be 24" above finished floor, adjacent to or in between lavatories.

2. **HB-2**: Narrow Wall Hydrants: Zurn Z-1350, or equal Jay R Smith; encased, moderate climate type, bronze body, all bronze interior parts, replaceable seat washer, screwdriver operated stop valve in supply, key operated control valve, and ¾ IP female inlet and ¾ male hose connection. Adjustable stainless steel box with hinged cover, cylinder lock and “WATER” stamped on cover.

2.6 CLEANOUTS

A. Cleanouts in membrane damproofed floors shall have flashing flange and membrane clamps. Plugs shall be bronze, with cast iron body ferrule for cast iron pipe.

B. Floor Cleanouts (FCO): Zurn ZN 1400-HD, “Level-trol” adjustable floor cleanouts, dura-coated cast iron with gas and water-tight ABS tapered thread plug, and round scoriated top, adjustable to finished floor.

C. Grade (COTG): Zurn Z-1474-IN or equal JR Smith. Housing to be dura-coated cast iron body with integral anchor flange and scoriated cover with lifting device. Cleanouts in un-paved areas shall be set in 18" x 18" x 4" concrete pads.

D. Accessible:

1. Cast iron pipe: Zurn Z-1440, dura-coated with gas and water-tight, bronze, taper thread plug

2. Steel pipe: Zurn Z-1470-A bronze, raised head, cleanout plug.

3. Copper tubing: Nibco figure 816 or 817.

E. Wall Cleanouts (WCO):

1. Copper tubing: Nibco figure 816 or 817, with Zurn Z-1462, 6” x 6” polished chrome-plated bronze wall plate and frame.

2. Cast iron pipe: Zurn Z-1441, dura-coated with gas and water-tight bronze, taper thread plug and round smooth stainless steel access cover with securing screw

3. Steel pipe: Zurn Z-1468, round stainless steel wall access cover, complete with securing screw and bronze raised hex head plug for steel pipe.

2.7 SHOCK ABSORBERS
A. Zurn “Shoktrol” series or equal Jay R Smith, stainless steel bellows. Install with gate valve shut-off and access door at all flush valves or other automatic valves. A single unit sized in accordance with the manufacturer’s recommendations may serve batteries of valves.

2.8 FLOOR DRAINS

A. Floor Drains: Drains in membrane dampproofed floors shall have flashing flange and membrane clamp.

B. FD-1: Zurn ZN-415-SS-P. Dura-Coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with type "S" polished nickel bronze strainer with trap primer connection. 5 x 5 top size. Drains in sheet vinyl floors shall have a 14" square latex flange (ZN-415-SL-P).

2.9 TRAP PRIMERS

A. Trap primers shall be installed for all floor drains as follows: Trap primers shall be Precision Plumbing Products (model P2-500 or PR-500). Trap Primers shall be pressure drop activated and be of all brass construction including a brass body with ½” male NPS inlet and ¾” female NPT discharge. Internal components shall consist of a stainless steel debris screen, brass piston and brass discharge jet. Lubricated O-rings shall be EPDM and seal O-rings shall be nitrile.

1. Trap primers shall be installed on fresh cold water lines of 1 ½” diameter or less and shall be located where they will be subjected to frequent pressure drops of at least 10 psi. Install with shut off valve and access doors in Janitor’s closets, Mechanical Rooms and other areas not served by, or in close proximity to, flushometer valve operated water closets.

2. Working pressure shall be 35 psi to 75 psi. Valves shall be listed with ASSE under standard #1018.

2.10 PIPE INSULATION

A. Insulate all hot water supply piping, all hot water return piping, all tempered water supply piping and all tempered water return piping with Johns Manville "Micro-Lok HP", or equal, rigid fiberglass one-piece pipe insulation or Knauf Insulation “Earthwool 1000™” or “Earthwool Redi-Klad 1000” rigid glass mineral wool one-piece pipe insulation, or approved equal.

B. Pipe covering shall have factory applied All Service Jackets (ASJ). Jackets shall be constructed of high density, white kraft bonded to aluminum foil with fiber glass yarn, with a pressure sensitive closure system, or of aluminum foil reinforced with a glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no exposed paper. Adhesives or staples shall not be required to seal the jacket and butt strips.
C. All insulation shall have composite (insulation, jacket, tape seal, and adhesive used to adhere the jacket to the insulation) Fire and Smoke Hazard ratings as tested under Procedure ASTM E 84 and NFPA 255, not exceeding: Flame Spread - 25, Smoke Developed - 50. PVC fitting covers, jacketing and accessories such as adhesives, mastics, cements and cloth for fittings should have the same component ratings.

D. Insulation thickness shall conform to Title 24, Part 6 requirements as indicated in the following table:

<table>
<thead>
<tr>
<th>FLUID TEMPERATURE RANGE (°F)</th>
<th>CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)</th>
<th>INSULATION MEAN RATING TEMPERATURE (°F)</th>
<th>NOMINAL PIPE DIAMETER (in inches)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 and less</td>
<td>1 to &lt;1.5</td>
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INSULATION THICKNESS REQUIRED (in inches)

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<th>Space heating, Hot Water systems (steam, steam condensate and hot water) and Service Water Heating Systems</th>
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</thead>
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<tr>
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<td>251-350</td>
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<tr>
<td>0.29-0.31</td>
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<td>100</td>
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<td>Space cooling systems (chilled water, refrigerant and brine)</td>
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<td>0.21-0.27</td>
</tr>
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<td>75</td>
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<td>Below 40</td>
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<td>0.20-0.26</td>
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<td>50</td>
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E. Fittings, valves and flanges shall be covered with Manville “Zeston 2000” insulated PVC fitting covers and Hi-Lo Temp insulation inserts or Knauf “Proto LoSmoke”. Insulation for all exposed piping and all piping in crawl spaces shall be covered with Zeston PVC jacketing. PVC jackets shall be 20 mils thick and shall be bonded with Zeston Perma-Weld adhesive. In crawl spaces, Knauf Earthwool RediKlad 1000* pipe covering shall serve as an acceptable alternate to standard pipe covering and PVC.

F. All piping exposed to the weather shall be finished with aluminum jacketing with a laminated moisture retarder or Earthwool RediKlad 1000* with Venture Clad embossed jacket. Aluminum jacketing shall be overlapped 2 to 3 inches and held in place with stainless steel bands to form a weather tight system. Elbows and tees shall be fitted with matching aluminum fitting covers. Other fittings in metal-jacketed systems shall be finished with conventional weather-resistant insulating materials with painted aluminum finish.
2.11 SLEEVES, WALL PLATES

A. Service pipe through exterior walls, roofs; interior walls, ceilings: Sioux Chief or equal, wall and ceiling plates; chrome plated at finished rooms.

B. Pipes through, under footings: 18 gauge iron sleeves two diameters larger than pipe, cast in concrete, annular space filled with mastic or plastic bituminous cement.

C. Pipes through fire rated walls shall be protected with fire retardant mastic as detailed on the drawings. Installation shall be in full accordance with the requirements of the UL system number. Hilti or approved equal.

D. Pipes through floors, interior concrete walls, and through fire rated walls and smoke stop partitions: 18 gauge iron sleeves, two diameters larger than pipe, annular space filled with 3M Brand Fire Barrier CP-25 caulk.

E. Pipes through 1-hour walls shall be protected with fire retardant mastic as detailed on the drawings. Installation shall be in full accordance with the requirements of the UL system number. Hilti or approved equal.

2.12 FIXTURES

A. The quantity and location of fixtures shall be taken from the Architectural and Plumbing drawings. Provide adequate supports and all standard trim normally furnished for fixtures. All enamel shall be acid resisting. Traps, unless otherwise noted shall be 17 gauge brass tubing, chrome plated when exposed.

B. Except as otherwise shown, provide ¾" steel backing plates, 36" wide by 12" high minimum size, secured to a minimum of three studs by welding, or with ¾" x 2¾" lag screws for all wall hung fixtures for which no other means of support is specified.

C. Stops and supplies: Provide stops for all fixtures. Unless otherwise specified, stops exposed at lavatories and similar fixtures shall be Chicago #1016ABCP, chrome plated, loose key. Concealed stops shall be Chicago #1771ABCP.

D. All fixtures shall be Zurn or equivalent Kohler or American Standard, except where specifically noted otherwise. All fixtures shall be standard white color, except as noted.

E. All fixtures shall meet or exceed the requirements of the California Administrative Code, Title 24, Part 5.

1. P-1 - WATER CLOSET

   a. Fixture: Kohler "Kingston" K-4325; vitreous china, elongated bowl, siphon jet; wall mounted; 1.28 gpf. See Architectural Drawings for mounting height.
b. Flush Valve: Toto TET3LA "EcoPower" high-efficiency flush valve; self-powered hydroelectric infra-red sensor operated flush valve; 4" x 4" stainless steel coverplate; manual flush override; sensor w/self-adjusting detection;

c. Seat: Olsonite #955SCT; open front; elongated; self-sustaining hinges; Sta-Tite fastening system; white.

d. Carrier: Zurn Z-1201 or 1202, no-hub; 500 lb. capacity with auxiliary inlets as required.

2. P-1A - WATER CLOSET (ADA)
   a. Fixture: Kohler "Kingston" #K-4325; vitreous china, elongated bowl, siphon jet; wall mounted; 1.28 gpf. See Architectural Drawings for ADA mounting height.

   b. Flush Valve: Toto TET3LA "EcoPower" high-efficiency, self-powered hydroelectric infra-red sensor operated flush valve; 4" x 4" stainless steel coverplate; manual flush override; sensor w/self-adjusting detection;

   c. Seat: Olsonite #955SCT; open front; elongated; self-sustaining hinges; Sta-Tite fastening system; white.

   d. Carrier: Zurn Z-1201 or 1202, no-hub; 500 lb. capacity with auxiliary inlets as required.

3. P-2 LAVATORY
   a. Fixture: Kohler "Kingston" K-2007; wall mounted; 21 ¾" x 18 1/8"; overflow; backsplash; single faucet hole; vitreous china.

   b. Faucet: Kohler "Sculpted Insight" K-7515; with mixer. single hole; 5 ¾" spout; vandal resistant aerator; 0.5 gpm (HW/CW).

   c. Drain: McGuire #155A; open grid P.O. plug

   d. P-Trap: McGuire #8902 adjustable trap w/cleanout

   e. Carrier: Zurn Z-1251

4. P-3 – URINAL:
   a. Fixture: Kohler "Bardon" L-4904-ET; high efficiency; vitreous china; washout type; 0.125 gpf

   b. Flush Valve: Toto "EcoPower" ultra high-efficiency self-powered hydroelectric flush valve; manual flush override; 0125 gpf

   c. Carrier: Zurn Z-1222

5. P-3A – URINAL (ADA)
a. Fixture: Kohler "Bardon" L-4904-ET; high efficiency; vitreous china; washout type; ADA compliant; 0.125 gpf

b. Flush Valve: Toto "EcoPower" ultra high-efficiency self-powered hydroelectric flush valve; manual flush override; 0.125 gpf

c. Carrier: Zurn Z-1222

6. P-6 - DRINKING FOUNTAIN

a. Fixture: Haws model 1119.14 “Hi-Lo” wall mounted barrier free drinking fountain; 14 gauge Type 304 Stainless Steel satin finish basins with integral ¼” mounting plates, push-button operated valves with front-accessible cartridge and flow adjustment, polished chrome-plated brass vandal resistant bubbler heads, polished chrome-plated brass vandal-resistant waste strainer, vandal-resistant bottom plate, stainless steel satin finish back panel, high and low fountain mounting levels, and 1-1/4” traps.

b. Mounting: Model 6700.4 universal mounting plate.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. This Contractor shall be held to have examined the site and compared it with the Contract Documents, and to have satisfied himself as to the conditions under which the work is to be performed. In the event of discrepancy, he shall notify the Architect and proceed as he directs. He shall be held responsible for all existing conditions, whether or not accurately described, and no allowance shall subsequently be made on his behalf for any error, omission, or extra expense to which he may be put due to failure or neglect on his part to make such examination and notification.

B. Prior to commencing the work of this Section, this Contractor shall inspect the installed work of other trades and verify that their work is sufficiently complete to permit the start of work under this Section and that the completed work will be in complete accordance with the original design. In the event of discrepancy immediately notify the Architect and proceed as he directs.

3.2 ACCESSIBILITY

A. Equipment shall be placed and piping connections made in such a manner that all routine adjustments and maintenance operations may be carried out without inconvenience and so that all code requirements for clearances are maintained.

3.3 VIBRATION AND SOUND CONTROL

A. Make all necessary provisions to prevent the transmission of vibration to the building structure and the passage of noise from the equipment rooms to other rooms. Provisions
shall include: vibration isolators for motor driven equipment; flexible pipe connections to motor driven equipment; resilient mounting for piping; sealing off pipe and duct penetrations of walls, floors and ceilings of equipment rooms.

3.4 INSTALLATION, GENERAL

A. Provide all necessary cutting in connection with the work of this Section. NO structural members shall be drilled, bored, or notched in a manner that will impair their structural capacity; all penetrations of concrete or masonry shall be made with core drills; NO cutting shall be done without the approval of the Architect.

3.5 INSULATION

A. Insulation shall be applied in complete accordance with the manufacturer's published installation instructions. All insulation shall be applied on clean, dry surfaces and shall be continuous through wall and ceiling openings and sleeves, except where fire stop materials are required.

B. All joints shall be firmly butted together and longitudinal jacket laps and butt strips shall be smoothly secured.

C. Specified adhesives, mastics and coatings shall be applied at the manufacturer's recommended minimum coverage per gallon.

D. Insulation on all cold surfaces must be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, etc. that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation. Seal all pipe terminations with vapor barrier mastic.

E. All surface finishes are to be extended to protect all surfaces, ends and raw edges of insulation.

F. Inserts shall be installed at outside hangers. Inserts between the pipe and pipe hangers shall consist of rigid closed cell pipe insulation of thickness equal to the adjoining insulation. Inserts shall not be less than 12" long for pipe sizes through 2½" and not less than 18" long for pipes larger than 2 ½". Refer to manufacturer's recommendations for densities, sectional length, gauge of metal shield and distance between centering.

G. Galvanized metal shields shall be applied between hangers or supports and the pipe insulation. Shields shall be formed to fit the insulation and shall extend up to the centerline of the pipe and the length specified for hanger inserts less 4" to allow for vapor retarding butt joints on each side of shields.

H. All pipe insulation ends shall be tapered and sealed, regardless of service.
3.6 INSTALLATION, PIPING

A. Soil, Waste, Vent, Drain Piping:

1. Soil, waste, and vent piping occurring within the building shall be installed to a uniform minimum grade of 3/4" per foot unless otherwise noted. Vent piping shall be graded so that all condensation shall flow directly to a soil or waste line.

2. Exterior soil and waste lines shall be installed to inverts or grades indicated on the drawings.

3. Bell and Spigot pipe shall be installed with the bell up grade.

4. Changes in direction of drainage piping shall be accomplished by the use of appropriate drainage and sanitary fittings.

5. Drilling and tapping of drains, soil, waste, or vent pipes and the use of saddle hubs and bands are prohibited.

6. Protection against breakage of piping passing under or through walls shall be provided using specified sleeves and caulking.

7. Adapters shall be installed between threaded iron and soil pipe.

8. Test tees shall be installed at the foot of all soil, waste, and storm water stacks.

9. Cleanouts shall be located where indicated on the Drawings; at all horizontal offsets; at ends of waste or sewer branches more than 5' in length; at intervals of 100' in straight runs of piping, or at closer intervals if directed or required by local code. Location of cleanouts in finished spaces shall be approved by the Architect prior to installation.

B. Hot, Cold Water Systems:

1. Di-electric unions shall be installed where copper pipe is connected to galvanized steel piping or stub outs.

2. Connections from copper pipe to fixture supply fittings shall be made with copper or brass nipples.

3. Provide 18" high vertical air chambers, of size equal to "local connection schedule" size, at all domestic water connections to fixtures and/or equipment that are not specified to have shock absorbers.

4. All domestic water piping shall be kept clear of the building structure. Where it is within 1" of the building structure it shall be wrapped with felt (3/16" minimum thickness).
5. To the greatest extent possible, domestic cold water piping shall be kept separated from hot piping and where there is a choice shall be run in the coolest portion of the available space.

C. Plumbing Fixtures:

1. Space between wall mounted fixtures and wall surface shall be neatly pointed up with G.E. silicone rubber compound of color matching fixture.

2. All exposed bolt heads and nuts used to secure fixtures shall be concealed with vitreous china caps.

D. Natural Gas Piping Systems:

1. Natural gas piping shall slope back to meter where possible; bottom of vertical natural gas lines shall be fitted with 6" long capped drip legs.

2. In addition to main shut-off valve, a natural gas stopcock shall be installed at each natural gas fired piece of equipment.

E. Indirect Waste Piping:

1. Indirect waste piping shall be installed to a uniform minimum grade of \( \frac{1}{4} \)" per foot unless otherwise noted.

2. Changes in direction of indirect waste piping shall be accomplished by the use of appropriate drainage fittings.

3. Drilling and tapping of indirect waste pipes and the use of saddle hubs and bands are prohibited.

4. Protection against breakage of piping passing under or through walls shall be provided using specified sleeves and caulking.

F. Excavation, Backfill:

1. Provide all excavation, trenching, and backfill in connection with the work of this Section.

2. Excavation shall be carried to 4" below the bottom of pipes. Provide a sand bedding for all sloped drainage piping, and provide smooth uniformly graded bedding of firm but yielding material for all other piping, catch basins, and similar structures.

G. Flashing:
1. All roof and wall penetrations shall be flashed and counterflashed water tight with
   26 gauge sheet metal, except as noted.

2. Vents through roof shall be flashed with Semco #1100-4 lead flashing assemblies.
   Flashing shall extended over top of pipe and shall be turned down inside top of
   pipe.

3.7 CONNECTION, OWNER FURNISHED EQUIPMENT

A. All electrical wiring and connections for equipment furnished under this Section shall be
   furnished and installed under the Electrical Sections.

3.8 TESTING, INSPECTIONS

A. This Contractor shall not allow or cause any work of this Section to be covered or enclosed
   until it has been inspected, tested, and approved by the Architect and the authorities
   having jurisdiction over the Work. Should any of this work be enclosed or covered up
   before such inspection, testing, and approval, this Contractor shall uncover the work, have
   the necessary inspections, tests, and approvals made and, at no expense to the Owner,
   make all repairs necessary to restore both his work and that of other contractors that may
   have been damaged, to be in conformity with the Contract Documents.

B. In any test, proper safety procedures and equipment should be used, including personal
   protective equipment such as protective eyewear and clothing. Installers should always
   consider local conditions, codes and regulations, manufacturer’s installation instructions,
   and Architects'/Engineers’ specifications in any installation.

C. Tests:

1. This Contractor shall make all tests required by all local, state, and federal laws,
   codes, ordinances, and regulations having jurisdiction over this work.

2. Furnish all necessary labor, materials, and equipment for conducting tests, and pay
   all expenses in connection therewith. Should leaks develop while testing, repairs
   shall be made, and tests shall be repeated until a satisfactory test is obtained.

3. Water Piping: Shall be hydrostatically tested for 6 hours at 150 psi. All equipment
   shall be tested water tight at utility pressure.

4. Drainage and Vent Piping: Shall be tested for 1 hour by plugging all outlets and
   filling the pipes with water to the top of vertical sections of pipes. No loss of water
   shall be permitted.

5. Natural Gas Piping: Shall be tested for twenty-four (24) hours at a pressure of 50
   psig with nitrogen or compressed air. NO pressure drop shall be allowed during
   the last four (4) hours of the test. Tests joints of natural gas piping with Leak-Tek
or Nupro-Snoop solution while maintaining ten (10) psig minimum internal pressure.

3.9 DOMESTIC WATER SYSTEM STERILIZATION

A. Upon completion of this work, the new domestic water system shall be thoroughly flushed, sterilized and flushed. Sterilization and flushing shall be performed using the procedure below. All work shall be performed in the presence of the inspector.

B. All domestic water outlets shall have signs posted at their location stating that the water has not been sterilized and shall not be used for human consumption. The signs shall remain until the sterilization process is complete.

C. Procedure

1. Introduce chlorine or a solution of sodium hypochlorite, filling the lines slowly and supplying the sterilization agent at a rate of 200 parts of chlorine per million. The entire system shall be completely filled with the solution. All valves shall be operated and ends of all branches tested for residual chlorine. Continue to inject the solution until at least 200 ppm of free chlorine is indicated.

2. After the sterilizing agent has been applied, the system shall be isolated with the solution retained for at least 3 hours. Test for residual chlorine after retention. If less than 200 ppm is indicated, repeat the sterilization procedure.

3. After satisfactory sterilization, flush the system until all traces of the chemical are removed or until the chlorine content is no greater than that in the existing supply.

D. After a period of 48 hours minimum, bacteriological tests, using samples from at least 3 representative points, shall be made by recognized testing agency, who shall certify to the Architect that the system is bacteriologically safe and at least equal in safety to that of the principal water supply. The laboratory report and certification shall be transmitted to the Architect.

3.10 CLEANING

A. Flush all water piping systems. Remove, clean and replace all strainer baskets prior to final inspection.

B. Blow out all compressible fluid piping with compressed air before connecting with regulators or equipment.

3.11 ADJUSTING

A. Properly adjust all stops, and controls, and demonstrate safe and satisfactory operation of all equipment.
3.12  CLEANUP

A.  Upon completion of the work of this Section, remove all surplus material, debris, and equipment associated with or used in the performance of this work.

END OF SECTION
SECTION 23 0000
HEATING, VENTILATING, AIR CONDITIONING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The requirements of the General Conditions, Supplemental General Conditions, Division 01
   Sections and Section 23 0500 General Mechanical applies to all work herein.

1.2 DESCRIPTION

A. This Specification establishes the required standards for all labor, materials, equipment
   and workmanship in connection with the furnishing, fabrication and installation of
   complete “Heating, Ventilating, Air Conditioning” systems. Heating, ventilating, air
   conditioning work includes but is not necessarily limited to the following:

1. Fan coil units;
2. Exhaust fans;
3. HVAC & piping insulation;
4. Hydronic piping and appurtenances;
5. Flashings, curbs and caps in connection with all equipment, piping and ductwork
   supplied under this Section;
6. Condensate drainage piping, inclusive of all pipe, fittings, anchors, support and
   bracing;
7. Temperature control wiring and control devices;
8. Start up, adjusting, and balancing.

1.3 RELATED WORK

A. Sheet metal flashing and trim: Section 07 62 00.

B. Line voltage wiring, disconnect switches, conduit for temperature control wiring, and final
   connection of electrical equipment: See Section 26 27 00 - Basic Electrical Materials &
   Methods.

C. Finish painting: See Section 09 91 00 - “Painting and Coatings”.
1.4 SUBMITTALS

A. All submittals shall be submitted under the provisions of Section 01 33 00 – SUBMITTAL PROCEDURES.

B. Product Data

1. For all HVAC equipment, include manufacturer’s specifications, data sheets, and certified drawings in compliance with specification and/or as scheduled.

2. Include physical and performance data such as weights, sizes, capacities, required clearances, performance curves, acoustical characteristics, finishes, color selection, and accessories. Include certified drawings on major equipment.

C. Coordination/Layout Shop Drawings

1. Prepare complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas. Shop drawings shall be prepared using AutoCAD 2012 or newer and shall be drawn at a minimum $\frac{3}{8}” = 1’ - 0”$ scale. Sections, details, and diagrams shall be to required scales for specified areas.

2. All drawings shall be fully coordinated with Plumbing, Fire Protection, Electrical, Structural, and Architectural work. Drawings shall be coordinated and dimensioned indicating equipment, pipe, duct, fire protection, and electrical in relation to architectural and structural features. Indicate exact locations of valves, piping specialties, access doors, etc. Clearly identify and dimension the proposed locations of the principal items of equipment and adequate clearance for all equipment, piping, pumps, valves and other items. Provide detailed layout of all piping systems showing the proposed routes.

3. Show the access means for all items requiring access for operations and maintenance.

4. Submit shop drawings to Architect for approval, prior to fabrication or installation of any work. Do not install equipment or piping until layout drawings have been approved. Any work installed without prior shop drawing approval shall be removed at the Contractor’s expense.

5. Complete and detailed shop drawings shall be maintained throughout the coordination and construction phase indicating all equipment and trades’ work clearly. All equipment including piping, etc. shall clearly identify both top and bottom elevations as well as distances from equipment to established building lines. Coordinate with other trades and field conditions and show dimensions and details including building construction and access for servicing.
6. Use of contract documents for shop drawings is not acceptable

7. Any work installed without prior shop drawing approval shall be removed at the Contractors expense.

D. Samples - (not required)

E. Shop-wiring diagrams of temperature controls and air conditioning unit controls as shown on Drawings.

F. Equipment manufacturer shall design, construct, and certify that his equipment satisfies the special minimum seismic resistance requirements and shall submit calculations or test results supporting his certification.

G. Refer to mechanical equipment specified herein for additional requirements

1.5 AS-BUILT DRAWINGS

A. Comply with the requirements of Section 01 78 39 – PROJECT RECORD DOCUMENTS and the following.

B. A complete set of Contract Drawings shall be maintained at the work site, and all changes in the work shall be recorded on this set on a daily basis. In addition to changes made during course of work, show the following:

1. Exact location, type and function of concealed valves and controllers.

2. Exact size, elevations and location of underground and under floor piping.

C. Submit to Architect for final approval.

1.6 OPERATION & MAINTENANCE DATA (Closeout)

A. Comply with the requirements of Section 01 78 23 – OPERATION AND MAINTENANCE DATA and the following.

B. Installing contractor shall provide all operating and maintenance instructions provided by the manufacturer, describing proper operation and maintenance of any equipment and devices installed. Operating and maintenance instructions shall cover maintenance, adjustment, and operation of each piece of apparatus.

C. Contractor shall also provide a parts list of all equipment and component parts for all equipment under this Section. The equipment list shall include manufacturer’s name, model number, and local representative, service facilities and normal channel of supply for each item.
D. Data shall be bound in a hard cover 3-ring binder, with table of contents identifying items therein, and index tabs for each system. Neatly obscure or cross out inapplicable data from manufacturer's literature. Include the following:

1. Manufacturer’s brochures, ratings, certified shop drawings, lubrication charts and data, and parts list with part numbers. Mark each sheet with equipment identification number and actual installed condition or system and location of installation. Specifically identify which options are provided.

2. Description of start-up and operating procedures for each system, including controls diagrams and description of operating sequences.

3. Recommend preventative maintenance schedule and procedures.

E. Submit data to the Architect for approval. Final acceptance of the work will not be made until a satisfactory submission of this material is received and approved by the Architect.

1.7 OPERATING & MAINTENANCE INSTRUCTIONS

A. Comply with the requirements of Section 01 79 00 – DEMONSTRATION & TRAINING and the following.

B. The Owner's authorized representative shall be instructed in the operation and servicing of all heating, ventilating, and air conditioning systems. Provide a minimum of one man-day of instruction time. All instruction shall be provided at no cost to the Owner.

1.8 AS-BUILT DRAWINGS

A. Comply with the requirements of Section 01 78 39 – PROJECT RECORD DOCUMENTS and the following.

B. A complete set of Contract Drawings shall be maintained at the work site, and all changes in the work shall be recorded on this set on a daily basis. In addition to changes made during course of work, show the following:

1. Exact location, type and function of concealed valves and controllers.

2. Exact size, elevations and location of underground and under floor piping.

C. Submit to Architect for final approval.

D. Submit data to the Architect for approval. Final acceptance of the work will not be made until a satisfactory submission of this material is received and approved by the Architect.

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A. Comply with the requirements of Section 01 79 00 – DEMONSTRATION & TRAINING and the following.

B. The Owner’s authorized representative shall be instructed in the operation and servicing of all heating, ventilating, and air conditioning systems. Provide a minimum of one man-day of instruction time. All instruction shall be provided at no cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Only specified materials shall be utilized in the work of this Section unless substitutions have been approved by the Architect and in accordance with Section 01 25 00 – SUBSTITUTION PROCEDURES.

B. All materials shall be new, of the best quality for the intended use, shall be listed by the ASA, AGA or UL as meeting their requirements and bearing their label wherever standards have been established and label services are regularly furnished by them.

C. Provide fan drives rated at 150% of motor horsepower. Drives shall be adjustable sheave type unless specified otherwise. Listed fan speeds are only approximate; select and/or change drives to operate at approximately midpoint of adjustable range after final balancing.

D. Provide guards to enclose exposed moving equipment components in accordance with California Department of Industrial Relations, CAL/OSHA Title 8 regulations. Fabricate belt guards with rigid angle iron frame, expanded metal screen, pivoted 4” diameter tachometer opening covers, and in two pieces to permit lubrication or sheave and belt adjustment without removing guard. Provide removable sheet metal guards at shafts and couplings and removable framed wire mesh guards at openings in mechanical systems.

2.2 PRESSURE PIPING (CHILLED and HEATING):

A. Pressure piping shall conform to the requirements of ANSI Safety Code for Pressure Piping, B31.1. Piping shall be commercially round and straight, be of uniform quality and workmanship, and free from all defects. All pressure piping shall be identified.

B. Pressure ratings herein are steam, unless specifically designated as "WOG" or "WWP".

C. Copper tubing shall be drawn (hard) temper. ASTM B 88, Type L, unless otherwise specified. Mueller Industries or equal.

1. Fittings shall be wrought copper solder joint, ASME B16.22. Anvil, Victaulic, or Nibco.

2. Fittings sizes not available in wrought copper shall be:
a. 2” and smaller: Cast bronze, threaded, ground joint unions

b. 2½” and larger: Cast bronze, flanged unions, 150 psi class.

D. Viega pressure seal fittings and couplings are an acceptable proprietary joining method. Contractor must be specially trained and use tools required by manufacturer for this joining method.

E. Black steel, threaded: ASME B36.20, Schedule 40, with malleable iron fittings, ASME B16.3, 150 psi class.
   1. 2” and smaller shall be threaded.

F. Black steel, welded and seamless: ASTM A 53, Schedule 40, with steel welding-neck flanges and flanged fittings, ASME B16.9; 150 psi class.
   1. 2½” and larger shall be welded.

2.3 CONDENSATE DRAINAGE PIPE

A. Condensate drainage piping shall be Mueller or equal.
   1. 1 ½” and larger shall be type DWV copper tube, ASTM B306.
   2. 1 ¼” and smaller shall be type M, hard temper copper, standard copper fittings.

B. Drainage fittings shall be ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings. 1 ¾” & smaller, standard pressure fittings.

C. Solder shall be ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 VALVES

A. Ball Valves: Nibco T-685-80, Watts B-6080, or KITZ 58; bronze body, two-piece, full port, lever handle, 600 psi CWP.

B. Check Valves:
   1. 2” and smaller:
      a. Horizontal: Nibco T/S 413, Stockham B-321, or KITZ 22/23; bronze body, regrinding type, Y-pattern, renewable disc, Class 150.
      b. Vertical: Nibco T-480 or KITZ 36; bronze body, inline lift type, Teflon seat, and discs, spring actuated 125 lb. SWP.
   2. 2½” and larger:
a. Horizontal: Nibco F918, Stockham G-931, or KITZ 78; IBBM, iron body, bolted cap, flanged, horizontal swing, renewable seats and discs, 125 lb. SWP

b. Vertical: Nibco F-910 or KITZ 7032, iron body, globe style, spring actuated, renewable seats and disc, 125 lb. class rating.

C. Air Eliminators: Air vents shall be installed at all high points in all water piping systems.

D. Automatic air vents: Spirtotherm Spirotop Air Release Valve, cast brass, rated for 150 psig design pressure and 270°F operating temperature. Units shall include non-ferrous floats, stainless steel linkage and a Viton seal, which closes against a brass spring operated seat.

E. Manual air vents: 1” IPS x 2” long air chambers with readily accessible Dole No. 10 vent valve and 1/8” copper tubing.

F. All valves, except pressure reducing and control valves, shall be the same size as the pipe to which they are installed.

G. Provide a union immediately downstream from each valve, unless the valve is flanged.

H. All valves shall be installed with the stem 45 degrees above horizontal, if possible. In no case shall the stem be installed below horizontal.

2.5 UNIONS

A. Steel Pipe: malleable iron, 150 lb., ground joint, Anvil figure 463, Kuhns, or equal.

B. Copper Pipe: soldered joint, Nibco series 633 or 733, Mueller, or equal.

C. Dielectric: EPCO, Watts, or equal.

2.6 FLEXIBLE CONNECTORS

A. Pipe: Bronze, double braided, sweat solder ends, Metraflex BBS series, equivalent Keflex, or approved equal.

2.7 STRAINERS

A. For pipes 1 ½”– 2”: Nibco T/S 221/222-A Wilkins S or YB series strainer, 20 mesh type 304 stainless steel screen, bronze construction, 200 psi, or equal. Provide with hose bibb drain.

B. For pipes 2 ½” & larger: Nibco F-721A, Wilkins F series, flanged, 125 lb., tapped bolted bonnet with plug and stainless steel screen.

C. For pipes 4” & larger: Wilkins F series. 125 lb., perforated metal screen, flanged.
2.8 PRESSURE AND TEMPERATURE TEST STATIONS

A. Supply and install where indicated “Pete’s Plug II” ¼ inch fitting to receive either a temperature or pressure probe ½ inch O.D. Fittings shall be solid brass with two valve cores of Nordel (Max 275°F) at 500 psi, fitted with a color coded cap strap with gasket, and shall be rated at 1000 PSI at 140°F.

B. Additionally, the Contractor shall supply to the Owner upon completion of testing, a pressure and temperature test kit. It shall consist of 0-100 psi (700kPa) pressure gauge with a number 500 gauge adaptor attached. It shall contain one 25-125°F and one 0-220°F dial pocket testing thermometer. Also included shall be an extra number 500 gauge adaptor and protective carrying case with foam inserts.

2.9 THERMOMETERS

A. Thermometers shall be of the bimetallic dial type (3") dial size with stainless steel case and stem, hermetically sealed, silicone damped, universal adjustable angle style, with external recalibrator screw, ¼ inch NPT connection. Thermometers shall be Tarris Adjustable Angle series, or equal.

B. Thermometer for pipeline or tank mounting shall have (brass or stainless steel) separable well.

C. Where insulation thickness exceeds 2 inches, a longer stem shall be used with an extension neck separable well. The extension neck shall be at least 2 inches long.

D. The proper range shall be selected so that the operating temperature of the material being measured shall fall approximately in the middle of the scale.

E. Thermometer for measuring fluid temperatures shall have stems with insertion length roughly half of the pipe diameter; minimum insertion length shall be 2 inches. Thermometers installed on tanks shall have 4 ½ inch minimum stem length.

F. Thermometers for measuring air temperature shall have duct flange connections in place of separable well.

G. For applications where the process media may be corrosive or contained under pressure, the use of a thermowell shall be required to prevent damage to the thermometer and facilitate its removal from the process.

2.10 PRESSURE GAUGES

A. Pressure gauges shall be Tarris No. 600CB or equal.

B. Pressure gauges shall be of the 4 ½ inch dial size with flangeless cast aluminum case, stainless steel friction ring and glass window. Movement shall be brass with a bourdon
tube and brass socket. Dial face shall be white with black graduations and markings. Pointer shall be friction adjustable type. Accuracy shall be ± 1% of scale range, ASME B40.100 Grade 1A.

C. Range of gauges shall be not more than the operating range x 1.5. The proper range will be selected so that the average operating pressure falls approximately in the middle of the scale selected.

D. A gauge cock shall be supplied at each gauge connection.

E. Gauges on service where pressure surges or pulsations are possible shall be provided with pressure snubbers.

2.11 FAN COILS

A. Daikin FCHH202 & FCHH206 as scheduled on the Drawings.

2.12 INSULATION

A. General

   1. All duct insulation materials including jackets, tapes, adhesives and coatings shall meet ASTM E84 25/50 Flame Spread/Smoke Development requirements.

B. Exterior of Ductwork: (Flexible Duct Wrap)

   1. Unless specified to be lined, all ductwork shall be wrapped with formaldehyde-free, flexible glass-fiber or mineral-wool, blanket type insulation with factory applied FSK aluminum foil facing. Thickness shall be 2”.


   3. Interior of Ductwork: (Duct Liner)

C. All ducts exposed to the weather shall be internally insulated. All other ductwork within 10 feet of a fan (supply and return) shall be internally insulated. Duct liner shall be installed in supply and return ducts and plenums where noted on the Drawings. Exhaust ductwork need not be insulated.

D. Duct liner shall meet the requirements of ASTM C 1071, NFPA 90A or NFPA 90B Type I and Type II. Operating temperature shall meet ASTM C411. Microbial growth shall meet ASTM C1338, G21 and G22.

   1. Type I - Plenum Liner Board: Johns Manville “Permacote Linacoustic R-300” or Knauf “Rigid Plenum Liner”, or approved equal. Thickness shall be 1 ½” unless
otherwise noted.

2. Type II - Flexible Duct Liner: Johns Manville “Linacoustic RC” or Knauf “Sonic XP Duct Liner”, with fire resistant facing; or approved equal. Thickness shall be 1 ½” unless otherwise noted.

E. Supply & Return Piping

1. Insulate all supply and return piping with Johns Manville "Micro-Lok HP" rigid fiberglass one-piece pipe insulation, Knauf Insulation "Earthwool 1000 Degree", "Earthwool Redi-Klad 1000 Degree, Owens Corning “Fiberglas” rigid glass mineral wool one-piece pipe insulation with an all purpose vapor retarder jacket, or approved equal.

2. ASJ+ jackets shall be constructed of high density, white kraft bonded to aluminum foil with fiberglass yarn, with a pressure sensitive closure system or aluminum foil reinforced with a glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no exposed paper. Adhesives or staples will not be required to seal the jacket and butt strips.

3. Fittings, valves and flanges shall be covered with Manville “Zeston 2000” insulated PVC fitting covers and Hi-Lo Temp insulation inserts or Knauf “Proto LoSmoke”.

4. Insulation for all exposed piping and all piping in mechanical rooms and similar spaces shall be covered with Zeston PVC jacketing. PVC jackets shall be 20 mils thick and shall be bonded with Zeston Perma-Weld adhesive. In crawl spaces, Knauf Earthwool RediKlad 1000” pipe covering shall serve as an acceptable alternate to standard pipe covering and PVC.

5. All piping exposed to the weather shall be finished with aluminum jacketing with a laminated moisture retarder or Earthwool RediKlad 1000” with Venture Clad embossed jacket. Aluminum jacketing shall be overlapped 2 to 3 inches and held in place with stainless steel bands to form a weather tight system. Elbows and tees shall be fitted with matching aluminum fitting covers. Other fittings in metal-jacketed systems shall be finished with conventional weather-resistant insulating materials with painted aluminum finish.
A. Insulation thickness shall be as follows:

<table>
<thead>
<tr>
<th>FLUID TEMPERATURE RANGE (°F)</th>
<th>CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)</th>
<th>INSULATION MEAN RATING TEMPERATURE (°F)</th>
<th>NOMINAL PIPE DIAMETER (in inches)</th>
<th>INSULATION THICKNESS REQUIRED (in inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 and less</td>
<td>1 to &lt; 1.5</td>
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<td></td>
<td></td>
<td></td>
<td>5</td>
<td>5.0</td>
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<tr>
<td>Above 350</td>
<td>0.32-0.34</td>
<td>250</td>
<td>4.5</td>
<td>5.0</td>
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<tr>
<td>251-350</td>
<td>0.29-0.31</td>
<td>200</td>
<td>3.0</td>
<td>4.0</td>
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<tr>
<td>201-250</td>
<td>0.27-0.30</td>
<td>150</td>
<td>2.5</td>
<td>2.5</td>
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<tr>
<td>141-200</td>
<td>0.25-0.29</td>
<td>125</td>
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<td>1.5</td>
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<tr>
<td>105-140</td>
<td>0.22-0.28</td>
<td>100</td>
<td>1.0</td>
<td>1.5</td>
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<tr>
<td>Space heating, hot water systems (steam, steam condensate and hot water) and Service Water heating systems</td>
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<tr>
<td>40-60</td>
<td>0.21-0.27</td>
<td>75</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Below 40</td>
<td>0.20-0.26</td>
<td>50</td>
<td>1.0</td>
<td>1.5</td>
</tr>
</tbody>
</table>

B. All tanks, expansion tank, pumps, volutes, valves and strainers shall be completely insulated with ½”Armaflex glued and sealed, vapor tight, in place with Armstrong #520 adhesive.

2.14 ROOF MOUNTED EXHAUST FANS

A. Greenheck “G” series exhaust fans as scheduled on the Drawings or approved equal.

B. Exhaust fans shall be of spun aluminum, direct drive type. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone. Wheels shall be statically and dynamically balanced. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure, and be leakproof. Shroud and motor cover shall be drawn from a disc.

C. Motors shall be mounted out of the airstream on vibration isolators. Fresh air for motor cooling shall be drawn into the motor compartment through a large space between the fan shroud and the motor cover. Motors shall be readily accessible for maintenance.

D. A NEMA 1 rated disconnect switch shall be factory installed and wired from the fan motor to a junction box within the motor compartment. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.
E. All fans shall bear the AMCA Certified Ratings Seal for sound and air performance.

F. Each fan shall bear a permanently affixed manufacturer’s engraved metal nameplate containing the model number and individual serial number for future identification.

G. Electronically Commutated Motor (Varigreen)
   1. Motor enclosures: Open type
   2. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable.
   3. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
   4. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
   5. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
   6. Motor shall be a minimum of 85% efficient at all speeds.

H. Accessories
   1. Bird screen
   2. Insulated roof curb, galvanized, GPI-22-G12, undersized 1.5 in. total liner.
   3. Gravity operated backdraft dampers shall have galvanized frames with prepunched mounting holes and be balanced for minimum resistance to flow. Non-coated

2.15 CEILING MOUNTED EXHAUST FANS

A. Panasonic “Whisper Green” series ventilation fans, “FV” series as scheduled on the Drawings or approved equal.

B. Ventilating fan shall be of the ceiling mount, ENERGY STAR rated type, with variable speed control that shall be built-in with a high/low delay timer and activated by a motion sensor. The motor shall be enclosed with a brushless DC motor engineered to run continuously. Power rating shall be 20v/60Hz. Detachable dual 4" or 6" diameter duct adaptor shall be included.

C. Fan shall be UL listed for tub/shower enclosure when used with GFCI branch circuit wiring.
Fan shall be ASHRAE 62.2, LEED, ENERGY STAR IAP, EarthCraft, and California Title-24 compliant.

2.16 FILTERS FOR AIR HANDLING EQUIPMENT

A. Filters shall be 2" completely disposable type with fiberglass media, Flanders “Pre-Pleat M13”, AAF, Farr, or approved equal, UL Class 2 listed. Permanent washable types are not acceptable. Change filters at job completion and furnish one complete filter change boxed at the jobsite for owner.

B. Each filter shall consist of synthetic only media, with corrosion-resistant expanded metal backing and moisture resistant enclosing frame. The filter shall be 2" nominal depth. The grid shall be 100% bonded to the media on the air exiting side to eliminate media vibration and pull-away.

C. The grid shall be formed to provide a uniform V-wedge shaped pleat with the open area on the air exiting side for maximum utilization of the media and low airflow resistance. The filter shall be classified for flammability by Underwriters Laboratories, Standard 900 as Class 2.

D. The filter shall have a Minimum Efficiency Reporting Value (MERV) of 13 by ASHRAE Standard 52.2.

E. During construction, protect all filters upstream of air handling units with blankets of 2" fiberglass filter media or 2" disposable panel filters. UL Class 2 listed. Remove after balancing, and prior to acceptance.

F. Systems shall not be operated without properly installed filters, including temporary filters for use during construction. If the final pressure drop of the temporary filters is reached during the construction or test and balance, replace them with the spare set. If not used, the spare set is to be delivered to the Owner at the time of acceptance.

2.17 REGISTERS, GRILLES, AND DIFFUSERS

A. Air terminals shall be Titus, Price, or approved equal, as scheduled on the Drawings.

1. Ceiling Diffusers - High Capacity

a. Ceiling diffusers shall be TITUS Model TDC (steel) for fixed, horizontal discharge pattern. These diffusers shall consist of an outer frame assembly of the sizes and mounting types shown on the Drawings and air terminal schedule. A square or rectangular inlet shall be an integral part of the frame assembly and a transition piece shall be available to facilitate attachment of round duct. An inner core assembly consisting of fixed deflection louver shall be available in one-, two-, three- or four-way horizontal discharge patterns. The inner core assembly must be
removable in the field without tools for easy installation, cleaning or
damper adjustment.

b. The finish shall be #26 white. The finish shall be an anodic acrylic paint,
baked at 315°F for 30 minutes. The pencil hardness must be HB to H.

2. Ceiling Exhaust Grilles

a. Ceiling exhaust grilles shall be Price Series 80 eggcrate return grilles of
aluminum construction, consisting of aluminum 1/2 in. x 1/2 in. x 1/2 in.
grid (eggcrate core) and an extruded aluminum border. The grille shall be
finished in B12 White Powder Coat.

3. Wall Supply Grilles

a. Heavy duty steel supply grilles shall be TITUS Model 300RS-HD (double
deflection) of the sizes and mounting types shown on the plans and outlet
schedule. The deflection blades shall be available parallel to the short
dimension of the grille.

b. Construction shall be of steel with a 1¼-inch wide border on all sides and a
minimum border gauge of 18. Screw holes shall be countersunk for a neat
appearance. Corners shall be welded with full penetration resistance
welds.

c. Front deflection blades shall be 14-gauge steel, adjustable from 0°- 40°,
and spaced on ½-inch centers. Rear deflection blades (if applicable) shall
be 26-gauge steel spaced on ¾-inch centers.

d. The grille finish shall be #26 white. The finish shall be an anodic acrylic
paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to
H. The paint must pass a 100-hour ASTM B117 Corrosive Environments
Salt Spray Test without creepage, blistering or deterioration of film. The
paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint
must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-
inch pound force applied.

4. Return Air Wall Diffuser

a. Steel return grilles shall be TITUS Model 350RL (¾-inch blade spacing) of
the sizes and mounting types shown on the plans and outlet schedule. The
fixed deflection blades shall be available parallel to the long or short
dimension of the grille. Construction shall be of steel with a 1¼-inch wide
border on all sides. Screw holes shall be countersunk for a neat
appearance. Corners shall be welded with full penetration resistance
welds.
b. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be firmly held in place by mullions from behind the grille and fixed to the grille by welding in place. Blade deflection angle shall be available at 35°.

B. All terminals shall be steel and shall be factory painted “off-white”, unless otherwise noted.

C. Air terminals for installation in gypsum board shall have a 1” border for surface mounting. All air terminals for installation in lay-in ceilings shall have a lay-in frame to match the specified grid system.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Prior to commencing the work of this Section, the Contractor shall inspect the installed work of other trades and verify that their work is sufficiently complete to permit the start of work under this Section, and that the completed work shall be in complete accordance with the original design. In the event of discrepancy, immediately notify the Architect and proceed as directed.

3.2 GENERAL INSTALLATION

A. Provide all necessary cutting in connection with the work of this Section. No structural members shall be drilled, bored, or notched in a manner which shall impair their structural capacity. All penetrations of concrete or masonry shall be made with core drills. No cutting shall be done without the approval of the Architect.

3.3 HEATING & AIR CONDITIONING EQUIPMENT INSTALLATION

A. All units shall be set with curbs plumb, level, and securely attached through framed opening with bolts and/or lag screws as noted on the Drawings. Connections to ductwork shall be secured, filter racks shall be aligned, enclosures and ductwork connections shall be fully waterproofed, and all utility and control connections shall be complete.

3.4 INSULATION INSTALLATION

A. Exterior Ductwork:

1. Duct wrap shall be cut in a manner to meet the manufacturers’ stretch-out guideline to provide a 2" staple lap and have minimum compression at the corners. All joints shall be lapped 2" and stapled with outward clinching staples 2" on center. The insulation shall be mechanically fastened to the underside of all ducts 24" wide or more using cup-head pins, weld pins, or stick pins with speed clips 18" on center. Insulation shall not be compressed to comply with required
installed R-value. All joints and penetrations of the vapor barrier jacket shall be sealed with a minimum 3" wide matching pressure sensitive tape. Pressure-sensitive tape shall be firmly rubbed in place immediately after application using a "squeegee" type tool.

2. When a vapor seal is required, two coats of vapor retarder mastic reinforced with one layer of 4" wide, open weave glass fabric may be used in lieu of pressure-sensitive tape. Mastic shall be brushed onto joint and glass fabric imbedded in it. A second coat of mastic shall be brushed over the glass fabric until the fabric is filled. Mastics shall be applied in accordance with application instructions on the container.

B. Interior Duct Liner

1. Apply to the inside face of ducts, coated side facing air stream. Fasten using fire retardant adhesive and secure with mechanical fasteners at 12" maximum o.c., both directions, for velocities up to 2,500 fpm. Velocities over 2,500 fpm shall have fastener spacing of 6" o.c.

2. Exposed edges must be factory or field coated with adhesive. Metal nosing shall be installed in all liner leading edges facing the airstream at fan discharge, at access doors, and at any interval of lined duct preceded by unlined duct.

3. Insulation with torn or broken coatings shall be removed and replaced. Loose corners, edges, and butt joints will not be accepted.

4. Maximum velocity: 5,000 ft/min.

C. Piping Insulation

D. Insulation shall be applied in complete accordance with the manufacturer's published installation instructions on clean, dry surfaces. All insulation shall be continuous through wall and ceiling openings and sleeves. All joints shall be firmly butted together and longitudinal jacket laps and butt strips shall be smoothly secured. Specified adhesives, mastics and coatings shall be applied at the manufacturer’s recommended minimum coverage per gallon.

E. Provide insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature with vapor retardant jackets with self-sealing laps. Seal all pipe terminations with vapor barrier mastic.

F. Inserts shall be installed at outside hangers. Inserts between the pipe and pipe hangers shall consist of rigid closed cell pipe insulation of thickness equal to the adjoining insulation. Inserts shall not be less than 12" long for pipe sizes through 2½" and not less than 18" long for pipes larger than 2 ½". Refer to manufacturer's recommendations for densities, sectional length, gauge of metal shield and distance between centering.
G. Galvanized metal shields shall be applied between hangers or supports and the pipe insulation. Shields shall be formed to fit the insulation and shall extend up to the centerline of the pipe and the length specified for hanger inserts less 4" to allow for vapor retarding butt joints on each side of shields.

H. All pipe insulation ends shall be tapered and sealed, regardless of service.

3.5 EXHAUST FAN INSTALLATION

A. Install fans in accordance with manufacturer's instructions and as indicated in the Installation, Operation and Maintenance Manual (IOM) and contract drawings.

B. Examine areas to receive fans. Notify the Architect of conditions that would adversely affect installation or subsequent utilization and maintenance of fans. Do not proceed with installation until unsatisfactory conditions are corrected.

C. Ensure roof openings are square, accurately aligned, correctly located, and in tolerance. Ensure duct is plumb, sized correctly, and to proper elevation above roof deck.

D. Adjusting
   1. Adjust exhaust fans to function properly
   2. Adjust belt tension
   3. Lubricate bearings
   4. Adjust drive for final system balancing
   5. Check wheel overlap

E. Clean as recommended by manufacturer. Do not use material or methods which may damage finish surface or surrounding construction

F. Protection

G. Protect installed product and finished surfaces from damage during construction.

H. Protect installed exhaust fans to ensure that, except for normal weathering, fans will be without damage or deterioration at time of substantial completion.

3.6 FILTERS

A. Systems shall not be operated without properly installed filters. Filters used during construction shall be removed and replaced with new filters after construction is completed and the systems are ready for final acceptance by the owner.
3.7 TESTS, INSPECTIONS

A. Make all necessary control adjustments and balancing of air and water flows. Operate the entire system for a period of time not less than three (3) working days for the purpose of proving satisfactory performance. During this period, instruct such persons as the Owner and/or Architect may designate in the proper operation of the systems. Should further adjustment prove necessary, operating tests shall be repeated until a satisfactory test is obtained.

B. This Contractor shall not allow or cause any work of this Section to be covered or enclosed until it has been inspected, tested, and approved by the Architect and the authorities having jurisdiction over the Work. Should any of this work be enclosed or covered up before such inspection, testing, and approval, this Contractor shall uncover the work, have the necessary inspections, tests, and approvals made and, at NO expense to the Owner, make all repairs necessary to restore both his work and that of other contractors which may have been damaged to be in conformity with the Contract Documents.

C. Furnish all necessary labor, materials, and equipment for conducting tests, and pay all expenses in connection therewith. Should leaks develop while testing, repairs shall be made, and tests shall be repeated until a satisfactory test is obtained.

D. Heating water and chilled water piping shall be hydrostatically tested at 125 psi pressure and proved tight before covering. Tests may be made in sections provided connection to service previously tested is included in each succeeding test. Systems shall be tight for eight hours.

E. Condenser water piping shall be hydrostatically tested at 125-psi pressure and proved tight before covering. Tests may be made in sections provided connection to service previously tested is included in each succeeding test. Systems shall be tight for eight hours.

3.8 CHEMICAL TREATMENT AND CLEANING OF HYDRONIC PIPING

A. After all hydronic piping has been hydrostatically tested, the piping shall be flushed thoroughly with water to remove all loose foreign material that may be present. Existing piping shall be drained and refilled.

B. Closed Loop Cleaning and Initial Preparations:

1. Initial Fill: As the first water is introduced into the system, add not less than 10 gallons for each 1,000 gallons of contained water volume of a liquid blend of alkaline detergent SANASOLV® 6103 or equal.

2. Circulation: The above closed loop detergent shall be re-circulated for not less than twelve (12) hours/not more than forty-eight (48) hours after which the system shall be rapidly dumped with re-circulating pumps operating to provide maximum practical motion, and whenever possible while simultaneously adding or
chasing with rinse water. It is important that make-up water rate exceed water discharge rate. In either case, the system shall be flushed until neutral to phenolphthalein, reaches the same pH and TDS levels as the clean flushing water, and is free from suspended material and color.

a. After flushing, all strainers shall be removed and cleaned. If the system contained a significant level of suspended solids, re-circulating pump seal replacement may be required as requested by the project engineer as recommended by the water treatment field service application specialist. These functions will be the responsibility of the mechanical contractor with supervision by the water treatment applications specialist.

b. Be sure that all heating and/or cooling coils are kept open during the cleaning process and that cleaning solution is circulating through them and totally flushed from the entire system. These functions will be the responsibility of the mechanical contractor with supervision by the water treatment applications specialist.

3. Initial Treatment Closed Loop: As soon as possible after flushing (within two hours) and with clean water in the systems, introduce 800 to 1,200 parts per million of sodium nitrite, pH buffer, yellow metal inhibitor and anti-scalants, SANACOR™ 2301-A or equal, and adjust system water pH to 8.5-10.5. Maintain treatment concentration in all closed systems using by-pass feeders.

3.9 CLEANUP

A. Upon completion of the work of this Section, remove all material, debris, and equipment associated with or used in the performance of this Work.

END OF SECTION
SECTION 23 0593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems
2. Balancing Hydronic Systems
3. Additional Tests
   a. Sound testing
   b. Vibration testing
   c. Duct leakage testing
   d. Controls verification

1.3 SCOPE

A. The T&B Agency will provide the following services:

1. Provide all supervision, personnel, instruments, calibration equipment, and all other materials necessary to perform balancing and testing, and compile test data including calculations and services necessary for the heating, ventilating, and air conditioning systems for this project, all in accordance with the project Drawings and Specifications and as specified herein.

2. The T&B Agency shall be responsible for inspecting, balancing, adjusting, testing, and logging the data of the performance of fans, all dampers in the duct systems, all air distribution devices or heat exchangers, and the flows of water through all coils.

3. The T&B Agency shall balance, test, and adjust the systemic components to obtain optimum conditions in each conditioned space in the building. If construction deficiencies are encountered which preclude obtaining optimum conditions, the deficiencies will be recorded and given to the Owner's Representative. The T&B Agency is advised that deficiencies in the HVAC construction are often encountered during final T&B services, and should include in the bid an amount deemed advisable to compensate for time in identifying the deficiencies.
B. During construction, the T&B Contractor shall inspect the installation of pipe systems, sheet metal work, temperature controls, and other component parts of the HVAC systems. Inspections shall be conducted a minimum of three times. Typically this is performed when 60% of the ductwork and piping are installed and again when 90% of the total system is installed and prior to insulation. A copy of the written report is to be issued to the Mechanical Engineer for review.

1.4 SUBMITTALS


B. System Readiness Checklists: Within 30 days of Contractor’s Notice to Proceed, submit system readiness checklists for use by systems installers in verifying system readiness for T&B. Examination Report: Within 30 days of Contractor’s Notice to Proceed, provide a summary report of the examination review required in Part 3 “Examination”, if issues are discovered that may preclude the proper testing and balancing of the systems.

C. Examination Report: Provide a summary report of the examination review if issues are discovered that may preclude the proper testing and balancing of the systems.

D. Certified T&B reports: Within 30 days of completion of balancing work, submit AABC-certified T&B report.

1. Submit one copy of the final T&B Report directly to the design professional of record. Provide three additional copies to the contractor.

1.5 QUALITY ASSURANCE

A. T&B Contractor Qualifications:

1. General Contractor will employ a T&B Agency that is certified by the Associated Air Balancing Council (AABC). The T&B Agency will have experience in the field of air and hydronic system balancing, possess calibrated instruments, and employ qualified Supervisors and skilled Technicians to perform all required tests. The T&B Agency shall have a minimum of ten (10) years experience in the Testing, Adjusting, and Balancing field.

B. T&B technician shall perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified T&B reports.

2. Certify that the T&B team complied with the approved T&B plan and the procedures specified and referenced in this Specification.

3. Certify the T&B report

C. T&B Conference: If requested by the Owner or Construction Manager after approval of the T&B Agency’s submittals, meet to develop a mutual understanding of the details

1. Agenda Items:

a. The examination report.
b. The Strategies and Procedures plan.

c. Systems readiness checklists.

d. Coordination and cooperation of trades and subcontractors.

e. Coordination of documentation and communication flow.

D. Approved Test and Balance agencies in the area:

   - **RS Analysis, Inc.**
     1035 SunCast Lane, Suite 130
     El Dorado Hills, CA 95762
     (916) 358-5672

   - **National Air Balance Company, Inc.**
     4171 Business Center Drive
     Fremont, CA 94538
     (510) 623-7000

   - **Raglen System Balance, Inc.**
     1121 University Terrace
     Reno, NV 89502
     (775) 747-0100

   - **Pacific Test & Balance, Inc.**
     724 California Blvd.
     Napa, CA 94559
     (707) 696-2444


F. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in “AABC National Standards for Total Systems Balance.”

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

3.1 CONTRACTOR RESPONSIBILITIES

A. Provide T&B agency one complete set of contract documents, change orders, and approved submittals in digital and hard copy formats. Project Schedule and Mechanical Contractor's Shop Drawings and Temperature Control Drawings shall be provided as issued or received.

B. Controls contractor shall provide required BAS hardware, software, personnel and assistance to T&B agency as required to balance the systems. Controls contractor shall also provide trending report to demonstrate that systems are complete.

C. Coordinate meetings and assistance from suppliers and contractors as required by T&B agency.
D. Provide additional valves, dampers, sheaves and belts to properly test and balance, which shall be installed by the Mechanical Contractor as directed by T&B agency, at no additional cost to owner.

E. Mechanical Contractor shall install test holes where indicated by the T&B Agency. Test holes shall be complete with removable and replaceable plugs.

F. Flag all manual volume dampers with fluorescent or other high-visibility tape.

G. Provide access to all dampers, valves, test ports, nameplates and other appurtenances as required by T&B agency.

H. Replace or repair insulation as required by T&B agency.

I. Have the HVAC systems at complete operational readiness for T&B to begin. As a minimum verify the following:

   1. Airside:
      a. All ductwork is complete with all terminals installed.
      b. All volume, smoke and fire dampers are open and functional.
      c. Clean filters are installed.
      d. All fans are operating, free of vibration, and rotating in correct direction.
      e. VFD start-up is complete and all safeties are verified.
      f. System readiness checklists are completed and returned to T&B agency.

   2. Hydronics:
      a. Piping is complete with all terminals installed.
      b. Water treatment is complete.
      c. Systems are flushed, filled and air purged.
      d. Strainers are pulled and cleaned.
      e. Control valves are functioning per the sequence of operation.
      f. All shutoff and balance valves have been verified to be 100% open.
      g. Pumps are started, and proper rotation is verified.
      h. Pump gauge connections are installed directly at the pump inlet and outlet flange or in discharge and suction pipe prior to any valves or strainers.
      i. VFD start-up is complete and all safeties have been verified.
      j. System readiness checklists are completed and returned to T&B agency.
J. Promptly correct deficiencies identified during T&B.

K. Maintain a construction schedule that allows the T&B agency to complete work prior to occupancy.

L. Before testing or balancing is started, the Mechanical Contractor shall adjust belts and sheaves; align all parts; oil and grease bearings in accordance with manufacturer's instructions; clean exterior surfaces of coil tubes and fins; flush interior of coil tubes, pull until clean; and check mixing damper operation to insure free operation and activation by the correct thermostat.

M. The Mechanical Contractor shall be responsible for certifying in writing that the system, as scheduled for balancing, is operational and complete. Completeness shall include not only the physical installation, but the Mechanical Contractor's certification that the prime movers are installed in good working order, and that full load performance has been preliminary tested under the certification of the Mechanical Contractor. Before any testing and balancing is started, a complete report shall be sent to the T&B Agency by the Mechanical Contractor.

N. The Mechanical Contractor shall be responsible for making all modifications to rectify discrepancies reported by the T&B Contractor as indicating non-compliance with the Contract Documents. By completing the work on time, the Mechanical Contractor shall provide sufficient time before the completion date so that balancing can be accomplished.

3.2 EXAMINATION & REVIEW

A. Review the Contractor shop drawing submittals for their effect on the test and balance process and overall performance of the HVAC system. Submit recommendations for enhancements or changes to the system.

B. Review location and type of volume damper inlet conditions to air terminals, air valves, and HVAC equipment.

C. Review location, type, and size of balancing valves, flow metering stations, and automatic control valves in the water flow station.

D. Review location of pressure sensors in the air and water distribution system.

E. Review automatic control systems as they affect the test and balance procedure.

F. Review sheet metal and piping shop drawings to verify the installation of flow control devices.

G. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Note the locations of devices that are not accessible for testing and balancing.

H. Review the approved submittals for HVAC systems and equipment.

I. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas.

J. Review equipment performance data including fan and pump curves.
K. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, clean permanent filters are installed, and controls are ready for operation.

L. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected, configured by the controls contractor and functioning.

M. Examine strainers to verify that Mechanical Contractor has replaced startup screens with permanent screens and that all strainers have been cleaned.

N. Examine two-way valves for proper installation and function.

O. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

P. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

Q. Examine air vents to verify that mechanical contractor has removed all air from all hydronic systems.

3.3 PREPARATION

A. Prepare a T&B plan that includes:

1. Equipment and systems to be tested.


3. Instrumentation to be used.

4. Sample forms with specific identification for all equipment.

B. Prepare system-readiness checklists, as described in the AABC National Standards for Total System Balance, for use by contractors in verifying system readiness for T&B. These shall include, at a minimum:

1. Airside:
   a. All ductwork is complete with all terminals installed.
   b. All volume, smoke and fire dampers are open and functional.
   c. Clean filters are installed.
   d. All fans are operating, free of vibration, and rotating in correct direction.
   e. VFD start-up is complete and all safeties are verified.
   f. Automatic temperature-control systems are operational.
   g. Ceilings are installed.
   h. Windows and doors are installed.
i. Suitable access to balancing devices and equipment is provided.

2. Hydronics:
   a. Piping is complete with all terminals installed.
   b. Water treatment is complete.
   c. Systems are flushed, filled and air purged.
   d. Strainers are pulled and cleaned.
   e. Control valves are functioning per the sequence of operation.
   f. All shutoff and balance valves have been verified to be 100% open.
   g. Pumps are started and proper rotation is verified.
   h. Pump gauge connections are installed directly at the pump inlet and outlet flange or in discharge and suction pipe prior to any valves or strainers.
   i. VFD start-up is complete and all safeties are verified.
   j. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for T&B procedures.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain approved submittals and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare single-line schematic diagram of systems for the purpose of identifying HVAC components.

C. For variable-air-volume systems, develop a plan to simulate diversity.
D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check condensate drains for proper connections and functioning.

H. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
   a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.
   b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
   c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
   d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:
   a. Measure static pressure directly at the fan outlet or through the flexible connection.
   b. Measure static pressure directly at the fan inlet or through the flexible connection.
   c. Measure static pressure across each component that makes up the air-handling system.
   d. Report any artificial loading of filters at the time static pressures are measured.

3. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust sub-main and branch duct volume dampers for specified airflow. 
   Re-measure each sub-main and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure airflow at all inlets and outlets.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after all have been adjusted.

D. Verify final system conditions.
1. Re-measure and confirm minimum outdoor air, return and relief airflows are 
   within design. Readjust to design if necessary.
2. Re-measure and confirm total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust, if 
   necessary.

6. Measure and record all operating data.

E. Record final fan-performance data

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located 2/3 of the distance down 
   the duct from the fan discharge.

2. Verify that the system is under static pressure control.

3. Select the terminal unit that is most critical to the supply-fan airflow. Measure 
   inlet static pressure, and adjust system static pressure control setpoint so the 
   entering static pressure for the critical terminal unit is not less than the sum of the 
   terminal-unit manufacturer's recommended minimum inlet static pressure plus 
   the static pressure needed to overcome terminal-unit discharge system losses.

4. Calibrate and balance each terminal unit for maximum and minimum design 
   airflow as follows
   a. Adjust controls so that terminal is calling for maximum airflow (note some 
      controllers require starting with minimum airflow. Verify calibration 
      procedure for specific project).
b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.

c. When maximum airflow is correct, balance the air outlets downstream from terminal units.

d. Adjust controls so that terminal is calling for minimum airflow.

e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.

f. When in full cooling or full heating, ensure that there is no mixing of hot deck and cold deck airstreams unless so designed.

g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After all terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.

b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.

c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.

b. Measure static pressure directly at the fan inlet or through the flexible connection.

c. Measure static pressure across each component that makes up the air-handling system.

d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
   a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
   b. Verify all terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure setpoint to the most energy-efficient setpoint to maintain the optimum system static pressure. Record setpoint and give to controls contractor.

9. Verify final system conditions as follows:
   a. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.
   b. Re-measure and confirm total airflow is within design.
   c. Re-measure all final fan operating data, rpms, volts, amps, static profile.
   d. Mark all final settings.
   e. Test system in economizer mode. Verify proper operation and adjust, if necessary. Measure and record all operating data.
   f. Verify tracking between supply and return fans.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils and heat exchangers. Obtain approved submittals and any manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Verify that hydronic systems are ready for testing and balancing:
   1. Check liquid level in expansion tank.
   2. Check that makeup water has adequate pressure to highest vent.
   3. Check that control valves are in their proper position.
   4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
   5. Verify that motor starters are equipped with properly sized thermal protection.
   6. Check that air has been purged from the system.

3.9 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.
1. Measure total water flow.
   a. Position valves for full flow through coils.
   b. Measure flow by main flow meter, if installed.
   c. If main flow meter is not installed determine flow by pump total dynamic head (TDH) or exchanger pressure drop.

2. Measure pump TDH as follows:
   a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
   b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
   c. Convert pressure to head and correct for differences in gauge heights.
   d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   e. With all valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.


B. Adjust flow measuring devices installed in mains and branches to design water flows.
   1. Measure flow in main and branch pipes.
   2. Adjust main and branch balance valves for design flow.
   3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow measuring devices installed at terminals for each space to design water flows.
   1. Measure flow at all terminals.
   2. Adjust each terminal to design flow.
   3. Re-measure each terminal after all have been adjusted.
   4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
   5. Perform temperature tests after all flows have been balanced.

D. For systems with pressure-independent valves at the terminals:
   1. Measure differential pressure and verify that it is within manufacturer’s specified range.
2. Perform temperature tests after all flows have been verified.

E. For systems without pressure-independent valves or flow measuring devices at the terminals:
   1. Measure and balance coils by either coil pressure drop or temperature method.
   2. If balanced by coil pressure drop, perform temperature tests after all flows have been verified.

F. Verify final system conditions as follows:
   1. Re-measure and confirm that total water flow is within design.
   2. Re-measure all final pumps' operating data, TDH, volts, amps, static profile.
   3. Mark all final settings.

G. Verify that all memory stops have been set.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:
   1. Verify that the differential-pressure sensor is located per the contract documents.
   2. Determine if there is diversity in the system.

C. For systems with no diversity:
   2. Prior to verifying final system conditions, determine the system differential-pressure set point.
   3. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
   4. Mark all final settings and verify that all memory stops have been set.

D. For systems with diversity:
   1. Determine diversity factor.
   2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.

4. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance the terminals that were just opened.

5. Prior to verifying final system conditions, determine the system differential-pressure set point.

6. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.

7. Mark all final settings and verify that all memory stops have been set.

3.11 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.12 TOLERANCES

A. Set HVAC system’s air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.

2. Air Outlets and Inlets: Plus or minus 10 percent.

3. Heating-Water Flow Rate: Plus or minus 10 percent.

4. Cooling-Water Flow Rate: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.13 FINAL TEST AND BALANCE REPORT

A. The report shall be a complete record of the HVAC system performance, including conditions of operation, items outstanding, and any deviations found during the T&B process. The final report also provides a reference of actual operating conditions for the owner and/or operations personnel. All measurements and test results that appear in the reports must be made on site and dated by the AABC technicians or test and balance engineers.

B. The report must be organized by systems and shall include the following information as a minimum:

1. Title Page:
a. AABC certified company name
b. Company address
c. Company telephone number
d. Project identification number
e. Location
f. Project Architect
g. Project Engineer
h. Project Contractor
i. Project number
j. Date of report
k. AABC Certification Statement
l. Name, signature, and certification number of AABC TBE

2. Table of Contents.

3. AABC National Performance Guaranty.

4. Report Summary:
   a. The summary shall include a list of items that do not meet design tolerances, with information that may be considered in resolving deficiencies.

5. Instrument List:
   a. Type.
   b. Manufacturer.
   c. Model.
   d. Serial Number.
   e. Calibration Date.

6. T&B Data:
   a. Provide test data for specific systems and equipment as required by the most recent edition of the "AABC National Standards."

C. One copy of the final test and balance report shall be sent directly to the Mechanical Engineer of record. Provide five additional copies to the contractor.
3.14 ADDITIONAL TESTS

A. Duct Leakage Test

1. All ductwork shall be tested for leaks, using necessary instruments before insulating any ductwork. Conduct test as follows and as recommended in SMACNA Balancing Manual.
   a. Seal all openings in duct section and plenum to be tested.
   b. Connect test apparatus to test section of cuts, using a flexible duct connection or hose (fitting provided by Mechanical Contractor).
   c. Close damper on blower suction side, to prevent excessive build-up of pressure.
   d. Start blower and gradually open damper on suction side of blower.
   e. Determine amount of air leakage and make repairs as required.
   f. Leakage factor allowable shall be 5% based on the total operating cfm of the section of duct under testing.
   g. Tested sections of ductwork shall be visually marked with certification sticker and initials of field test inspector. Tests shall be made before duct sections are concealed.

2. Witness the duct pressure testing performed by the mechanical/installing contractor.

3. Verify that proper test methods are used and that leakage rates are within specified tolerances.

4. Report any deficiencies observed.

B. Sound Level Reading

1. After the systems are balanced and the spaces are architecturally complete, sound level readings shall be taken in at least ten locations in the building with an Octave Band Analyzer.

2. In order to reduce the ambient noise level, the reading shall be taken at night.

3. Instrumentation:
   a. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
   b. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).
   c. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
4. Test Procedures

a. Perform test at the quietest background noise period. Note any cause of unpreventable sound that may affect the test outcome.

b. Equipment should be operating at design values.

c. Calibrate the sound-testing meter prior to taking measurements.

d. Use a microphone suitable for the type of noise levels measured that is compatible with the meter. Provide a windshield for outside or in-duct measurements.

e. Record a set of background measurements in dB(A), and sound pressure levels in the eight un-weighted octave bands with the equipment off.

f. Take sound readings in dB(A), and sound pressure levels in the eight un-weighted octave bands with the equipment on.

g. Take readings no closer than 3’ from a wall or from the operating equipment, and approximately 5’ from the floor, with the meter held or mounted on a tripod.

h. For outdoor measurements, move the sound-testing meter slowly and scan the area that has the greatest exposure to the noise source being tested. (This type of reading is generally performed using the A-Weighted scale).

5. Reporting

a. The test data for each area will be recorded on Noise Criteria curves indicating the decibel level read in each Frequency Band - the NC level required and the NC level measured. The sound level shall not exceed NC 30 in all areas.

b. The report must record: the location, the system tested, the dB(A) reading, and the sound pressure level in each octave band with equipment on and off.

c. Plot all the sound pressure levels on the [work sheet, with the equipment on and off.

6. The T&B Agency will submit the test data and test equipment data to the Architect and Engineer for review, and include the approved forms in the T&B report.

C. Vibration Testing

1. After the systems are balanced and the spaces are architecturally complete, read and record vibration levels on all equipment with motor horsepower equal to or greater than 10. Vibration field measurements shall be taken as required for each circulating water pump, water chilling unit, air handling unit, and fan driven by a
motor over 10 hp. Reading shall include shaft alignment, equipment vibration, bearing housing vibration, foundation vibration, and building structure vibration.

2. Instrumentation:
   a. The vibration meter should be portable, battery-operated, and microprocessor-controlled, with or without a built-in printer.
   b. The meter shall automatically identify engineering units, filter bandwidth, amplitude and frequency scale values.
   c. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.

3. Test Procedures:
   a. Verify that the vibration meter calibration date is current before taking readings.
   b. To ensure accurate readings, verify that the accelerometer has a clean, flat surface and is mounted properly.
   c. With the unit running, set up the vibration meter in a safe, secure location. Connect the transducer to the meter with the proper cables. Hold the magnetic tip of the transducer on top of the bearing, and measure the unit in mils of deflection. Record the measurement, then move the transducer to the side of the bearing, and record in mils of deflection. Record an axial reading in mils of deflection by holding the nonmagnetic, pointed transducer tip on the end of the shaft.
   d. Change the vibration meter to velocity (inches per second) measurements. Repeat and record the above measurements.
   e. Record the CPM or the RPM.
   f. Read each bearing on the motor, fan, and/or pump as required. Track and record vibration levels from the rotating component through the casing to the base.

4. Reporting
   a. The report must record the location and the system tested.
   b. Include horizontal-vertical-axial measurements for all tests.
   c. Verify that vibration limits follow specifications, or, if not specified, follow the “General Machinery Vibration Severity Chart” or “Vibration Acceleration General Severity Chart” from the AABC National Standards. Acceptable levels of vibration are normally “Smooth” to “Good.”
   d. Include in the report the Machinery Vibration Severity Chart, with conditions plotted.
5. Maximum vibration at any point listed above shall not exceed criteria listed in the ASHRAE Handbook, HVAC Systems and Application, Chapter 52 “Sound and Vibration Control”, Table 26 “Equipment Vibration Criteria”, unless otherwise specified. Reading shall be taken with vibration isolation blocked solid to the foundation.

6. The T&B Agency will submit the test data and equipment data to the Mechanical Engineer for review. The approved forms will be included in the T&B report.

D. Controls Verification

1. In conjunction with system balancing perform the following:
   a. Work with the temperature control contractor to ensure the system is operating within the design limitations, and gain a mutual understanding of intended control performance.
   b. Verify the integrity of valves and dampers in terms of tightness of close-off and full-open position. This includes dampers in multi-zone units.
   c. Check that all valves are properly installed in the piping system in relation to direction of flow and location.
   d. Verify the proper application of all normally open and normally closed valves.
   e. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
   f. Check the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures, humidities, or pressures. Control Contractor will relocate as deemed necessary by the TAB Agency.
   g. Check the sequence of operation for any control mode is in accordance with approved shop drawings. Verify that only minimum simultaneous heating and cooling occurs. Observe that heating cannot take place until the cooling zone of valve is completely closed.
   h. Verify that all controller set points meet the design intent.
   i. Verify the operation of all interlock systems.
   j. Verify that controllers are calibrated and function as intended.
   k. Verify that controller setpoints are as specified.
   l. Verify the operation of lockout or interlock systems.
   m. Verify the operation of all valve and damper actuators.
   n. Verify that all controlled devices are properly installed and connected to the correct controller.
Verify that all controlled devices travel freely and are in the position indicated by the controller: open, closed, or modulating.

Perform all system verification to assure the safety of the system and its components.

2. Reporting

a. The report shall include a summary of verifications performed, remaining deficiencies, and any variations from specified conditions.

A systematic check of the above requirements shall be included in the final TAB report.

3.15 FINAL ACCEPTANCE

A. At the time of final inspection, the T&B Agency shall recheck, in the presence of the Owner's Representative, specific and random selections of data, i.e. water and air quantities, recorded in the Certified Report.

B. Points and areas for recheck shall be selected by the Owner's Representative.

C. Measurement and test procedures shall be the same as approved for work forming basis of Certified Report.

D. Selections for recheck, specific plus random, will not normally exceed 25% of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.

E. If random tests elicit a measured flow deviation of 10% or more from that recorded in the Certified Report listings, by 10% or more of the selected recheck stations, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, new Certified Report submitted, and new inspection tests made, all at no additional cost to the Owner.

F. Following final acceptance of the Certified Report by the Owner's Representative the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the T&B Agency, so that adjustment can be restored if disturbed at any time. Devices shall not be marked until after final acceptance.

END OF SECTION
SECTION 23 09 23

CONTROLS FOR HVAC

PART 1  GENERAL

1.1  WORK INCLUDED

A.  Related Documents: The General Provisions of the Contract, including General, Supplementary, and Special Conditions, and Division 01 - General Requirements, apply to work specified in this Section. Subcontractor must familiarize himself with the terms of the above documents.

1.2  DESCRIPTION

A.  BAS Contractor:

1.  The Building Automation System (BAS) is to be furnished and installed by a factory authorized Andover distributor with factory warranted Andover parts. The designated distributor for this work is EMCOR Mesa Energy Systems Inc (Contractor). Contact: Andy Bruch; andy_bruch@emcorgroup.com; (510) 909-9980

   a.  All bidders must be building automation contractors in the business of installing Direct Digital Controls (DDC) for a minimum of 3 years.

   b.  All bidders must have an office in the San Francisco Bay/Central Valley area.

   c.  All bidders must be a channel partner for “Andover Controls”.

   d.  All bidders must have a trained staff of application engineers who have been certified by Andover in administration, networking, configuration, programming and service of the automation system.

   e.  All installers must have a factory-trained technician on-site at all times during installation of the DDC controls.

2.  Integration of the BAS system to the central BAS system shall be coordinated with the Facilities Manager at the work site.

B.  Scope of Work

1.  The BAS contractor shall review and study all HVAC drawings and the entire
2. The Contractor shall furnish and install a complete building automation system including all necessary hardware and all operating and applications software necessary to perform the control sequences of operation as called for in this specification. Andover Controls only to match existing campus system architecture. At a minimum, provide controls for the following:

a. Air handling units.
b. Exhaust and supply fans.
c. CAV/VAVs w/reheat.
d. Power wiring to DDC devices CAV/VAV and BAS panels by Division 26.
e. Lighting.

3. Provide services and manpower necessary for commissioning of system in coordination with the HVAC Contractor, Balancing Contractor and Owner’s representative.

4. All work performed under this section of the specifications will comply with all codes, laws and governing bodies. If the drawings and/or specifications are in conflict with governing codes, the Contractor shall submit a proposal with appropriate modifications to the project to meet code restrictions. If this specification and associated drawings exceed governing code requirements, the specification will govern.

C. Training: Provide a minimum of (40) hours of on-site training for (3) system operators. The training will be hands-on type, at the owner’s office. The training class will use the actual Operator’s Manual that will be submitted for this project. In addition, projects over $100,000 will include (2) weeks of classroom training for (1) individual at the Manufacturer's sponsored training courses.

D. Portable handheld assist tools: Provide owner with one Roam I/O remote assist tool as indicated by Facilities at time of completion.

E. System Description:

1. The Building Automation System (BAS) shall consist of PC-based workstation (existing) and microcomputer controllers of modular design, providing distributed processing capability and allowing future expansion of both input/output points and processing/control functions:

a. For this project the system shall consist of the following (new)
components:

1) Ethernet-based Network Controller.

2) Stand-alone Digital Control Units.

F. Ethernet-based Network Controller: The BAS Contractor shall furnish (1) Ethernet-based network controller. This controller will connect directly to the campus LAN over the existing Ethernet system. (1) Building network controller (as required) shall be assigned to an existing Infinet Loop.

G. Provide the necessary quantity and types of SDCUs to meet the requirements of the project for mechanical equipment control, including air handlers, return/exhaust fans, and terminal unit control. Each SDCU will operate completely standalone, containing all of the I/O and programs to control its associated equipment: i2 series and Infinet II.

H. Work by Others

1. The BAS Contractor shall cooperate with other contractors performing work on this project necessary to achieve a complete and neat installation. To that end, each contractor shall consult the drawings and specifications for all trades to determine the nature and extent of others’ work.

2. The BAS Contractor shall furnish all control valves, sensor wells, flow meters and other similar equipment for installation by the Mechanical Contractor.

3. The Electrical Contractor shall provide:

   a. All power wiring to VAV transformer disconnects. See floor plan for location and BAS panels.

I. Code Compliance

1. All wiring shall conform to the National Electrical Code.

2. Comply with FCC rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments.


J. Submittals

1. All shop drawings shall be prepared in AutoCAD software. In addition to the drawings, the Contractor shall furnish a diskette containing the identical information. Drawings shall be B size or larger.

2. Shop drawings shall include a riser diagram depicting locations of all controllers.
and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points, with reference to their associated controller. "Typical" will be allowed where appropriate.

3. Submittal data shall contain manufacturer's data on all hardware and software products required by the specification. Valve, damper, and airflow station schedules shall indicate size, configuration, and capacity of all equipment.

4. Software submittals shall contain narrative descriptions of sequences of operation, program listings, point lists, and a complete description of the graphics, reports, alarms and configuration to be furnished with the workstation software. Information shall be bound or in a three ring binder with an index and tabs.

5. Submit five (5) copies of submittal data and shop drawings to the Architect and (1) copy to Facilities for review, prior to ordering or fabrication of the equipment. Prior to submitting, the Contractor shall check all documents for accuracy.

6. The Engineer will make corrections, if required, and forward to Architect for distribution. The Contractor will then resubmit with the corrected or additional data. All corrections shall be made to the satisfaction of the Architect and Engineer and all submittals shall be fully approved before continuing with the installation.

K. System Startup & Commissioning

1. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation. Successful completion of the system test shall constitute the beginning of the warranty period. A written report shall be submitted to the owner indicating that the installed system functions in accordance with the plans and specifications.

2. The BAS contractor shall commission and set in operating condition all major equipment and systems, such as the chilled water, hot water and all air handling systems, in the presence of the equipment manufacturer’s representatives, as applicable, and the Owner and Architect’s representatives.

3. The BAS Contractor shall provide all manpower and engineering services required to assist the HVAC Contractor and Balancing Contractor in testing, adjusting, and balancing all systems in the building. The BAS Contractor shall have a trained technician available, on request, during the balancing of the systems. The BAS Contractor shall coordinate all requirements to provide a complete air balance with the Balancing Contractor and shall include all labor and materials in their contract.
L. Training

1. The BAS Contractor shall provide both on-site and classroom training to the Owner’s representative and maintenance personnel. On-site training shall be per section 1.2 C and shall consists of “hands-on” instruction geared at the operation and maintenance of the systems. The curriculum shall include
   a. System overview.
   b. System software and operation.
   c. System access.
   d. Software features overview.
   e. Changing setpoints and other attributes.
   f. Scheduling.
   g. Editing programmed variables.
   h. Displaying color graphics.
   i. Running reports.
   j. Workstation maintenance.
   k. Application programming.
   l. Operational sequences including start-up, shutdown, adjusting and balancing.
   m. Equipment maintenance.

M. Operating and Maintenance Manuals

1. The operation and maintenance manuals shall contain all information necessary for the operation, maintenance, replacement, installation, and parts procurement for the entire BAS. This documentation shall include specific part numbers and software versions and dates. A complete list of recommended spare parts shall be included with the lead time and expected frequency of use of each part clearly identified.

2. Following project completion and testing, the BAS contractor will submit as-built drawings reflecting the exact installation of the system. The as-built documentation shall also include a copy of all application software both in written
form and on diskette.

N. Warranty: The BAS contractor shall warrant the system for 12 months after system acceptance and beneficial use by the owner. During the warranty period, the BAS contractor shall be responsible for all necessary revisions to the software as required to provide a complete and workable system consistent with the letter and intent of the Sequence of Operation section of the specification.

PART 2 PRODUCTS

2.1 SYSTEM ARCHITECTURE

A. General: The Building Automation System (BAS) shall consist of Network Control Units (NCUs), a family of Standalone Digital Control Units (SDCUs), Input/Output Unit Modules (IOU Modules), Operator Workstations (OWs), and (1) File Server to support system configurations where more than one operator workstation is required. The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN) if applicable, from a single ODBC-compliant database.

B. Level 1 Network Description:

1. Level 1, the main backbone of the system, shall be an Ethernet LAN/WAN. Network Control Units, Operator Workstations, and the Central File Server shall connect directly to this network without the need for Gateway devices.

C. Level 2 Network Description:

1. Level 2 of the system shall consist of one or more field busses managed by the Network Control Units. The Level 2 field busses may consist of one or both of the following types:

   a. An RS485 token passing bus that supports up to 127 Standalone Digital Control Units (SDCUs) per communication port for operation of HVAC equipment and lighting, or

   b. An RS485 field bus that supports up to 32 devices from a family of plug-in, IOU modules. These IOU modules may be mounted within the NCU enclosure or remotely mounted via a single, twisted, shielded pair of wires.

D. BAS:

1. The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN), sharing a single file server. This enables workstations to manage a single LAN (or building), and/or the entire system with all devices being assured of being updated and sharing the
most current database. In the case of a single workstation system, the workstation shall contain the entire database, with no need for a separate file server.

E. Standard Network Support

1. All NCUs, Workstation(s) and File Server shall be capable of residing directly on the owner’s Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NCU’s, Workstation(s) and File Server shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner’s Information Systems Department, as all devices utilize standard TCP/IP components.

F. System Expansion

1. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same Level 1 and Level 2 controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.

2. The BAS shall be expandable to include Security and Access Control functions at any time in the future, with no additional workstations, front-end software or Level 1 controllers required. Standalone Digital Control Units or IOU modules shall be able to be added to the existing Level 1 controller’s field bus (es), to perform security and card access applications. In this way, an owner’s existing investment in wiring infrastructure may be leveraged and the cost and inconvenience of adding new field bus wiring will be minimized.

3. Additionally, an integrated video badging option must be able to be included, with no additional workstations required. This photo ID option must share the same database as the BAS in order to eliminate the need for updating multiple databases.

4. The system shall use the same application programming language for all levels: Operator Workstation, Network Control Unit, Remote Site Control Unit and Standalone Digital Control Unit. Furthermore, this single programming language shall be used for all applications: environmental control, card access control, intrusion detection and security, lighting control, leak detection / underground storage tank monitoring, and digital data communication interfaces to third party microprocessor-based devices.

G. Support for Open Systems Protocols

1. The BAS design must include solutions for the integration of the following “open
systems” protocols: BACnet, LonTalk™, MODBUS and digital data communication to third party microprocessors such as chiller controllers, fire panels and variable frequency drives (VFDs).

2. The system shall also provide the ability to program custom ASCII communication drivers that will reside in the NCU, for communication to third party systems and devices. These drivers will provide real time monitoring and control of the third party systems.

2.2 NETWORK CONTROL UNITS (NCUs)

A. General

1. Network Control Units shall be microprocessor based, multi-tasking, multi-user, and employ a real time operating system. Each NCU control panel shall consist of modular hardware including power supply, CPU board, and input/output modules. A sufficient number of NCUs shall be supplied to fully meet the requirements of this specification and the attached point list.

2. NCUs for telephone dialup sites shall be of the same design as the Ethernet control units but without the plug-in Ethernet network interface card (NIC), i.e., NCUs, which include a NIC, shall be interchangeable whether used on a LAN/WAN or a dialup site.

B. Webserver Functionality

1. All NCUs on the Ethernet TCP/IP LAN/WAN shall be capable, out-of-the box, to be set up as a Web Server. The NCU shall have the ability to store HTML code and “serve” pages to a web browser. This provides the ability for any computing device utilizing a TCP/IP Ethernet connection and capable of running a standard Internet browser (Microsoft Internet Explorer™, Netscape Navigator™, etc.) to access real-time data from the entire BAS via any NCUs.

2. Graphics and text-based web pages shall be constructed using standard HTML code. The interface shall allow the user to choose any of the standard text or graphics-based HTML editors for page creation. It shall also allow the operator to generate custom graphical pages and forms.

3. The WEB server interface shall be capable of password security, including validation of the requesting PC’s IP address. The WEB server interface shall allow the sharing of data or information between any controller, or process or network interface (BACnet, LonTalk and TCP/IP) that the BMS has knowledge of, regardless of where the point is connected on the BAS network or where it is acquired from.
4. The BAS network controller must act directly as the WEB server. It must directly generate the HTML code to the requesting user (i.e. WEB browser), eliminating the need for and reliance on any PC-based WEB server hardware or software. To simplify graphic image space allocation, HTML graphic images, if desired, shall be stored on any shared network device. The BAS WEB server shall have the ability to acquire any necessary graphics using standard pathing syntax within the HTML code mounted within the BAS WEB server. External WEB server hardware and software are not acceptable.

C. Hardware Specifications

1. Memory: A minimum of 32 MB of RAM shall be provided for NCUs and shall include a floating-point math co-processor.

D. Communication Ports

1. Each NCU shall provide communication to both the Workstation(s) and the field busses. In addition, each NCU must have at least 3 other communications ports that support a telephone modem, portable service tool, serial printer and connection to third party controllers such as a chiller control panel. On a LAN/WAN system the NCU shall be provided with a 10/100 baseT Mbps plug-in Ethernet TCP/IP network interface card (NIC).

E. Input/Output (I/O):

1. Each NCU shall support the addition of the following types of inputs and outputs:
   a. Digital Inputs for status/alarm contacts.
   b. Counter Inputs for summing pulses from meters.
   c. Thermistor inputs for measuring temperatures in space, ducts and thermowells.
   d. Analog inputs for pressure, humidity, flow and position measurements.
   e. Digital Outputs for on/off equipment control.
   f. Analog Outputs for valve and damper position control, and capacity control of primary equipment.

F. Modular Expandability: The system shall employ a modular I/O design to allow easy expansion. Input and output capacity is to be provided through plug-in modules of various types or DIN-mountable IOU modules. It shall be possible to combine I/O modules as desired to meet the I/O requirements for individual control applications.
G. Real Time Clock (RTC): Each NCU shall include a battery-backed, real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. In normal operation the system clock will be based on the frequency of the AC power. The system shall automatically correct for daylight savings time and leap years and be Year 2000 compliant.

H. Power Supply: The power supply for the NCUs shall be auto sensing, 120-220VAC, 60/50 Hz power, with a tolerance of +/- 20%. Line voltage below the operating range of the system shall be considered outages. The controller shall contain over voltage surge protection, and require no additional AC power signal conditioning. Optionally, if indicated on the drawings, the power supply shall accept an input voltage of (~48 VDC).

I. Automatic Restart After Power Failure: Upon restoration of power after an outage, the ECU shall automatically and without human intervention: update all monitored functions; resume operation based on current, synchronized time and status, and implement special start-up strategies as required.

J. Battery backup: Each NCU with the standard 120-220VAC power supply shall include a programmable DC power backup system rated for a minimum of 72 hours of battery backup to maintain all volatile memory or, a minimum of 2 hours of full UPS including modem power. This power backup system shall be configurable such that at the end of a settable timeframe (such as 1 hour) of running on full UPS, the unit will shut off full UPS and switch to memory retention-only mode for the remainder of the battery power. The system shall allow the simple addition of more batteries to extend the above minimum battery backup times. Each NCU with a control transformer shall include a minimum of 7 days of power failure backup of RAM memory.

K. Software Specifications

1. User Programming Language:
   a. The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be English language-based and programmable by the user. The language shall be structured to allow for the easy configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, passwords, and histories. The language shall be self-documenting. Users shall be able to place comments anywhere in the body of a program. Program listings shall be configurable by the user in logical groupings.

2. Control Software:
   a. The NCU shall have the ability to perform the following pre-tested control algorithms:
1) Proportional, Integral plus Derivative Control (PID).
2) Self Tuning PID.
3) Two Position Control.
4) Digital Filter.
5) Ratio Calculator.
6) Equipment Cycling Protection.

3. Mathematical Functions
   a. Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

4. Energy Management Applications
   a. NCUs shall have the ability to perform any or all of the following energy management routines:
      1) Time of Day Scheduling.
      2) Calendar Based Scheduling.
      3) Holiday Scheduling.
      4) Temporary Schedule Overrides.
      5) Optimal Start.
      6) Optimal Stop.
      7) Night Setback Control.
      8) Enthalpy Switchover (Economizer).
      9) Peak Demand Limiting.
     10) Temperature Compensated Duty Cycling.
     11) CFM Tracking.
12) Heating/Cooling Interlock.
13) Hot/Cold Deck Reset.
14) Free Cooling.
15) Hot Water Reset.
16) Chilled Water Reset.

5. History Logging
   a. Each controller shall be capable of logging any system variable over user defined time intervals ranging from 1 second to 1440 minutes. Any system variables (inputs, outputs, math calculations, flags, etc.) can be logged in history. A maximum of 32767 values can be stored in each log. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logs can be automatic or manual. Logged data shall be downloadable to the Operator Workstation for long term archiving based upon user-defined time intervals, or manual command.

6. Alarm Management
   a. For each system point, alarms can be created based on high/low limits or conditional expressions. All alarms will be tested each scan of the NCU and can result in the display of one or more alarm messages or reports.
   b. Up to 8 alarms can be configured for each point in the controller.
   c. Messages and reports can be sent to a local terminal, to the front-end workstation(s), or via modem to a remote-computing device.
   d. Alarms will be generated based on their priority. A minimum of 255 priority levels shall be provided: If communication with the Operator Workstation is temporarily interrupted, the alarm will be buffered in the NCU. When communications return, the alarm will be transmitted to the Operator Workstation if the point is still in the alarm condition.

7. Reporting
   a. The NCU shall be able to generate user-definable reports to a locally connected printer or terminal. The reports shall contain any combination of text and system variables. Report templates shall be able to be created by users in a word processing environment. Reports can be displayed based on any logical condition or through a user command.

2.3 STANDALONE DIGITAL CONTROL UNITS (SDCUs)
A. General

1. Standalone Digital Control Units shall provide control of HVAC and lighting. Each controller shall have its own control programs and will continue to operate in the event of a failure or communication loss to its associated NCU.

B. Memory

1. Control programs shall be stored in battery backed-up RAM and EPROM. Each controller shall have a minimum of 128K bytes of user RAM memory and 128K bytes of EPROM.

C. Communication Ports

1. SDCUs shall provide a communication port to the field bus. In addition, a port shall be provided for connection of a portable service tool to support local commissioning and parameter changes with or without the NCU online. It shall be possible from a service port on any SDCU to view, enable/disable, and modify values of any point or program on any controller on the local field bus, any NCU or any SDCU on a different field bus.

D. Input/Output

1. Each SDCU shall support the addition of the following types of inputs and outputs:
   a. Digital Inputs for status/alarm contacts.
   b. Counter Inputs for summing pulses from meters.
   c. Thermistor Inputs for measuring temperatures in space, ducts and thermowells.
   d. Analog inputs for pressure, humidity, flow and position measurements.
   e. Digital Outputs for on/off equipment control.
   f. Analog Outputs for valve and damper position control, and capacity control of primary equipment.

E. Expandability

1. Input and output capacity shall be expandable through the use of plug-in modules. A minimum of (2) modules shall be added to the base SDCU before additional power is required.

F. Networking
1. Each SDCU will be able to exchange information on a peer-to-peer basis with other Standalone Digital Control Units during each field bus scan. Each SDCU shall be capable of storing and referencing global variables (on the LAN) with or without any workstations online. Each SDCU shall be able to have its program viewed and/or enabled/disabled either locally through a portable service tool or through a workstation connected to an NCU.

G. Indicator Lamps

1. SDCUs will have as a minimum, LED indication of CPU status, and field bus status.

H. Real Time Clock (RTC)

1. An SDCU shall have a real time clock in either hardware or software. The accuracy shall be within 10 seconds per day. The RTC shall provide the following information: time of day, day, month, year, and day of week. Each SDCU shall receive a signal, every hour, over the network from the NCU, which synchronizes all SDCU real time clocks.

I. Automatic Restart after Power Failure

1. Upon restoration of power, the SDCU shall automatically and without human intervention, update all monitored functions, resume operation based on current, synchronized time and status, and implement special start-up strategies as required.

J. Battery Back Up

1. Each SDCU shall have at least 3 years of battery back up to maintain all volatile memory.

K. Alarm Management

1. For each system point, alarms can be created based on high/low limits or conditional expressions. All alarms will be tested each scan of the SDCU and can result in the display of one or more alarm messages or reports.

2. Up to 8 alarms can be configured for each point in the controller enabling the escalation of the alarm priority (urgency) based upon which alarm(s) is/are triggered.

3. Alarm messages can be sent to a local terminal or modem connected to an NCU or to the Operator's Workstation(s).

4. Alarms will be generated based on their priority. A minimum of 255 priority levels shall be provided.
5. If communication with the NCU is temporarily interrupted, the alarm will be buffered in the SDCU. When communications return, the alarm will be transmitted to the NCU if the point is still in the alarm condition.

L. Air Handler Controllers (To be used on units with less than 40 points)

1. AHU Controllers shall be capable of meeting the requirements of the sequence of operation found in the Execution portion of this specification and for future expansion.

2. AHU Controllers shall support all the necessary point inputs and outputs as required by the sequence and operate in a standalone fashion.

3. AHU Controllers shall be fully user programmable to allow for modification of the application software.

4. An LCD display shall be optionally available for readout of point values and to allow operators to change setpoints and system parameters.

5. A manual override switch shall be provided for all digital and analog outputs on the AHU Controller. The position of the switch shall be monitored in software and available for operator displays and alarm notification.

M. VAV Terminal Unit Controllers

1. VAV Terminal Unit Controllers shall support, but not be limited to the control of the following configurations of VAV boxes to address current requirements as described in the Execution portion of this specification, and for future expansion:
   a. VAVR.
   b. Single Duct Cooling with Reheat (Hot Water).

2. VAV Controllers to be Andover i2866-V, i2865-V with LED smart stats.

3. VAV Controllers for single duct applications will come equipped with a built-in actuator for modulation of the air damper. The actuator shall have a minimum torque rating of 50 in.-lb., and contain an override mechanism for manual positioning of the damper during startup and service.

4. VAV Controllers shall contain an integral velocity sensor accurate to +/- 5% of the full range of the box’s CFM rating.

5. Each controller shall perform the sequence of operation described in Part 3 of this specification, and have the capability for time of day scheduling, occupancy mode control, after hours operation, lighting control, alarming, and trending.
6. VAV Controllers shall be able to communicate with any other Standalone Digital Control Unit on the same field bus with or without communication to the NCU managing the field bus. Systems that fail to provide this (true peer-to-peer) capability will be limited to a maximum of 32 VAV controllers per field bus.

N. Display Controllers

1. Display controllers are standalone, touch screen based operator interfaces. The controller shall be designed for flush mounting in a finished space, with a minimum display size of 9 x 9 inches.

2. Software shall be user programmable allowing for custom graphical images that simulate floor plans, menus, equipment schematics along with associated real time point values coming from any NCU on the network.

3. The touch screen display shall contain a minimum of 64 possible touch cells that permit user interaction for changing screens, modifying setpoints or operating equipment.

4. Systems that do not offer a display controller as specified must provide a panel mounted computer with touch screen capability as an alternative.

2.4 OPERATOR WORKSTATION REQUIREMENTS (existing LAN System) Workstation and Server are not added to this project. However, all controllers will be added to the existing Infinet and LAN system.

A. General

1. The BAS workstation software shall be configurable as either a single workstation system (with a local database) or multi-workstation system where the database is located on a central file server. The client software on multi-workstation system shall access the file server database program via an Ethernet TCP/IP network running at either 10MBPS or 100MBPS.

2. New Workstation shall be:

<table>
<thead>
<tr>
<th>PROCESSOR</th>
<th>Intel® Core™ i5 Processor 680 with VT (3.60GHz, 4M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPERATING SYSTEM</td>
<td>Windows 7 Professional</td>
</tr>
<tr>
<td>WARRANTY &amp; SERVICE</td>
<td>3 Year ProSupport and 3 Year NBD Onsite Service</td>
</tr>
<tr>
<td>SYSTEMS MANAGEMENT MODE</td>
<td>Intel Core i7/i5 vPro Technology Enabled</td>
</tr>
<tr>
<td>MEMORY</td>
<td>4GB DDR3 Non-ECC SDRAM,1333MHz, (2 DIMM)</td>
</tr>
<tr>
<td>HARD DRIVE</td>
<td>500GB 2.5 SATA 3.0Gb/s and 16MB DataBurst Cache™</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>OPTICAL DRIVE</td>
<td>16X DVD+/−RW SATA, Roxio Creator™ Cyberlink PowerDVD™</td>
</tr>
<tr>
<td>VIDEO CARD</td>
<td>Integrated Intel® Graphics Media Accelerator HD, DisplayPort/ VGA</td>
</tr>
<tr>
<td>MONITOR</td>
<td>Dell UltraSharp™ 2007FP 20in HAS Monitor, VGA/ DVI</td>
</tr>
<tr>
<td>ENERGY SMART</td>
<td>Dell Energy Smart Enable (ESMART)</td>
</tr>
<tr>
<td>FILE SYSTEM</td>
<td>NTFS File System for all Operating Systems</td>
</tr>
<tr>
<td>SYSTEM DOCUMENTATION</td>
<td>Resource DVD contains Diagnostics and Driver for Dell OptiPlex System</td>
</tr>
<tr>
<td>KEYBOARD</td>
<td>Dell Multimedia Pro Keyboard, English</td>
</tr>
<tr>
<td>MOUSE</td>
<td>Dell MS111 USB Optical Mouse</td>
</tr>
</tbody>
</table>

3. The application software shall be capable of communication to all Network Control Units and Standalone Digital Control Units, feature high-resolution color graphics, alarming, reporting, and be user configurable for all data collection and data presentation functions.

4. For multi-workstation systems, a minimum of 256 workstations shall be allowed on the Ethernet network along with the central file server. In this client/server configuration, any changes or additions made from one workstation will automatically appear on all other workstations without the requirement for manual copying of files. Multi-workstation systems with no central database will not be acceptable. Multi-workstation systems with distributed/tiered file servers and a central (master) database will be acceptable.

B. Workstation Software

1. General Description:

   a. The software architecture must be object-oriented in design, a true 32-bit application suite utilizing Microsoft’s OLE, COM, DCOM and ODBC technologies. These technologies make it easy to fully utilize the power of the operating system to share, among applications (and therefore to the users of those applications), the wealth of data available from the BAS.
b. The workstation functions shall include monitoring and programming of all DDC controllers. Monitoring consists of alarming, reporting, graphic displays, long-term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.

c. Programming of controllers shall be capable of being done either off-line or online from any operator workstation. All information will be available in graphic or text displays. Graphic displays will feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.

C. System Database

1. The files server database engine must be Microsoft SQL Server (depending on version). This ODBC (Open Database Connectivity) compliant database engine allows for an owner to utilize “their” choice of database and due to its “open” architecture, allows an owner to write custom applications and/or reports which communicate directly with the database avoiding data transfer routines to update other applications. The system database shall contain all point configurations and programs in each of the controllers that have been assigned to the network. In addition, the database will contain all workstation files including alarm reports, text reports, historical data logs, schedules, and polling records.

2. New Workstation shall be:

<table>
<thead>
<tr>
<th>PRIMARY PROCESSOR</th>
<th>Intel® Xeon® E5620 2.4Ghz, 12M Cache,Turbo, HT, 1066MHz Max Mem</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEMORY</td>
<td>8GB Memory (4x2GB), 1333MHz 1R LV UDIMMs for 1 Processor, Advanced ECC</td>
</tr>
<tr>
<td>SYSTEMS MANAGEMENT MODE</td>
<td>Intel Core i7/i5 vPro Technology Enabled</td>
</tr>
<tr>
<td>OPERATING SYSTEM</td>
<td>Windows Server 2008 R2, Standard Edition,x64, Includes 5 CALS</td>
</tr>
<tr>
<td>HARD DRIVE CONFIGURATION</td>
<td>RAID 1 for H700, PERC 6/i, H200 or SAS 6/iR Controllers</td>
</tr>
<tr>
<td>INTERNAL CONTROLLER</td>
<td>PERC H200 Integrated RAID Controller</td>
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<tr>
<td>HARD DRIVES</td>
<td>500GB 7.2K RPM SATA 2.5-in HotPlug Hard Drive</td>
</tr>
<tr>
<td>MICROSOFT SQL SERVER</td>
<td>Microsoft®SQL Server™2008R2 Workgroup w5 CALs,</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------</td>
<td>--------------------------------------------------</td>
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<tr>
<td>NETWORK ADAPTER</td>
<td>Broadcom 5709 Dual Port 1GbE NIC w/TOE iSCSI, PCIe-4</td>
</tr>
<tr>
<td>EMBEDDED MANAGEMENT</td>
<td>iDRAC6 Express</td>
</tr>
<tr>
<td>INTERNAL OPTICAL DRIVE</td>
<td>DVD+/-RW, SATA, Internal</td>
</tr>
<tr>
<td>SERVER ACCESSORIES</td>
<td>Keyboard and Optical Mouse, USB, Black, English, with 17 LCD Monitor</td>
</tr>
<tr>
<td>SYSTEM DOCUMENTATION</td>
<td>Electronic System Doc, OpenManage DVD Kit with Dell Management Console</td>
</tr>
<tr>
<td>HARDWARE SUPPORT SERVICES</td>
<td>3 Year ProSupport and Mission Critical 4HR 7x24 Onsite Pack</td>
</tr>
</tbody>
</table>

**D. User Interface**

1. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user that has logged into the workstation software. This interface shall support the creation of “hot-spots” that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface must be able to be configured to become a user’s “PC Desktop” – with all the links that a user needs to run other applications. This, along with the Windows NT user security capabilities, will enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shut down the active alarm viewer and/or unable to load software onto the PC.

**E. User Security**

1. The software shall be designed so that each user of the software can have a unique username and password. This username/password combination shall be linked to a set of capabilities within the software, set by and editable only by, a system administrator. The sets of capabilities shall range from: View only, Acknowledge alarms, Enable/disable and change values, Program, and Administer. The system shall allow the above capabilities to be applied independently to each and every class of object in the system. The system must allow a minimum of 256 users to be configured per workstation. There shall be an inactivity timer adjustable in software that automatically logs off the current operator after the timer has expired.
F. Configuration Interface

1. The workstation software shall use a familiar Windows Explorer™-style interface for an operator or programmer to view and/or edit any object (controller, point, alarm, report, schedule, etc.) in the entire system. In addition, this interface shall present a “network map” of all controllers and their associated points, programs, graphics, alarms, and reports in an easy to understand structure. All object names shall be alphanumeric and use Windows long filename conventions. Object names shall not be required to be unique throughout the system. This allows consistency in point naming. For example, each VAV controller can have an input called Space Temperature and a setpoint called CFM Setpoint. The VAV controller name shall be unique such as VAV for LAB101. Systems requiring unique object names throughout the system will not be acceptable.

2. The configuration interface shall also include support for template objects. These template objects shall be used as building blocks for the creation of the BAS database. The types of template objects supported shall include all data point types (input, output, string variables, setpoints, etc.), alarm algorithms, alarm notification objects, reports, graphics displays, schedules, and programs. Groups of template object types shall be able to be set up as template subsystems and systems. The template system shall prompt for data entry if necessary. The template system shall maintain a link to all “child” objects created by each template. If a user wishes to make a change to a template object, the software shall ask the user if he/she wants to update all child objects with the change. This template system shall facilitate configuration and programming consistency and afford the user a fast and simple method to make global changes to the BAS.

G. Color Graphic Displays

1. The system shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse. Requirements of the color graphic subsystem include:

   a. SVGA, bit-mapped displays. The user shall have the ability to import AutoCAD generated picture files as background displays.

   b. A built-in library of animated objects such as dampers, fans, pumps, buttons, knobs, gauges, ad graphs which can be “dropped” on a graphic through the use of a software configuration “wizard”. These objects shall enable operators to interact with the graphic displays in a manner that mimics their mechanical equivalents found on field installed control panels. Using the mouse, operators shall be able to adjust setpoints, start or stop equipment, modify PID loop parameters, or change schedules.
c. Status changes or alarm conditions must be able to be highlighted by objects changing screen location, size, color, and text, blinking or changing from one display to another.

d. Graphic panel objects shall be able to be configured with multiple “tabbed” pages allowing an operator to quickly view individual graphics of equipment, which make up a subsystem or system.

e. Ability to link graphic displays through user-defined objects; alarm testing, or the result of a mathematical expression.

f. Operators must be able to change from one graphic to another by selecting an object with a mouse - no menus will be required.

H. Alarm Management

1. The software shall be capable of accepting alarms directly from controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) will be integrated into the overall alarm management system and will appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.

2. Alarm management features shall include:

a. A minimum of 255 alarm notification levels. Each notification level will establish a unique set of parameters for controlling alarm display, acknowledgment, keyboard annunciation, alarm printout and record keeping.

b. Automatic logging in the database of the alarm message, point name, point value, connected controller, timestamp, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement)

c. Automatic printing of the alarm information or alarm report to an alarm printer or report printer.

d. Playing an audible beep or audio (wav) file on alarm initiation or return too normal.

e. Sending an email or alphanumeric page to anyone listed in a workstation’s email account address list on either the initial occurrence of an alarm and/or if the alarm is repeated because an operator has not acknowledged the alarm within a userconfigurable timeframe. The ability to utilize email and alphanumeric paging of alarms shall be a standard feature of the software integrated with the operating system’s mail application interface.
f. Individual alarms shall be able to be re-routed to a workstation or workstations at user-specified times and dates. For example, a critical high temp alarm can be configured to be routed to a Facilities Dept. workstation during normal working hours (7am-6pm, Mon-Fri) and to a Central Alarming workstation at all other times.

g. An active alarm viewer shall be included which can be customized for each user or user type to hide or display any alarm attributes.

h. The font type and color, and background color for each alarm notification level as seen in the active alarm viewer shall be customizable to allow easy identification of certain alarm types or alarm states.

i. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.

I. Scheduling

1. It shall be possible to configure and download from the workstation schedules for any of the controllers on the network.

2. Time of day schedules shall be in a calendar style and shall be programmable for a minimum of one year in advance. Each standard day of the week and user-defined day types shall be able to be associated with a color so that when the schedule is viewed it is very easy, at-a-glance, to determine the schedule for a particular day even from the yearly view. To change the schedule for a particular day, a user shall simply click on the day and then click on the day type.

3. Each schedule will appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.

4. Schedules will be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation will be automatically updated to the corresponding schedule in the controller.

J. Programmer’s Environment

1. The programmer’s environment will include access to a superset of the same programming language supported in the controllers. Here the programmer will be able to configure application software off-line (if desired) for custom program development, write global control programs, system reports, wide area
networking data collection routines, and custom alarm management software. On the same screen as the program editor, the programming environment shall include dockable debug and watch bars for program debugging and viewing updated values and point attributes during programming. In addition a wizard tool shall be available for loading programs from a library file in the program editor.

K. Saving/Reloading

1. The workstation software shall have an application to save and restore field controller memory files. This application shall not be limited to saving and reloading an entire controller – it must also be able to save/reload individual objects in the controller: This allows off-line debugging of control programs, for example, and then reloading of just the modified information.

L. Data Logging

1. The workstation software shall have the capability to easily configure groups of data points with trend logs and display the trend log data. A group of data points shall be created by drag-and-drop method of the points into a folder. The trend log data shall be displayed through a simply menu selection. This data shall be able to be saved to file and/or printed.

M. Audit Trail

1. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.

N. Fault Tolerant File Server Operation:

1. The system shall provide the option to provide fault tolerant operation in the event of the loss of the CPU, disk drives, or other hardware required to maintain the operational integrity of the system. Operational integrity includes all user interfaces, monitoring of alarm points and access points, and executing access control functions.

2. The switchover mechanism provided shall be automatic. Should the failure be caused by hardware, and then the system shall immediately switch to the Backup computer. Should the system failure be caused by software (instruction or data), the system shall not pass the faulted code to the Backup computer, otherwise the Backup shall fail in the same manner of the Primary computer.

3. Switchover to the Backup computer shall be initiated and effective (complete) in a manner and time frame that precludes the loss of event data, and shall be transparent to the system users, except for an advisory alarm message indicating
that the switchover has occurred.

4. When the system fails-over from the Primary to the Backup computer, no alarm or other event shall be lost, and the Backup computer shall take control of all system functions.

5. A single component failure in the system shall not cause the entire system to fail. All system users shall be informed of any detectable component failure via an alarm event. System users shall not be logged off as a result of a system failure or switchover.

6. The Primary computer shall provide continual indication that the Backup computer is unavailable until such time that the fault has been purged.

7. Full screen, laptop service tools shall communicate directly to all controllers. The laptop software shall enable users to monitor both instantaneous and historical point data, modify control parameters, and enable/disable any point or program in any controller on the network.

O. Temperature Sensors

1. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of -30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.

   a. Zone Sensors- Andover Model Number: TTS-SD-LCD-1

   b. Duct Sensors- Andover TT-D Series, Veris TJ Series, or equivalent

   c. Well Sensors- Andover TT-I Series

2. Standard space sensors shall be available in an off white enclosure for mounting on a standard electrical box.

3. Where manual overrides are required, the sensor housing shall feature both an optional Sliding mechanism for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.

4. Where a local display is specified, the sensor shall incorporate either an LED or LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons, operators shall be able to adjust setpoints directly from the sensor.

5. Duct temperature sensors shall incorporate a thermistor bead embedded at the tip of a stainless steel tube. Probe style duct sensors are useable in air handling applications where the coil or duct area is less than 14 square feet.
6. Averaging sensors shall be employed in ducts, which are larger than 14 square feet. The averaging sensor tube must contain at least one thermistor for every 3 feet, with a minimum tube length of 12 feet.

7. Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications as well as refrigerant applications. Thermal wells shall be brass or stainless steel for non-corrosive fluids below 250 degrees F and 300 series stainless steel for all other applications.

8. A pneumatic signal shall not be allowed for sensing temperature.

P. Humidity Sensors

1. Humidity devices shall be accurate to +/- 5% at full scale for space and +/- 3% for duct and outside air applications. Provide Minco or Setra.

2. Provide a hand held field calibration tool that both reads the output of the sensor and contains a reference sensor for ongoing calibration.

Q. Pressure Sensors

1. Air pressure measurements in the range of 0 to 10” water column will be accurate to +/- 1 percent using a solid-state sensing element. Acceptable manufacturers include Setra and Dwyer.

2. Differential pressure measurements of liquids or gases shall be accurate to +/- 0.5% of range. The housing shall be Nema 4 rated. Acceptable manufacturers include Setra and Dwyer.

R. Current and KW Sensors

1. Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in solid core models, and offer either a digital or an analog signal to the automation system. Acceptable manufacturer is Veris or approved equal.

2. Measurement of three-phase power shall be accomplished with a kW/kWh transducer. This device shall utilize direct current transformer inputs to calculate the instantaneous value (kW) and a pulsed output proportional to the energy usage (kWh). Provide Veris Model 6000 Power Transducer or approved equal.

S. Flow Sensors

1. Provide an insertion flowmeter for measurement of liquid; gas or steam flows in pipe sizes above 3 inches.

2. Install the flow meter on an isolation valve to permit removal without process
shutdown.

3. Sensors shall be manufactured by ONICON, Badger, or approved equal.

T. Electric/Pneumatic Transducers

1. Electric to pneumatic transducers shall operate from an analog signal. E/P transducers shall be rated for 0 - 20 psi operation and accurate to 2% of full scale. E/P transducers shall have a maximum air consumption of 100 SCIM.

2. E/P transducers may be installed at the end device (damper or valve), or mounted separately in a field interface panel, or in the control panel. All transducers will be calibrated. Panel mounted transducers shall be Mamac or approved equal.

U. Electric/Pneumatic Solenoid Valves

1. Electric solenoid operated pneumatic valves (EP’s) shall have a three-port operation: common, normally open and normally closed. They shall be rated for 50 psig when used for 25 psig or less applications, or rated for 150 psig when used for 100 psig or less applications. The coils shall be equipped with transient suppression devices to limit transients to 150 percent of the rated coil voltage.

2.5 CONTROL VALVES

A. Provide automatic control valves suitable for the specified controlled media (Hot and Chilled Water). Provide valves, which mate and are compatible with the material of the connected piping. Equip control valves with the actuators of required input power type and control signal type to accurately position the flow control element and provide sufficient force to achieve required leakage specification. Control valves to be DuraDrive or equivalent.

B. Contractor to size valve Cv so that differential pressure at rated flow is between 3 to 5 psig for Chilled Water and 2 to 3.5 psig for Hot Water.

C. Control valves shall meet the heating and cooling loads specified, and close off against the differential pressure conditions within the application. Valves should be sized to operate accurately and with stability from 10 to 100% of the maximum design flow.

D. Electric actuation should be provided on all terminal unit reheat applications.

E. The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The actuator shall have electronic overload circuitry to prevent damage. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-spring return actuators shall have an external manual gear release to allow positioning of the damper when the actuator is not powered. Actuators to be DuraDrive or equivalent.
2.6 SMOKE DETECTORS

A. Smoke detector to be furnished and wired by Division 26, installed by Division 23. Smoke Detector – Robertshaw Model Number: 2650-450

2.7 AIRFLOW MEASURING STATIONS

A. Provide a thermal anemometer using instrument grade self-heated thermistor sensors with thermistor temperature sensors.

B. The flow station shall operate over a range of 0 to 5,000 feet/min with an accuracy of +/- 2% over 500 feet/min and +/- 10 ft/min for reading less than 500 feet/min.

C. The output signal shall be linear with field selectable ranges including 0-5 VDC, 0-10 VDC and 4-20 mA.

D. Furnish Ebtron Series GTx116 airflow stations or approved equal.

PART 3 EXECUTION

3.1 CONTRACTOR RESPONSIBILITIES

A. The BAS system is to be furnished and installed by an Andover approved Contractor. The Contractor shall certify all work as proper and complete. Under no circumstances shall the design; scheduling, coordination, programming, training, and warranty requirements for the project are delegated to a subcontractor.

B. Unless notified otherwise, entrance to building is restricted. No one will be permitted to enter the building unless their names have been cleared with the Owner or the Owner’s Representative.

C. All wiring shall be installed in accordance with all applicable electrical codes and shall comply with equipment manufacturer's recommendations.

D. At the completion of the work, all equipment pertinent to this Section shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract. Clean the exposed surfaces of tubing, hangers, and other exposed metal of grease, plaster, or other foreign materials.

3.2 WIRING, CONDUIT, TUBING AND CABLE

A. All wire shall be copper and meet the minimum wire size and insulation class listed below:
<table>
<thead>
<tr>
<th>Wire Class</th>
<th>Wire Size</th>
<th>Isolation Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>12 Gauge</td>
<td>600 Volt</td>
</tr>
<tr>
<td>Class Two</td>
<td>14 Gauge Std.</td>
<td>600 Volt</td>
</tr>
<tr>
<td>Class Two</td>
<td>18 Gauge Std.</td>
<td>300 Volt</td>
</tr>
<tr>
<td>Class Two</td>
<td>18 Gauge Std.</td>
<td>300 Volt</td>
</tr>
<tr>
<td>Communications</td>
<td>Per Mfr.</td>
<td>Per Mfr.</td>
</tr>
</tbody>
</table>

B. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.

C. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.

D. Where wiring is required to be installed in the conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Setscrew fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

E. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated cable. Plenum rated cable can be run without conduit above suspended ceilings. Cabling shall be installed in conduit systems in mechanical and electrical rooms.

F. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be used in exterior locations and interior locations subject to moisture.

G. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.

H. Pneumatic tubing will be FR rated polyethylene instrumentation tubing, type M, hard copper tubing, or soft copper tubing. All pneumatic tubing will be sized for a maximum pressure drop of 2 PSI from the pressure-reducing valve to end device.

I. Coaxial cable shall conform to RG62 or RG59 rating. Provide plenum rated coaxial cable when running in return air plenums.

J. Fiber optic cable shall include the following sizes; 50/125, 62.5/125 or 100/140: Only glass fiber is acceptable, no plastic.

K. Fiber optic cable shall only be installed and terminated by an experienced contractor. The BAS contractor shall submit to the Engineer the name of the intended contractor of the fiber optic cable with his submittal documents.

3.3 HARDWARE INSTALLATION
A. Installation Practices for Wiring and Tubing

1. All controllers are to be mounted vertically and per the manufacturer’s installation documentation.

2. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.

3. Conduit in finished areas shall be concealed in furred spaces and wall construction. Exception: metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.

4. Conduit, in non-finished areas where possible, shall be concealed in furred spaces and wall construction. Exposed conduit shall run parallel to or at right angles to the building structure.

5. Wires are to be kept a minimum of 3 inches from hot water, steam, or condensate piping.

6. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.

7. Wire or pneumatic tubing will not be allowed to run across telephone equipment areas.

8. All wiring running down exposed fire rated walls to controls or control panels shall be run in EMT or completely enclosed in metal raceways.

9. All control wiring in concrete walls or floors shall run in rigid conduit.

B. Installation Practices for Field Devices

1. Well-mounted sensors shall include thermal conducting compound within the well to ensure good heat transfer to the sensor.

2. Actuators shall be firmly mounted to give positive movement, and linkage shall be adjusted to give smooth continuous movement throughout 100% of the stroke.

3. Waterline mounted sensors shall be removable without shutting down the system in which they are installed.

4. For duct static pressure sensors, the high-pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low-pressure port shall be left open to the plenum area at the point that the high-pressure port is tapped into the ductwork.
5. For building static pressure sensors, the high-pressure port shall be inserted into the space via a metal tube. Pipe the low-pressure port to the outside of the building.

C. Enclosures

1. For all I/O requiring field interface devices, these devices where practical shall be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure, which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.

2. FIPs shall contain power supplies for sensors, interface relays and contactors, safety circuits, and I/P transducers.

3. The FIP enclosure shall be of steel construction with baked enamel finish, NEMA 1 rated with a hinged door and keyed lock. The enclosure will be sized for twenty percent spare mounting space. All locks will be keyed identically.

4. All wiring to and from the FIP shall be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts on control signal wires within the FIP is prohibited.

5. All outside mounted enclosures shall meet the NEMA-4 rating.

6. The tubing and wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

D. Identification

1. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.

2. Identify all pneumatic tubing with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.

3. All field enclosures, other than controllers, shall be identified with a Bakelite nameplate. The lettering shall be in white against a black or blue background.

4. Junction box covers shall be marked to indicate that they are a part of the BAS system.

5. All I/O field devices (except space sensors) that are not mounted within FIP’s shall be identified with nameplates.

6. All I/O field devices inside FIP’s shall be labeled.

E. Location
1. The location of sensors shall be per mechanical and architectural drawings.

2. Space humidity or temperature sensors shall be mounted away from machinery generating heat, direct light and diffuser air streams.

3. Outdoor air sensors shall be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.

4. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

3.4 SOFTWARE INSTALLATION

A. The software design and implementation is to be facilitated only by an Andover approved Contractor. The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

B. The Contractor will provide all labor to configure those portions of the database that are required by the point’s list and sequence of operation.

C. Color Graphic Slides:

1. Unless otherwise directed by the owner, the Contractor shall provide color graphic displays matching the Campus Standards for each system and floor plan.

2. For each system or floor plan, the display shall contain the associated points identified in the point list and allow for setpoint changes as required by the owner.
   a. Animations and 3D Rendering.
   b. Animations to mimic all moving devised, status and operation.
   c. Animations set to maximum performance, compatible with Version 1.81.
   d. Individual slides; mechanical equipment, VAV/CAV boxes, pumps, motors, fans, dampers, thermostats, and valves.

D. Reports

1. The Contractor shall configure a minimum of 6 reports for the owner as listed below:
b. VAV Status Report.


E. Documentation

1. As built software documentation shall include the following:
   a. Descriptive point lists.
   b. Application program listing.
   c. Application programs with comments.
   d. Printouts of all reports.
   e. Alarm list.
   f. Printouts of all graphics.

3.5 COMMISSIONING AND SYSTEM STARTUP

A. Point to Point Checkout

1. Each I/O device (both field mounted as well as those located in FIPs) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Facilities Manager for submission to the owner’s representative.

B. Controller and Workstation Checkout

1. A field checkout of all controllers and front-end equipment (computers, printers, modems, etc.) shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the owner or owner’s representative by the completion of the project.

C. System Acceptance Testing

1. All application software shall be verified and compared against the sequences of operation. Control loops shall be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the Test Results Sheet.

2. Test each alarm in the system and validate that the system generates the
appropriate alarm message, that the message appears at all prescribed
destinations (workstations or printers), and that any other related actions occur as
defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test
Results Sheet to the owner.

3. Perform an operational test of each unique graphic display and report to verify
that the item exists, that the appearance and content are correct, and that any
special features work as intended. Submit a Test Results Sheet to the owner.

4. Perform an operational test of each third party interface that has been included as
part of the automation system. Verify that all points are properly polled, that
alarms have been configured, and that any associated graphics and reports have
been completed. If the interface involves a file transfer over Ethernet, test any
logic that controls the transmission of the file, and verify the content of the
specified information.

END OF SECTION
SECTION 23 05 00

GENERAL MECHANICAL

PART 1 - GENERAL

1.1 INCLUSION OF GENERAL CONDITIONS AND GENERAL REQUIREMENTS

A. The Contract Documents, including Bidding Requirements, Contract Forms, General Conditions, Supplemental General Conditions, and Division 01 Sections, General Requirements are a part of this Section and the Contract for this work and apply to this Section as fully as if repeated herein.

1.2 SUMMARY

A. The requirements of this Section apply to all work of Division 22 and Division 23.

B. Furnish and install any incidental work not shown or specified, which can be reasonably inferred as part of the work necessary to provide complete functional systems. When an item not shown or listed is clearly necessary for proper operation of equipment which is shown or listed, provide an item that will allow the system to function properly, at no increase in Contract Sum.

1.3 QUALITY ASSURANCE

A. Regulatory compliance: All work performed under Divisions 21, 22 & 23 shall comply with the latest currently adopted editions of all codes and regulations and all requirements of all Authorities having Jurisdiction. The following references and standards are hereby made a part of these sections and work shall conform to applicable requirements herein, except as otherwise specified herein or shown on the Drawings.

B. Codes, Standards: Conform to all applicable codes and standards as stated herein and as described in Division 01 of the Specifications, including the following:

1. American Gas Association (AGA)
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standards 55 and 62.1
5. American Society for Testing and Materials (ASTM)
6. California Building Code (CBC)
7. California Code of Regulations Titles 8, 17, 19, 20, 21 & 22
8. California Electric Code (CEC)
9. California Energy Conservation Code (Title 24)
10. California Fire Code (CFC)
11. California Mechanical Code (CMC)
12. CAL Green Building Standards
13. California Plumbing Code (CPC)
14. City Fire Marshal requirements
15. National Electrical Manufacturers Association (NEMA)
17. NSF/ANSI 61 Standard, Drinking Water System Components – Health Effects for fixture materials that will be in contact with potable water.
18. Office of Statewide Health Planning and Development (OSHPD)
19. Sheet Metal and Air Conditioning Contractors Nation Association (SMACNA) Standards
20. Underwriters Laboratories (UL)
21. Comply with all ADA requirements for disabled access.
22. Comply with the latest edition of all applicable standards, including AWWA, PDI and OSHA

C. Minimum requirements: The requirements of these are the minimum that will be allowed unless such requirements are exceeded by applicable codes or regulations, in which the regulatory codes or regulation requirements shall govern.

D. When the Contract Documents call for materials or construction of a higher standard than is required by the above, the Contract Document requirements shall take precedence over the requirements of the said laws, rules, and/or regulations, accepting that nothing in the Contract Documents shall be interpreted as permitting work in violation of said laws, rules, and/or regulations. The Contractor for this work shall furnish any additional materials and/or labor as may be required for compliance with these laws, rules, and/or regulations though such materials and/or labor are not specifically set forth in the Contract Documents, with no additional charges to Owner.
E. Seismic construction and restraints shall be in accordance with the requirements of Title 17 and Title 24 of the California Code of Regulations. All equipment mounts, isolators, and hanging systems must meet local authority approval requirements.

F. Comply with the Safety Orders issued by Cal-OSHA and any other regulations of the State of California and any districts having jurisdictional authority.

1.4 LICENSES, PERMITS, FEES

A. The Contractors for this Section of work shall provide, procure and pay for all licenses, permits, fees, etc. as required to carry on and complete their work.

1.5 LICENSING REQUIREMENTS

A. All work of Divisions 21, 22 and 23 shall be performed by an appropriately licensed contractor. The licenses shall be current, valid through the term of the contract and in the name of the contractor.

1. All HVAC work, which includes warm air heating systems and water heating pumps, ventilating systems, air conditioning systems, and ductwork, registers, flues, humidity, and thermostatic controls in connection with these systems, shall be performed by a C-20 - Warm-Air Heating, Ventilating and Air-Conditioning Contractor.

2. All Fire Protection work, which includes lay out, fabrication and installation of all types of fire protection systems; including all the equipment associated with these systems, excluding electrical alarm systems, shall be performed by a C-16 Fire Protection Contractor.

3. All plumbing systems shall be installed by a C-36 Plumbing Contractor. Plumbing systems include: waste removal and connection of on-site waste disposal systems; piping, storage tanks, and venting for supply of gases and liquids for any purpose; all gas appliances, flues, and gas connections; water and gas piping from the owner’s side of utility meter to the structure or fixed works; installation of any type of equipment to heat water or fluids to a suitable temperature; and maintenance and replacement of the items described above, including health and safety devices.

1.6 CONTRACT DRAWINGS

A. The Contract Drawings indicate diagrammatically the general layout of the mechanical systems and other related work. Field verification of scaled dimensions taken from the Drawings is required. The Contractors for the work shall review and compare the Architectural, Structural, Plumbing, Mechanical and Electrical Drawings and all Owner supplied equipment Drawings, and adjust their work to be in conformity with the conditions indicated thereon. Discrepancies between different Drawings, between
Drawings and actual field conditions, or between Drawings and Specifications, shall be brought to the attention of the Architect promptly for a determination of the modifications to be effected.

1.7 SUBMITTALS

A. General:

1. All submittals shall be in accordance with the requirements of the General Conditions and Division 01 Sections for Submittal Procedures and Product Requirements.

2. Before any fixtures, materials, or equipment are purchased, the Contractor shall submit to the Architect for approval, a complete list of materials, fixtures, and equipment, giving the manufacturers' names, catalog number, capacity, size, power requirements, and other pertinent data. Submittal lists and drawings shall be specifically applicable to this project, shall include identifying marks assigned by Specifications and Drawings, and shall not contain extraneous material or optional choices.

3. The Contractor shall submit for the approval of the Architect, shop drawings of proposed material and equipment that differ from the specified materials and equipment, and of any specified materials and equipment with special conditions and/or arrangements. These drawings shall show necessary modifications of Owner, plumbing, electrical and mechanical work required by the proposed materials and equipment.

4. Submittal of substitutions shall be limited to one (1) proposal for each type or kind of item, unless otherwise permitted by the Architect. If the first proposed product submittal is rejected, the Contractor shall then submit the first named or scheduled product.

5. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements. Review of drawings and other material submitted shall not be construed as a complete check or constitute a waiver of the requirements of the Drawings and Specifications, but will indicate that the material submitted is acceptable in quality and utility. This review shall not relieve the Contractor of the responsibility to fit the proposed materials to the spaces provided, and to effect necessary rearrangement or construction of other work.

1.8 WARRANTIES

A. Equipment warranties shall be provided for all equipment, with all necessary information filled in, except purchase date, in favor of the Owner.
1.9 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall be responsible for delivery, storage, protection and placing of all equipment and materials.

1. Contractor shall protect the work and materials from damage during construction. Equipment stored at the jobsite shall be protected from dust, water or other damage, and be covered if equipment is exposed to weather. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.

2. Any items damaged shall be repaired or replaced, at no additional cost to the Owner.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.

2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.

3. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.10 COOPERATION WITH OTHER TRades

A. Cooperate fully with other trades doing work on the project as may be necessary for the proper completion of the project. Refer to the Structural, Plumbing, and Electrical Drawings for details of the building structure and equipment installation that will tend to overlap, conflict with, or require coordination with the work of this Section, and schedule this work accordingly.

B. Priority of right of way in space shall be as follows, in decreasing order of authority:

1. Electrical lights, electrical panels and drain piping.

2. Ductwork.

3. Fire protection piping, domestic hot water, domestic cold water and condenser water piping.

C. Any work done without regard for other trades shall be moved, replaced, or redone as required, without extra charges to Owner.

1.11 VERIFICATION OF EXISTING CONDITIONS AND DEMOLITION
A. Before installation of any new work, verify the location, size and other conditions at all points of connection to services or other existing piping, and at all locations where new work will cross or pass near existing piping, electrical, or other facilities.

B. Information shown relative to existing services is based upon available records and data during preparation of the Drawings, but shall be verified. Make reasonable deviations found necessary to conform with actual locations and conditions, without extra charge.

C. Remove piping, controls, fixtures, and equipment that is not to remain in service as shown on the Drawings or as required. This includes the removal of associated appurtenances and supports.

D. Patch, cap, or repair existing works affected by this demolition in concealed spaces within 6" of a live main or branch.

E. Deliver removed material to the Owner as directed by the Architect. Dispose of all other removed material offsite.

1.12 ACCURACY OF DATA

A. The data given herein and on the Drawings are as exact as could be reasonably secured, but absolute accuracy is not guaranteed. Exact locations, distances, elevations, etc. will be governed by shop drawings, the building itself, and actual field conditions.

1.13 UTILITY CONNECTIONS

A. Arrange for all utility connections, determine their exact requirements, and pay all costs incurred.

B. Send proper notices, make necessary arrangements, and perform other services required for care and maintenance of all utilities and assume all responsibility concerning same. Observe all rules and regulations of the respective utilities in executing the work.

1.14 DAMAGE BY LEAKS

A. Contractor shall be responsible for any damage to work of other Contractors that is caused by leaks in any temporary or permanent piping systems due to pipe rupture, disconnected pipes or fittings, or by overflow of equipment.

PART 2 - PRODUCTS

2.1 PRODUCTS CRITERIA

A. All materials, appliances, and equipment shall be new and best of their respective kinds, free from defects, and of the make, brand or quality specified or as accepted by the Architect.
B. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.

C. Apply and install all items in accordance with the manufacturer’s written instructions. Refer conflicts between the manufacturer’s instructions and the contract drawings and specifications to the Architect for resolution.

D. All fixtures, materials, and equipment equal in quality and utility to those herein mentioned will be accepted. When specific names are used in describing fixtures, materials, and equipment they are mentioned as standards only, but this implies no right on the part of the Contractor to use other fixtures, materials and equipment, or methods, unless approved as equal in quality and utility by the Architect. The decision of the Architect shall govern as to what fixtures, materials, and equipment are equals to those mentioned, but the burden of proof as to the quality of any proposed fixtures, materials, or equipment shall be upon the Contractor. If any tests are necessary to determine the quality of proposed fixtures, materials, or equipment, an unbiased laboratory shall make such tests at the expense of the Contractor satisfactory to the Architect.

2.2 SEISMIC FORCE RESISTANCE: MECHANICAL, PLUMBING


B. Equipment:

1. Each piece of equipment installed under this Section shall be constructed and anchored to structural supports to resist a seismic force and displacement in accordance with CBC Section 1616A1.17 through 1616A.1.26 and ASCE 7-10 Chapter 13, Sections 13.1 – 13.4 & 13.6. Supports, anchors and braces shown shall be minimum.

2. Equipment manufacturer shall construct and certify that his equipment satisfies the special minimum seismic resistance requirements.

C. Piping:

1. Flexibility of piping systems must be maintained by the use of flexible devices at critical points at junctions of separate building structures. Braces or anchors shall be designed to damp oscillations or check excessive movement. Flexible devices for piping of gas shall be loops or offsets. Flexible devices for other piping may be loops, Victaulic grooved, or roustabout couplings.

2. Piping at tops and bottoms of risers are critical points where flexibility is required, as well as at changes in direction on long runs of piping 4” and larger.
3. Tops of risers shall be restrained from motion in horizontal direction, and midpoints shall be anchored in all directions.

4. All piping systems bracing shall be designed to resist a seismic force and displacement in accordance with CBC Section 1615A.1.12 through 1615A.1.22 and ASCE 7-10 Section 13.6.8 & 13.6.9.

5. The following table shows maximum lengths of shapes used for sway bracing:

<table>
<thead>
<tr>
<th>TYPE/SIZE</th>
<th>MAX. LENGTH (l/r=200)</th>
<th>TYPE/SIZE</th>
<th>MAX. LENGTH (l/r=200)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle</td>
<td></td>
<td>Flat Bar</td>
<td></td>
</tr>
<tr>
<td>1½ x 1½ x ¾&quot;</td>
<td>4'-10&quot;</td>
<td>1½ x ¾&quot;</td>
<td>1'-2&quot;</td>
</tr>
<tr>
<td>2 x 2 x ¾&quot;</td>
<td>6'-6&quot;</td>
<td>2 x ¾&quot;</td>
<td>1'-2&quot;</td>
</tr>
<tr>
<td>2½ x 2½ x ¾&quot;</td>
<td>8'-2&quot;</td>
<td>2 x ¾&quot;</td>
<td>1'-9&quot;</td>
</tr>
<tr>
<td>3 x 3 x ¾&quot;</td>
<td>9'-10&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Threaded Rod</td>
<td></td>
<td>Pipe (Schedule 40)</td>
<td></td>
</tr>
<tr>
<td>¼&quot;</td>
<td>1'-7&quot;</td>
<td>1&quot;</td>
<td>7'-0&quot;</td>
</tr>
<tr>
<td>½&quot;</td>
<td>2'-1&quot;</td>
<td>1¼&quot;</td>
<td>9'-0&quot;</td>
</tr>
<tr>
<td>¾&quot;</td>
<td>2'-7&quot;</td>
<td>1½&quot;</td>
<td>10'-4&quot;</td>
</tr>
<tr>
<td>1&quot;</td>
<td>3'-1&quot;</td>
<td>2&quot;</td>
<td>13'-1&quot;</td>
</tr>
</tbody>
</table>

2.3 HANGERS, SUPPORTS

A. Pipe supports shall be manufactured by Thomas & Betts, “Superstrut” or equivalent Cooper B-Line, Nibco (Tolco), or Anvil International.

B. All hangers shall be electro-chromate finished. Hanger rods shall have electro-galvanized finish.

C. Copper tubing:
   1. C-711 copper tube hanger complete with C-716 isolator.
   2. Copper pipe shall be attached to channels with A-716 “Cush-A-Clamp”.

D. Insulated pipe:
   1. C-711 pipe hanger fitted to outside of insulation with C-790 galvanized shields.

E. Trapeze hangers:
   1. Grouped pipes may be supported by A-1200 channel bolted to rods.
F. Point of support connectors:

1. Wood construction:
   a. Stationary pipes: 540 side beam hanger
   b. Pipes subject to movement: SS41


4. Steel beams: Series 500 beam brackets.

5. Plywood decks: machine bolts, nuts and washers.

G. Vertical pipe risers:

1. Vertical pipe risers shall be securely supported with C-720 pipe clamps anchored to construction.

2. C-720P for bare cold water pipe, anchored to construction.

H. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

I. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

J. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

K. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

L. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

M. Trapeze and Riser Supports:


3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.
N. Pipes through studs or joists shall be isolated from structure with properly sized Hubbard "Hold-Rite" suspension clamps or LSP “Acousto-Plumb” system.

2.4 PIPE LABELS

A. Brady, Seton or approved equal pipe labels. Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

D. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.


1. For pipes or covering with outside diameter ¾ to 1¾ inch, minimum length of label: 8 inches, minimum height of letters: ½ inch.

2. For pipes or covering with outside diameter 1½ to 2 inches, minimum length of label: 8 inches, minimum height of letters: ¾ inch.

3. For pipes or covering with outside diameter 2½ to 6 inches, minimum length of label: 12 inches, minimum height of letters: 1¾ inch.

4. For pipes or covering with outside diameter 8 to 10 inches, minimum length of label: 24 inches, minimum height of letters: 2½ inches.

5. For pipes or covering with outside diameter over 10 inches, minimum length of label: 32 inches, minimum height of letters: 3½ inches.

2.5 ELECTRICAL MOTORS

A. With exception of motors in AGA or UL labeled equipment, motors for HVAC blowers and fans, pumps, and other general purpose applications using an adjustable speed drive shall be Baldor Premium Efficient Super-E®, three phase, foot mounted, Class H insulated motor with AEGIS shaft grounding ring installed internally, regreasable ball bearings, dynamically balanced rotors.

B. Motors shall be certified for quiet operation and shall bear a label so stating. Motors shall be drip-proof frame, 1.15 minimum service factor in 40°C, ambient windings specially impregnated and epoxy coated for outdoor service.
C. Torque characteristics of motors shall be as required to accelerate machine to 100% full load speed within 10 seconds. Motors shall be dynamically balanced to maximum deflection as follows:

1. 15 HP and larger: 0.0003 inches.
2. 10 HP and smaller: 0.0002 inches.

D. Motors shall be Inverter duty, meet NEMA MG-1 and part 30 and 31, and shall be guaranteed to satisfactorily operate at ± 10% voltage shown on Drawings. Transformers of adequate capacity shall be provided if necessary to satisfy this requirement.

E. All 3-phase motors shall be provided with phase and brown-out protection to shut down all motors in the unit if the phases are more than 10% out of balance on voltage or the voltage is more than 10% under design voltage.

F. Fractional horsepower fan motors (¼ hp, ½ hp, ¾ hp) shall be Greenheck Vari-Green series motors, DC electronic commutation type, specifically designed for fan applications. Motors shall be permanently lubricated with heavy duty ball bearings to match the fan load and pre-wired to the specific voltage and phase. Internal motor circuitry shall convert AC power supplied to the fan to DC power to operate the motor. Motor shall be controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal. Motor shall be a minimum of 85% efficient at all speeds.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide all necessary cutting in connection with the work of this Section. No cutting shall be done without the approval of the Architect. Comply with requirements specified in Cutting and Patching Section.

B. No structural members shall be drilled, bored, or notched in a manner that will impair their structural capacity.

C. All penetrations of concrete or masonry shall be made with core drills.

3.2 EQUIPMENT

A. Equipment shall operate quietly and without objectionable vibration. Such problems, other than from equipment operating at optimum conditions, shall be the Contractor's responsibility and shall be eliminated at the direction of the Architect.

B. Install equipment to provide good appearance, easy access, and adequate space to allow replacement and maintenance. Provide bases, supports, anchor bolts, and other items
required to achieve this. Installation shall be level, above moisture level, and adequately braced.

C. Extend ¼" schedule 40 black steel lubrication pipes from hard-to-reach locations to front of equipment or to access doors. Terminate with proper lubrication fittings.

D. Move equipment into building through available openings. Dismantle equipment where necessary to accomplish this. After reassembly, test equipment to verify its satisfactory operating condition.

E. Thoroughly lubricate equipment before operating. Repair of damage resulting from failure to comply with this requirement shall be the Contractor's responsibility.

F. Connections to piping shall be secured and properly aligned and all utility and control connections shall be properly isolated from the building structure by means of vibration isolators and flexible connections. Any equipment not meeting this requirement will be modified and properly reinstalled at no expense to the Owner.

3.3 MECHANICAL SERVICES

A. Terminals and services weighing no more than 20 pounds, may be supported directly on the runners of a heavy duty grid system but, in addition, they must have a minimum of (2) #12 gage slack safety wires attached at diagonally opposite corners and anchored to the structure above.

3.4 CONCRETE EQUIPMENT BASES

A. Concrete work that is part of the mechanical installations, as such is shown and/or detailed on the Drawings, shall conform to the requirements of the Concrete Section of these Specifications.

B. Bases shall be neatly finished, have rounded corners and smooth trowel finish.

3.5 ELECTRICAL REQUIREMENTS

A. Electrical work in this Section shall conform to the requirements of Division 26. Equipment shall conform to the standards of the National Electric Manufacturer's Association. Electrical equipment shall bear the label of Underwriters' Laboratories, Inc., where examination and listing service is available for such materials. Motors and motor control equipment shall be as specified below.

1. The work shall include the furnishing of:

a. Motor controls mounted as integral part of equipment assemblies.

b. Pre-wired control panels as described and shown.
c. Electronic control panels and their components.

d. Wiring for low voltage controls and "interlock work" except where specifically shown otherwise.

2. Installing of:
   a. All motors.
   b. All control panels and their components.
   c. Low voltage wiring, line voltage "interlock" wiring, control wiring for safety devices, alarms, and refrigeration.

B. Wiring includes all connections to devices, and all wiring shall be installed in conduit.

1. Conduit fittings and devices shall be as specified in the basic electrical materials section of Division 26 - Electrical.

2. Line voltage work (in equipment assemblies) shall be as specified in Division 26 - Electrical.

3. Devices shall be installed in NEMA enclosures of type required for location.
   a. Flush enclosures: Keystone "Telephone Cabinets" type PF with pull box knockouts.
   b. Surface enclosures: Keystone LJC.

C. Electrical Controls:

1. Submit shop-wiring diagrams of temperature controls and air conditioning unit controls for approval. Furnish approved wiring diagrams and assistance to Electrician.

2. Refer to Electrical, Fire Protection, Plumbing and Mechanical documents for work and devices required. All wiring required by plumbing and heating, ventilating and air conditioning work shall be performed by the Controls Contractor.

D. The following work will be furnished and installed under the Electrical Section of these Specifications:

1. Disconnect switches, remote switches, motor starters, relays and test switches not mounted as integral part of equipment assemblies or in temperature control panels.
2. All line voltage controls and interlocks, all other controls, circuits from electric panel board to disconnect switches, starters, motors, switches and/or other motor controls, to temperature controls and safety devices.

3.6 PAINTING
   A. Properly prepare work under this Section to be painted under Painting Section, except preservative and special painting as described herein.
   B. Priming as required herein, shall conform to Painting Section requirements and be of a material compatible with paint for finish painting.
   C. All equipment and materials shall be cleaned of grease, wax, oil, rust or dirt in preparation for finish painting. Any prime coated surfaces showing signs of rust before being finish painted shall be thoroughly cleaned and a new prime coat applied.
   D. Prime paint both sides of flashings prior to installation.
   E. Furnish can of touch-up paint with each factory finished piece of equipment.
   F. Paint all piping in mechanical rooms. Color as selected by the Architect.
   G. Black steel piping exposed to the environment shall be painted with rust-inhibiting paint. Color as selected by Architect.

3.7 IDENTIFICATION OF SYSTEMS
   A. Piping
      1. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
         a. Adjacent to all valves and flanges
         b. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
         c. At both sides of wall, or floor penetrations.
         d. Near penetrations through ceilings, and inaccessible enclosures.
         e. Adjacent to changes in direction.
         f. At access doors, manholes, and similar access points that permit view of concealed piping.
g. Near major equipment items and other points of origination and termination.

h. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

i. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

2. All piping shall be identified.

   
a. Potable, Cooling, Boiler Feed and other Water Piping:
   1) Background Color: Green.
   
b. Fire Quenching Fluids:
   1) Background Color: Red.
   
c. Toxic and Corrosive Fluids
   1) Background Color: Orange.
   2) Letter Color: Black
   
d. Combustible Fluids:
   1) Background Color: Brown.
   2) Letter Color: White
   
e. Flammable Fluids:
   1) Background Color: Yellow.
   2) Letter Color: Black

B. Valves

1. For identification and Owner's maintenance records, all valves shall be numbered and identified with clearly stamped 1¼” diameter brass tags, in accordance with drawings and service performed.
2. Control valves shall be also marked whether normally open (N.O.) or normally closed (N.S.).

3. Affix Underwriter's standard porcelain enameled identification signs to all fire protection sprinkler control valves, drain valves, and flow switches.

C. Equipment

1. All equipment shall be labeled with 1" high stencils showing identifying mark noted on drawings, and usage.

2. Warning signs shall be placed on machines driven by electrical motors that are controlled by fully automatic starters, per California Code of Regulations, Title 8, Subchapter 7 - General Industry Safety Orders, Article 7, Section 3320.

D. A typewritten schedule of all stencils and valve tags used, with identification, shall be framed and posted in mechanical rooms, at locations as directed.

3.8 INSTALLATION, HANGERS & SUPPORTS

A. Installation of piping shall be such that damage cannot result through loading, expansion or contraction of piping. Anchors shall be installed to obtain uniformity of pipe movement.

B. Hanger rod sizes shall be no smaller than 3/8-inch for pipe and tube sizes ½ to 4 inches and ½ inch for sizes 5 - 8 inches.

C. Pipe supports shall be spaced sufficiently close to support pipes properly without formation of pockets. Hangers shall be installed at ends of mains and branches. Maximum horizontal support spacing shall be as follows:

1. Steel Pipe for water or DWV: 10 feet for pipe sizes ¾ inch and smaller and 12 feet for sizes 1 inch and larger.

2. Copper Tube and Pipe, soldered or brazed: 6 feet for pipe sizes 1 ½ inches and smaller and 10 feet for sizes 2 inches and larger.

3. Hubless Cast-Iron shall be supported at every other joint, unless over 4 feet, then support each joint. Support adjacent to joint, not to exceed 18 inches, brace at not more than 40 foot intervals to prevent horizontal movement. Support at each horizontal branch connection. Hangers shall not be placed on the coupling.

D. Provide resilient mounting for domestic water piping. Thermal insulation may serve as resilient mounting for insulated piping.

E. Suspended water piping shall be anchored with steel struts installed at midpoint of each run.
F. No valve or piece of equipment shall be used to support piping.

G. Pipes through studs or joists shall be isolated from structure with properly sized Hubbard "Hold-Rite" suspension clamps.

3.9 INSTALLATION, PIPING

A. Rough in shall proceed as rapidly as general construction will permit. All rough-in shall be complete, at locations verified by Architect and Owner, and tested and inspected prior to installation of concrete, lath, plaster, gypsum wallboard, or other finishes.

B. All piping shall be concealed in finished rooms, installed in furred walls and partitions. Where furred or suspended ceilings occur, piping shall be installed in the concealed space at points adjacent to beams and/or other structural members, and coordinated with ductwork and equipment. Where exposed piping occurs, it shall be installed parallel to or at right angles to building walls, unless specifically shown otherwise on the Drawings.

C. Installation of piping shall be such that damage cannot result, through thermal expansion or contraction, to piping, building, or pipe hangers and supports. Anchors shall be installed at midpoints of all runs in main piping for the purpose of localizing pipe expansion or prevention of creepage.

D. All pipe lines shall be installed free from traps and air pockets, true to line and grade, with suitable supports properly spaced. All piping shall be installed without undue stresses and with provision for expansion and contraction.

E. All piping shall be new and free from foreign substances. American standard pipe threads shall be used for IPS threaded work. Joints in threaded piping shall be made up with Teflon tape applied to the male threads only. No screwed pipe joints shall be caulked or packed with rope or other packing materials. Pipe shall be free from tool marks, threads cut accurately with not more than two (2) threads showing beyond fitting. Friction wrenches shall not be used with plated, polished, or soft metal piping. All changes in pipe size shall be made with reducing fitting. Bushings will not be permitted.

F. Protect unattended openings in piping during construction.

G. Weld all pipe 2.5 inches and larger. Use the following procedure. All welders must be AWS certified. AWS B2.1 SMAW 6G Pipe Welding Procedure Specifications

<table>
<thead>
<tr>
<th>Welding process: SMAW</th>
<th>Grove Angle: 60 degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weld Progression: Up</td>
<td>Thickness (pipe/tube): Groove (in) .280</td>
</tr>
<tr>
<td>Backing: No</td>
<td>Notes: Sch. 40 Pipe</td>
</tr>
<tr>
<td>Current/Polarity: DCEP</td>
<td>Filler Metal Class: E6010Rt/E7018F1</td>
</tr>
<tr>
<td>Root Opening: 1/16 to 1/8</td>
<td>Other Filler Metal Class: Rt. 1/8, 3/32 Filler</td>
</tr>
</tbody>
</table>
H. Welded joints shall be beveled and butt-welded. Reductions of pipe shall be made with forged steel welding fittings. Branch reductions of two or more pipe sizes smaller than the main, may be Bonney "Weld-O-Let" fittings, or equal. Job fabricated reductions and branches shall not be used. All pipe burrs shall be reamed out. Welding rods shall be as follows, or approved equal:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Arc Welding</th>
<th>Gas Welding</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; and larger</td>
<td>Fleetweld #5</td>
<td>Oxweld #1 or Page Hi-Test M</td>
</tr>
<tr>
<td>1½&quot; and smaller</td>
<td>None</td>
<td>Oxweld #1 or Page Hi-Test M</td>
</tr>
</tbody>
</table>

I. No water or drainage piping shall pass over electrical equipment unless adequate protection is provided to prevent damage by leaks or condensation.

J. All copper tubing shall be formed in a workmanlike manner, in accordance with the Pipe and Tube Bending Handbook of the Copper and Brass Research Association. A tube bender giving support to the periphery of the tube shall be used. The tubing shall be protected against flatting or other injury.

K. All copper connections and joints shall be made in accordance with the Copper Tube Handbook, Copper and Brass Research Association. No swaged connections will be permitted. All valves, pumps, and similar equipment shall be connected to copper piping through union or flange adapter fittings.

L. All underground hydronic piping shall be installed per manufacturer's installation instructions. Provide protection of piping from damage due to expansion. Provide thrust blocks where required as indicated by the manufacturers installation instructions.

M. Install air vents at all water piping high points when direction of flow is downward.

N. Install sediment drain faucets at all low points.

O. Valves, cocks, etc., shall be installed to allow convenient accessibility and operation.

P. Unions and flanges shall be installed to allow convenient replacement of all equipment and cleaning tubes.

Q. A union connection shall be installed downstream from all valves, at equipment connections and at other locations as required or directed.

R. Shut off valves shall be provided in all main services, and where required to permit proper servicing of equipment. Valves of one type shall be of one manufacturer.

S. All valves shall be of the same size as the pipelines in which they are installed, unless specifically sized on the Drawings. All hand controlled line valves shall be ball valves, except where throttling control or frequent operation is required, in which case globe or angle valves shall be used. Globe valves in horizontal lines shall be installed with stem in horizontal to permit line draining. All globe and angle valves shall be installed to close
against pressure. Disc valves shall have discs suitable for the services for which they are to be used.

T. All valves shall be accessible and shall not be installed with the stems below the horizontal plane. Provide access panels at walls, ceilings, or floors.

U. Provide prime coated escutcheon plates at all points where exposed piping penetrates finished wall ceilings or floors.

V. Cutting or boring of joists or other structural members shall be done only when alternative routing is impossible and only upon written approval of the Architect or Owner.

3.10 CLEANING OF PIPING

A. All new piping shall be thoroughly cleaned of rust, scale, etc., prior to enclosing and placing in operation. Water shall be forced through pipes until the systems are free from foreign substances.

3.11 CLEANUP

A. Upon completion of the work of this Section, remove all material, debris, and equipment associated with or used in the performance of this work.

END OF SECTION
SECTION 26 05 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work included in this Section: All materials, labor, equipment, services, and incidentals necessary to install the Electrical Work as shown on the drawings and as specified hereinafter, including, but not limited to the following:

1. Branch circuit wiring, wiring devices and connections to all equipment requiring electrical service.

2. Lighting fixtures completely lamped, including switches, raceways and wiring.

3. Emergency egress/exit illumination system.

4. Fire Alarm system.

5. Mechanical equipment power connections, and motor starters where noted.

6. Low voltage lighting control system and programming.

7. All required incidental work, such as roof flashing, electrical testing, title 24 acceptance testing, and temporary power.

8. Any other electrical work as might reasonably be implied as required, even though not specifically mentioned herein or shown on the drawings.

9. It is the intent of the drawings and specifications that systems be complete and, except as otherwise noted, be ready for operation.

1.2 RELATED WORK

A. Division 1 - General Requirements

B. Division 9 - Finishes

C. Division 23 - Mechanical

D. Section 07270 - Firestopping

1.3 INCORPORATED DOCUMENTS

A. Requirements of the General Conditions, Supplementary Conditions, and Division 1 Sections apply to all work in this Section, unless modified herein.
B. Published specifications, standard tests or recommended methods of trade, industry or government organizations apply to work of this Section where cited by abbreviations noted below, unless modified herein.

1. 2013 California Code of Regulations.

2. 2013 California Building Standards Administrative Code, Part 1, Title 24, C.C.R.


7. California Energy Code, Part 6, Title 24, C.C.R.


10. Underwriters' Laboratories, Inc. (UL).

11. Local Utility Company regulations.

C. All State and Municipal Codes and Ordinances.

1.4 CONDITIONS AT SITE:

A. Visit to site is required of all bidders prior to submission of bid. All will be held to have familiarized themselves with all discernible conditions and no extra payment will be allowed for work required because of these conditions, whether specifically mentioned or not.

B. Lines of other services that are damaged as a result of this work shall promptly be repaired at no expense to the Owner to the complete satisfaction of the Owner.

1.5 QUALITY ASSURANCE

A. Conformance:

1. All work shall conform to the applicable requirements of Article 1.3 above.
2. The Contractor shall notify the Architect, prior to submission of bid, about any part of the design, which fails to comply with abovementioned requirements.

3. If after contract is awarded, minor changes and additions are required by aforementioned authorities, even though such work is not shown on drawings or covered in the specifications, they shall be included at Contractor's expense.

B. Coordination:

1. The Contractor shall become familiar with the conditions at the job site, and with the drawings and specifications and plan the installation of the electrical work to conform with the existing conditions and that shown and specified so as to provide the best possible assembly of the combined work of all trades.

2. The Contractor shall work out in advance all "tight" conditions, involving all trades and if found necessary, supplementary drawings shall be prepared by this Contractor, for the Architect's approval, before work proceeds in these areas. No additional costs will be considered for work, which must be relocated due to conflicts with the work of other trades.

3. The Contractor shall coordinate and verify all backbox, device, lighting fixture, or equipment mounting requirements with the devices or equipment to be installed, prior to rough in.

1.6 SUBMITTALS

A. Product Data:

1. Comply with the provisions of Section 01 33 00 - Submittals.

2. Within 15 days after award of the Contract, submit:

   a. Complete electrical, lighting, and signal systems material list of all items proposed to be furnished and installed under this Division. Provide manufacturers data sheets for all devices, raceways, fixtures, equipment, and related products to be used for the Division 26, 27, and 28 work.

   b. Manufacturers' specifications and other data required demonstrating compliance with the specified requirements.

   c. Manufacturers' recommended installation procedures which, when approved by the Architect, shall become the basis for inspecting and accepting or rejecting actual installation procedures used on the work.

3. Shop Drawings: Furnish shop drawings and/or equipment cuts for the following:

   a. Light fixtures including lamps and ballasts
b. Fire alarm system
c. Disconnect switches
d. Motor starters
e. Low voltage lighting control system
f. Mechanical and Plumbing equipment. The Electrical Contractor shall review the Mechanical and Plumbing Submittals, and verify the voltage, wire size and overcurrent protection required. Also provide the Electrical Engineer with a copy of the submittals for their review.

4. Test Reports:
   b. Field Tests: Performance tests as specified for specific equipment.
   c. Megger Tests: As specified under TESTING.
   d. When series rated circuit breakers are used, provide a letter from the manufacturer of the equipment confirming that U.L. series rating exists for all protective devices. State the available fault current from the Utility Company and indicate that the overcurrent devices exceed the available fault current at the respective point of protection.
   e. Special Seismic Certification documentation as per CBC Section 1616A and ASCE/SEI 7-10 requirements for all equipment defined as 'critical' with an importance factor of 1.5 in Paragraph 1.10.M.3 of this Section.
   f. Manufacturer's Seismic Certification or Project-Specific Design of Supports and Attachments for all other equipment and fixtures as per CBC Section 1616A and ASCE/SEI 7-10 requirements.

5. Maintenance and Operating Manuals:
   a. Systems Description: Description of operating procedures.
   b. Controls: Diagrams and description of operation of each system.
   c. Equipment: Manufacturer's brochures, ratings, certified shop drawings, maintenance data, and parts lists with part numbers. Mark each sheet with equipment identification number and actual installed condition.
   d. Materials and Accessories: Manufacturer's brochures, parts lists with part numbers, and maintenance data where applicable. Mark each sheet with identification number of system and location of installation.
e. The Maintenance and Operation Manual shall be presented in a three ring binder that has tabbed sections as stated below. Provide all information in each section as stated below.

1) 26 51 01:

(a) Insert the approved submittals for the light fixtures.

(b) Highlight the lamp type that was installed for each light fixture.

(c) Provide the names, address and telephone numbers of the manufacturer and the closest manufacturer's representative for each light fixture.

2) 26 51 01:

(a) Insert the approved submittals for the motion sensing light control equipment.

(b) Insert all operating instructions.

(c) Provide the names, address and telephone number of the manufacturer and the closest manufacturer's representative of the equipment.

(d) Include the manufacturer's recommended maintenance of the equipment.

3) 27 00 00:

(a) Insert the approved submittals for the telephone/data system.

(b) Provide the names, address and telephone number of the manufacturer and the closest manufacturer's representative of the equipment.

(c) Include the manufacturer's recommended maintenance of the equipment.

4) 28 31 01:

(a) Complete the “Record Of Completion” entirely.

(b) Provide the names, address and telephone number of the manufacturer and the closest manufacturer’s representative of the equipment.
(c) Include the manufacturer's recommended maintenance of the equipment.

(d) Insert an abbreviated data sheet that states how to test, reset and silence the fire alarm system.

5) 26 08 00:

(a) Insert all feeder system testing results.

6. Record Documents: "As-builts": As specified under Paragraph 3.2 of this Section.

1.7 DELIVERY, STORAGE AND HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all trades.

B. Delivery and Storage: Deliver all materials to the job site in their original containers with all labels intact and legible at time of use. Store in strict accordance with approved manufacturers' recommendations.

C. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

D. This Contractor shall personally, or through an authorized representative, check all materials upon receipt at jobsite for conformance with approved shop drawings and/or plans and specifications.

1.8 SCHEDULING/SEQUENCING

A. Place orders for all equipment in time to prevent any delay in construction schedule or completion of project. If any materials or equipment are not ordered in time, additional charges made by equipment manufacturers to complete their equipment in time to meet the construction schedule, together with any special handling charges, shall be borne by this Contractor.

B. The Contractor shall coordinate production and delivery schedule for all Owner-supplied equipment with the equipment suppliers to ensure that all Owner-supplied equipment is delivered to site in coordination with the construction schedule and in such a manner as to cause no delays in completion of the Contract as scheduled.

1.9 REQUIREMENTS

A. The contract drawings indicate the extent and general arrangements of the conduit wiring systems, etc. If any departures from the contract drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall
be submitted as soon as practicable, and within thirty-five (35) days after award of the electrical contract.

B. Unless material list and data is received as a complete and all inclusive submittal within the stipulated time all items shall be provided as specified, with no deviations permitted.

C. Any and all additional costs incurred by the substitution of electrical material or equipment, or installation thereof, whether architectural, structural, plumbing, mechanical or electrical, shall be borne by the Contractor under this Section.

D. Burden of proof of equality of any substitution for a specified product is the responsibility of this Contractor.

E. Where required by Architect to ascertain equality of substitute product, Contractor may be requested to provide the specified item and the submitted substitution for comparison, at no additional cost to the Owner.

1.10 SEISMIC CERTIFICATION AND INSTALLATION OF EQUIPMENT

A. See Architectural and Structural Drawings and Specifications for description of Occupancy Group and Seismic Design Category applicable to this project.

B. Provide Special Seismic Certification per CBC Section 1616A and ASCE/SEI 7-10 for all equipment and components defined as critical with an importance factor 1.5 in Paragraph 1.10.M.3 of this Section.

C. Special Seismic Certification shall require either certification through approved analytical method or approved shake table testing in accordance with Section 13.2.5 of ASCE/SEI 7-10 or experience data in accordance with Section 13.2.6 of ASCE/SEI 7-10.

D. Manufacturer's Seismic Certification or Project-Specific Design of Supports and Attachments for all other equipment and fixtures as per CBC Section 1616A and ASCE/SEI 7-10 requirements.

E. Provide seismic restraints per applicable code and as specified or indicated. Design restraints to prevent permanent displacement in any direction caused by lateral motion, overturning, or uplift.

F. Rigidly Supported Equipment, Conduits, and Raceways.

G. Components supported by chains or simply suspended from above are not required to meet lateral seismic force requirements and seismic relative displacement requirements provided that they cannot be damaged or cannot damage any other component when subject to seismic motion. They must have ductile or articulating connections to the structure at the point of attachment.

H. Electrical Cabinets:
1. Electrical cabinet design shall conform to National Electrical Manufacturers Association (NEMA) 250 and NEMA ICS6 standards. Cutouts in the lower shear panel that do not appear to have been made by the manufacturer and significantly reduce the strength of the cabinet are not permitted unless analysis demonstrates that the remaining strength is sufficient.

2. A latch or fastener to prevent opening during an earthquake event and damaging the cabinet and internal components shall secure all doors.

3. Slide-out components in electrical control panels, etc., shall have a latching mechanism to hold contents in place.

4. Attached cabling shall have adequate slack or flexibility between the cabinets and surrounding structure supporting the conduit to preclude severing of the cabling due to differential seismic displacements.

I. The design load shall include the effects of loading on the equipment imposed by attached utility or service lines that are also attached to separate structures.

J. The attachment of additional external items is not permitted unless such items have either been provided by the Manufacturer, or analysis shows that their effects are supported by design.

K. Conduit and their connections shall be constructed of ductile materials unless otherwise approved by the Architect. Conduits and their connections constructed of non-ductile materials (e.g., cast iron, no-hub pipe and plastic) shall have brace lengths reduced to one-half that allowed for ductile material.

1. All trapeze assemblies supporting conduit shall be braced to resist CBC design forces considering the total weight of the elements on the trapeze.

2. Seismic restraint spacing shall be in accordance with hanger spacing.

L. Critical Equipment:

1. Design with importance factor of 1.5.

2. Provide Special Seismic Certification for all equipment and components and their installation per CBC and ASCE/SEI requirements.

3. Critical Equipment shall include the following:
   a. Fire Alarm system equipment.
   b. Lighting System Inverter (where applies).

M. Seismic Design Submittals: For all Critical Equipment included in paragraph 26 05 00.1.10.M.3.
1. The Manufacturer of each item of critical equipment shall arrange for the testing or analysis by an approved agency of each component and assembly and its mounting system or anchorage.

2. The Manufacturer shall submit a Certificate of Compliance for each item for approval by the Architect and by the Authority Having Jurisdiction.

3. Based on Manufacturer's approved submittal, Contractor shall retain the services of a State of California registered Structural Engineer to prepare final installation details and drawings for equipment supports and attachments.

4. Submit drawings of the equipment showing dimensions, support equipment, connections, and the proper anchorage locations.

5. Equipment weight and weight distribution (e.g., center of gravity in elevation and plan).

6. Thickness of sheet metal bases.

7. Seismic Vibration Isolation Devices: Manufacturer's product information indicating class and type. Indicate load ratings as published manufacturer's data or shop drawings. Indicate proper orientation of devices on plan.

8. Inertia bases and support frames.

9. Specific details of restraints including anchor bolts and welds and maximum load at each location.

N. Independent Supports: An independent means of secure support shall be provided for all wiring methods in non-fire-rated assemblies. Where independent support wires are used, they shall be distinguishable by color, tagging, or other effective means.

1.11 DESCRIPTION OF WORK

A. This project involves the renovation of an existing building. As such, the project scope for this contractor will include all associated electrical, lighting, and signal system upgrades and demolition/removal work at the existing site. The intent is that all systems will be complete and functional at the completion of this contract and that all old systems, equipment, feeders, circuits, wiring, and related devices (no longer used) be completely and neatly removed. Where discrepancies between the drawings and existing conditions are noted, the project manager shall be notified immediately for resolution.

B. As with every renovation project, the electrical work will include (and require) exploration and other field work on a daily basis to complete the new designed equipment and connections within the constraints of the existing building and existing site conditions.
C. The contractor shall include as part of the base bid, sufficient labor hours to provide such exploration and field work throughout the duration of the project. Change orders for misc. coordination of existing conditions will not be approved unless specific and latent conditions are uncovered that warrant such additional compensation or require additional work not shown on the plans or implied by the designed conditions.

D. New raceways and wiring to new and renovated equipment are to be installed unless otherwise noted. Where raceways are installed in accessible concealed locations (i.e. unfinished spaces or electrical / mechanical / attic spaces), EMT with wire shall be used. Where new wiring is required to be routed through existing walls and ceilings that can not easily be accessible for new conduit, MC cable or flex conduit and wiring may be installed, fished through and secured in each space as required by code. Non-metallic sheathed cable shall not be utilized on this project.

E. All new raceways shall be installed concealed and all new equipment installed flush, unless otherwise noted on the plans or in these specifications.

1.12 GUARANTEE

A. This Contractor shall guarantee that all work executed under this Section will be free from defects of materials and workmanship for a period of one (1) year or as per the General Conditions of this project, whichever is longer. Dates shall be from the date of final acceptance of the building. The contractor shall further guarantee that he will, at his own expense, repair and replace all such defective work, and all other work damaged thereby, which becomes defective during the term of the guarantee. Such repair or replacement shall be guaranteed for one (1) year from the date of repair or replacement.

1.13 PERMITS AND INSPECTIONS

A. This Contractor shall arrange for and obtain all required inspections.

B. Do not allow or cause any of the work to be covered or enclosed until it has been tested and/or inspected.

1.14 IDENTIFICATION

A. Switchboards, feeder circuit breakers in switchboards, panels, disconnect switches, motor starters, transformers, motor disconnect switches, cabinets, and other apparatus used for the operation of, or control of circuits, appliances or equipment, shall be properly identified by means of engraved laminated plastic descriptive nameplates mounted on apparatus using stainless steel screws. Nameplates shall have white letters with black background and be submitted to the Architect for approval. Cardholders in any form are not acceptable.

B. Provide p-touch style labeling of circuit designations for all receptacles on the project.
C. Each branch circuit of panel boards to have a permanently fixed number with load directory, mounted under celluloid on inside of cabinet door, showing circuit numbers and typewritten description of equipment supplied by breakers.

D. Provide label on all motors: "Caution. Automatic equipment. May start at any time."

E. Provide silk-screened or engraved identification labels on all switch box covers identifying specific loads that are not readily apparent to the user, including electroshades, projection screens, exhaust fans, etc. Submit proposed labels to Architect for approval prior to manufacture of labels.

F. Provide identification of all pull boxes, junction boxes, and conduit stub-ups on the project as outlined below:

1. For Power Feeders:
   a. Stencil cover with identifying circuit number.
   b. Lettering 1" high.
   c. Color of lettering black.
   d. Place lettering on cover in neat manner; run parallel to long sides of box.

2. For branch circuits, grounding, communication, signal, and control systems boxes and blank conduit stub-outs:
   a. Paint inside back of each j-box, front of each cover, and ends of each blank conduit stub-out with identifying system color as listed below:
      1) 277/480-volt Orange
      2) 120/208-volt Blue
      3) Ground system Green
      4) Fire Alarm Red
      5) Lighting control Orange/White

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to applicable Division 26, 27, and 28 Sections for complete products specifications.
2.2 MATERIALS

A. Materials of the same type or classification, used for the same purpose, shall be the product of the same manufacturer.

2.3 ACCEPTABLE MANUFACTURERS

A. Materials shall be of make mentioned elsewhere in this specification. All materials shall be the best of their several kinds, perfectly new and approved by the Underwriters' Laboratories.

B. Where material, equipment, apparatus or other products are specified by manufacturer, brand name, type or catalog number, such designation is to establish standards of desired quality, style and utility and shall be the basis of the bid. Materials so specified shall be furnished under the contract unless changed by written approval of the Architect. Where two or more designations are listed, choice shall be optional with this Contractor, but this Contractor must submit his choice for final approval.

2.4 POSTED OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment where indicated in the technical sections for use by operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions as directed. Attach or post operating instructions adjacent to each principal system and equipment including startup, proper adjustment, operating, lubrication, shutdown, safety precautions, procedure in the event of equipment failure, and other items of instruction as recommended by the manufacturer of each system or equipment. Provide weather-resistant materials or weatherproof enclosures for operating instruction exposed to the weather. Operating instruction shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

2.5 CATALOGED PRODUCTS/SERVICE AVAILABILITY

A. Materials and equipment shall be current products by manufacturers regularly engaged in the production of such products. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The 2-year period shall be satisfactorily completed by a product for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6,000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished. The equipment items shall be supported by service organizations which are reasonable convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions under which the work of this Section will be installed. Correct conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Drawings:

1. The general arrangement and location of wiring and equipment is shown on the electrical drawings and shall be installed in accordance therewith, except for minor changes required by conflict with the work of other trades.

2. The Contractor shall coordinate and verify all backbox, device, lighting fixture, or equipment mounting requirements with the devices or equipment to be installed, prior to rough in.

3. Drawings indicate the circuit and panel which supplies each device or fixture. Provide and install conduit and conductors to make all connections from panel to nearest device and from first device to additional devices on same circuit. Conduit size and fill shall satisfy NEC requirements. Two or three different phases supplied by a 3-phase panel may share a single neutral only if circuit positions are adjacent in the panel. Do not exceed 4 #12 or 3 #10 conductors in a ¾" conduit, 7 #12 or 5 #10 in a 3/4" conduit, and 11 #12 or 9 #10 in a 1" conduit, unless otherwise noted. Provide common handle-tie on breakers for multi-wire branch circuits (with common neutral), per NEC. If more than three current carrying conductors are installed in one conduit, conductor size shall be increased as required per NEC. Do not share neutrals for branch circuit runs to electronic equipment or where noted on the drawings.

4. Drawings indicate the location of all light switches. Where fixtures in a room are controlled by more than one switch, the same lower case letter is drawn adjacent to a switch and each fixture controlled by that switch. Where no lower case letter is adjacent to a switch, all fixtures in the room are controlled by that switch. Provide and install conduit and wire from fixture to switch and between fixtures as required to accomplish switching shown. Do not route branch circuit wiring for light fixtures through switch boxes.

5. Drawings indicate location of all signal outlet boxes. Provide and install conduit system as required and complete system wiring, unless otherwise noted.

6. Control wiring is generally not shown on the plans. Contractor shall refer to control diagrams and provide and install all wiring and raceways required to make all interconnections.
7. All branch circuit wiring No. 12 or No. 10 as noted, all control wiring No. 14, except as noted next to "slash marks" on drawings, or as noted under "Wire," as specified herein.

8. All dimensions, together with locations of doors, partitions, etc. are to be taken from the Architectural Drawings, verified at site by this Contractor.

9. Maintain "as-built" records at all times, showing the exact location of concealed conduits and feeders installed under this contract, and actual numbering of each circuit. Upon completion of work and before acceptance can be considered, this Contractor must forward to the Architect, updated CAD plans, corrected to show the electrical work as actually installed.

10. Branch circuit conductors shall be #12 minimum and #10 minimum for runs longer than 150 feet.

B. Measurements: Before ordering any material or closing in any work, verify all measurements on the job. Any differences found between dimensions on the drawings and actual measurements shall be brought to the Architect’s attention for consideration before proceeding.

3.3 FIELD QUALITY CONTROL

A. All workmanship shall be first class and carried out in a manner satisfactory to and approved by the Architect.

B. This Contractor shall personally, or through an authorized and competent representative, constantly supervise the work and so far as possible keep the same foreman and workmen on the job throughout.

3.4 COORDINATION

A. In electrical rooms, where electrical equipment is located at walls with brace framing, provide and install steel channel supports for mounting of electrical equipment away from wall to avoid conflict with brace framing. Steel channel supports shall be unistrut or equal, and shall include all channels, bases, fittings, etc., as required for a complete installation.

B. In electrical rooms, Contractor is responsible for installation of electrical equipment within the space provided. Contractor shall provide ¼" scale plans of electrical room layouts, and elevations of steel channel supports (where used or required) of electrical equipment for review and approval prior to any installation or rough-in

3.5 INSTALLATION/APPLICATION/ERECTION

A. All electrical raceways and devices shall be installed concealed (for raceways) and/or flush mounted (for devices), unless otherwise noted. Provide cut-in boxes and "fish" flexible MC or flex conduit and wire through existing walls to remain, unless shown
otherwise on plans. Cut and patch to facilitate such installation to match adjacent and original finish.

B. All cutting, repairing and structural reinforcing for the installation of this work shall be done by the General Contractor in conformance with the Architect’s requirements.

3.6 EMERGENCY POWER SOURCES

A. All emergency source circuits shall be installed in separate raceways (from normal power), per 2014 NEC 700.10(B), or the applicable code at the time of permitting.

3.7 TEMPORARY LIGHTING AND POWER

A. Provide and install temporary lighting and power systems for the duration of construction, of adequate size to accommodate the required lighting and power loads. Coordinate with other trades to insure adequate sizing.

B. Provide distribution equipment as required to support all construction activities.

3.8 FIRE STOPPING AND FIRE RATED PENETRATIONS

A. All electrical equipment mounted in, on, or through fire rated construction shall be installed to maintain the fire rating of the construction.

B. Provide fire rated pads (or other suitable assembly) around all electrical junction boxes in fire rated walls/ceilings/floors to maintain the fire rating.

C. Provide fire rated construction around all recessed light fixtures and/or panel board / cabinets mounted flush in fire rated walls to maintain the fire rating. Coordinate depth of construction with other trades to avoid conflicts.

D. Conduit sleeves shall be provided as a means of routing cables through fire-rated walls or floors. Openings in sleeves and conduits used for system cables and those which remain (empty) spare shall be sealed with an approved fireproof, removable sagging material. Sleeves which pass vertically from floor to floor shall be sealed in a similar manner using an approved re-enterable system. Additional penetrations through rated assemblies necessary for passage of tel/data wiring shall be made using an approved method and permanently sealed after installation of cables.

3.9 ADJUSTING AND CLEANING

A. All electrical equipment, including existing equipment not "finish painted" under other sections, shall be touched up where finished surface is marred or damaged.

B. All equipment, lighting fixtures, etc., shall be left in clean condition, with all shipping and otherwise unnecessary labels removed there from.
3.10 SCHEDULES
A.  Coordination: Coordinate installation of electrical items with the schedule for other work to prevent unnecessary delays in the total Work.

3.11 WARNING SIGN MOUNTING
A.  Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.12 PAINTING OF EQUIPMENT
A.  Factory Applied: Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.
B.  Field Applied: Paint electrical equipment as required to match finish or meet safety criteria. Painting shall be as specified in the respective equipment section.

3.13 TESTS
A.  Testing and inspection: See Section 26 08 00 - Testing.

END OF SECTION
SECTION 26 08 00
TESTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work Included in This Section: All materials, labor, equipment, services, and incidentals necessary to perform the testing and inspection of the electrical work, including but not limited to the general systems noted below:

1. Grounding System.
2. Lighting System.
3. Distribution System.
5. Lighting control system.
6. Title 24 Acceptance Testing

B. Any other electrical work as might reasonably be implied as required, even though not specifically mentioned herein or shown on the drawings.

C. All work shall comply with Sections 26 05 00 and 26 27 00.

D. In addition to the general system tests and inspections indicated above, the Contractor shall retain the services of a recognized corporately and financially independent testing firm (Emerson Network Power or equal) for the purpose of performing the following inspections and tests. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections:

1. System Grounding.

E. The purpose of these tests is to assure that all tested electrical equipment is operational and within industry and manufacturer’s tolerances and is installed in accordance with design specifications.

1.2 APPLICABLE CODES, STANDARDS, AND REFERENCES

A. All inspections and tests shall be in accordance with the International Electrical Testing Association - Acceptance Testing Specifications ATS-2013 (referred to herein as NETA ATS-2013).

1.3 QUALIFICATIONS

A. Qualifications of the Testing Firm shall be as listed in NETA ATS-2013.
PART 2 - PRODUCTS

2.1 THIS ARTICLE DOES NOT APPLY TO TESTING.

PART 3 - EXECUTION

3.1 GENERAL

A. Final test and inspection to be conducted in presence of the Authority having Jurisdiction (AHJ) or Inspector of Record (IOR). Test shall be conducted at the expense of, and managed by, the Contractor, at a mutually agreed time. Submit written test report of all tests, with test result values and overall outcome.

B. All portions of the electrical installation shall be inspected and tested to ensure safety to building occupants, operating personnel, conformity to code authorities and Contract Documents, and for proper system operation.

3.2 INSPECTIONS AND TESTS

A. Tests: Field tests shall be performed and reports submitted, as per Section 26 05 00, Part 1.

1. Final Inspection Certificates: Prior to final payment approval, deliver to the Owner, with a copy to the Architect, signed certificates of final inspection by the appropriate local authority having jurisdiction.

B. Grounding System:

1. All ground connections shall be checked and the entire system shall be checked for continuity. The resistance of grounding electrodes in the system shall be measured using a 3 point fall-of-potential method. The maximum ground resistance shall be three ohms. If the measured ground resistance exceeds three ohms, install an additional ground rod, bonded and interconnected with the grounding electrode system.

2. Ground tests shall meet or exceed the requirements of the National Electric Code.

C. Lighting Systems:

1. The interior and exterior lighting systems shall be checked for proper local controls and operation of entire installation, including the operation of the low voltage lighting control system.

D. Power Distribution System:

1. Test panel boards for grounds and shorts with mains disconnected from feeders, branch circuits connected and circuit breakers closed, all fixtures in
place and permanently connected and grounding jumper to neutral lifted and with all wall switches closed.

2. Check verification of color coding, tagging, numbering, and splice make-up.

3. Verify that all conductors associated with each circuit are in same conduit.

4. Demonstrate that all lights, jacks, switches, outlets, and equipment operate satisfactorily and as called for.

5. Test proper functioning of the ground fault protective system(s).

6. Perform megger tests of all distribution system feeders prior to energizing. All Cables failing megger tests or with evidence of damage shall be removed and replaced in their entirety (no splices), at no cost to the Owner. Damaged cables may not be field repaired without specific approval of the Architect.

E. Fire Alarm System: Verify that all equipment, components, and devices function as specified. Refer to Section 28 3101 for additional testing requirements.

F. Lighting Control System: Verify that all equipment, components, and devices function as specified. Refer to Section 26 5101 for additional testing requirements.

G. Title 24 Acceptance Testing: Contractor shall complete the requirements for Title 24 Acceptance Testing, as per CA Title 24, Part 6.

1. Perform testing requirements as per Title 24 Lighting Acceptance requirements. Testing shall include construction inspection of installed controls, occupancy / motion sensor testing, manual daylighting controls testing, automatic time switch controls testing, and demand response system interface, as applicable.

2. Complete and submit all required forms for complete Acceptance Testing.

3. Obtain required review and approval of Acceptance Forms to allow final certificate of occupancy to be granted.

END OF SECTION
SECTION 26 27 00

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work included in this Section: All materials, labor, equipment, services, and incidentals necessary to install the electrical work as shown on the drawings and as specified hereinafter, including but not limited to the work listed below:

1. Raceways, feeders, branch circuit wiring, wiring devices, safety switches and connections to all equipment requiring electric service.

B. Any other electrical work as might reasonably be implied as required, even though not specifically mentioned herein or shown on the drawings.

C. All work shall comply with Section 26 05 00.

1.2 RELATED WORK

A. Division 09 - Finishes

B. Division 23 - Motors and Mechanical Equipment Installation

1.3 SUBMITTALS

A. Comply with the provisions of Section 26 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Refer to Section 26 05 00, Basic Electrical Requirements, Part 2 - Products.

B. List of Equipment Manufacturers:

Conduit and Conduit Fittings


Wire and Cable (600V)
American Wire Company, General Wire and Cable Corporation, Okonite Company, Rome Cable Corporation, Cerrowire, American Insulated Wire, AFC Cable Systems, Essex, Simplex Wire and Cable Company, Southwire.

Solderless Lugs and Grounding Connections


Pull Boxes, Gutters, Special Cabinets


Outlet Boxes


Steel City Electric Company, Hubbell Inc, RCI, Walker.

Wiring Devices

Leviton, Arrow-Hart, Cooper, Hubbell, Lutron, Bryant.

Conduit Racks, Hangers


Safety Switches (Disconnect and Fusible)

Fuses

Bussman Manufacturing Company, Chase-Shawmut Company.

Firestopping

3M, Nelson.

2.2 MATERIALS

A. Raceways: Only the raceways specified below shall be utilized on this project. Substitutions shall be pre-approved in writing. All bare conduit ends (stub-ups or stub-outs) shall be provided with bushed ends or manufactured insulated throat connectors:

1. Rigid Type - hot dip galvanized or sherardized steel, use on all exterior locations, below grade or in concrete slab, and to 18" on either side of structural expansion joints in floor slabs, with completely watertight, threaded fittings throughout. Compression fittings are not acceptable.

   a. All rigid steel conduit couplings and elbows in soil or concrete or under membrane to be ½ lap wrapped with Scotch #50 tape and threaded ends coated with T&B #S.C.40 rust inhibitor prior to installation of couplings.

   b. ½ lap wrap all rigid steel conduit stub-ups from slab or grade to 6" above finished grade level with Scotch #50 tape.

2. Intermediate metal conduit may be used in all exposed interior locations, except that electrical metallic tubing may be used in some locations as noted below. Utilize steel compression type fittings for all exposed conduit runs, unless otherwise noted. Cast fittings are unacceptable.

3. Electrical metallic tubing shall be used exposed in interior electrical and mechanical rooms, in interior unfinished spaces, and in interior concealed and furred spaces, made up with steel watertight or steel set screw type fittings and couplings. EMT shall not be used in under-building crawl spaces or other areas subject to moisture. Set screws shall have hardened points. Cast fittings are unacceptable.

4. Use flexible conduit for all motor, transformer and recessed fixture connections, minimum ⅛"; "Seal tite" type used outdoors and in all wet locations, provide with code size (minimum No. 12) bare ground wire in all flexible conduit.
5. All conduit cuts (factory or field cut) shall be perfectly square to the length of the conduit and cut ends shall be reamed with a reaming tool to provide a smooth edge to the passing conductors and to remove all burs and scrapes. Use of a hand file is not acceptable.

6. All electrical raceways shall be installed concealed, unless otherwise noted. Cut and patch to facilitate such installation to match adjacent and original finish. All exposed conduits, where required, shall be installed parallel to building members.

7. All emergency source circuits shall be installed in separate raceways (from normal power), per 2014 NEC 700.10(B), or the applicable code at the time of permitting.

8. Where existing conditions preclude the installation of EMT in existing walls to remain, provide and install cut-in type boxes and "fish" flexible MC or flex conduit and wire through existing walls to remain, unless shown otherwise on plans.

9. Fasten conduits securely to boxes with locknuts and bushings to provide good electrical continuity.

10. Provide chrome escutcheon plates at all exposed wall, ceiling and floor conduit penetrations.

11. Support individual suspended conduits with heavy malleable strap or rod hangers; supports for ½ inch or 3/4 inch conduit placed on maximum 7-foot centers; maximum 10-foot centers on conduits 1 inch or larger.

12. Support multiple conduit runs from Kindorf B907 channels with C-105 and C-106 straps.

13. Conduit bends - long radius.

14. Flash conduits through roof, using approved roof jack; coordinate with General Contractor.

15. To facilitate pulling of feeder conductors, install junction boxes as shown or required.

16. All empty conduits on the project shall be provided with a nylon pull rope to allow pulling of future conductors intended for the specific raceway. Provide plastic wire-tie style nameplate tags on each end of pull rope with printed identification of conduit use and the location of the opposite end of the rope. Pull ropes for telephone and cable tv service conduits shall meet the respective utility company requirements.
17. Where conduits pass through structural expansion joints in floor slab, rigid galvanized conduit shall be used 18" on either side of joint, complete with Appleton expansion couplings and bonding jumpers, or equal. All above grade expansion joint crossings shall also utilize expansion joint couplings or flex conduit transitions as required for each particular installation. Installed condition shall allow for a minimum deflection of raceway and wire (in any direction) equal to the structural expansion joint dimension (building to building). No solid conduits shall be allowed to cross expansion joints without proper provisions for building and seismic movement.

18. Minimum cover of conduits in ground outside of building - 36 inches, unless otherwise noted.

19. Provide and install exterior wall conduit seals and cable seals in the locations listed below. Coordinate installation and scheduling with other trades:

   a. Conduit seals through exterior wall or slab (below grade): O.Z. Gedney series “FSK” in new cast in concrete locations, series ”CSM” in cored locations.

   b. Conduit seals through exterior wall or slab (above grade): O.Z. Gedney series ”CSMI.”

   c. Cable seals at first interior conduit termination after entry through exterior wall or slab: O.Z. Gedney series ”CSBI.” Coordinate quantity of conductors at each location.

B. Outlet Boxes and Junction Boxes. Verify all backbox requirements with devices to be installed prior to rough-in.

1. One piece steel knockout type drawn boxes, unless otherwise noted, sized as required for conditions at each outlet or as noted.

2. Flush-mounted boxes equipped with galvanized steel raised covers for device mounting flush with finished surface. Provide extension rings as required on all acoustical or additional wall treatment areas to bring top of cover flush with finished surface (coordinate with architectural drawings). Devices shall be capable of being tightly mounted to boxes without distorting or bending device or mounting hardware.

3. Boxes for fixture outlets: 4-inch octagon or larger as required, or as noted.

4. Switch and receptacle outlets - not smaller than 4-inch-square in furred walls, with raised cover for single device; ganged where required.

5. Outlet and switch boxes for wet locations, cast aluminum FS or FD type with cast aluminum gasketed spring lid cover. Weatherproof “Bell” type boxes are not acceptable.
6. All connectors from conduit to junction or outlet boxes shall have insulated throats. Connectors shall be manufactured with insulated throats as integral part. Insertable insulated throats are unacceptable.

7. Conduit Bodies: Malleable iron type, with lubricated spring steel clips over edge of conduit body, O-Z/Gedney type EW, or equal.

8. Pull boxes: All site pull boxes shall be flush in-ground concrete, with engraved covers identifying service use (i.e. electrical, communications, etc.). Boxes shall be Nema 250, Type 6, outside flanged, with recessed cover for flush mounting, by Christy or equal, with required depth to provide box and conduit depths shown or required.

   a. Provide concrete covers for all boxes in planted or paved areas (up to available concrete cover size).

   b. Provide galvanized steel covers for all larger boxes (when concrete is not available), or in traffic areas. No cast iron covers.

   c. Provide bolted covers and slab bottoms (with grouted perimeter) or vault type boxes for all electrical distribution and signal system pull boxes used for site distribution, to prevent rodent entry. No collar type boxes with dirt or gravel bottoms

   d. Provide drain hole at bottom of all vault type boxes, with loose aggregate base below, for proper drainage.

   e. All covers to be completely flush with finished adjacent surfaces.

   f. Provide galvanized steel H20 rated covers and installation of box rated for H20 in all traffic areas.

   g. Provide pullboxes per utility company specifications for all electrical primary and secondary services and for cable TV and telephone service runs. Verify exact size and type prior to order with each utility company.

C. Wire and Cable (line voltage and signal systems):

1. 600-volt class where used for or run with line voltage power wiring, insulation color coded, minimum No. 12 awg for power branch circuits, No. 14 for power control circuits, and wiring size and type as directed by signal system manufacturer for each signal system.

2. All conductors shall be copper.

3. Size and insulation type:
a. Standard locations: #12 to #1 AWG: THWN for wet locations and THHN for dry locations. #1/0 through #4/0 AWG: XHHW (55 Mils). 250MCM and larger: XHWH (65 Mils). All wire sizes used shall be based on a 75 degree insulation rating, unless specifically used with 90 degree rated breakers and devices.

b. All wiring (power and signal) installed underground between buildings, or in wet or damp locations, shall be outside listed and rated for wet locations.

c. High temperature and non-standard locations: Provide wire type and insulation category suitable for area of use as defined in NEC table 310-13.

4. Conductor No. 8 and larger and as otherwise noted on drawings shall be stranded. Conductor No. 10 and smaller shall be solid.

5. Install all wiring branch circuits and feeders (low voltage and line voltage) in conduit unless noted otherwise in the drawings. Contractor shall mandrel all feeders and pass a "sock" (or utilize other suitable means) through each raceway prior to pull to remove all water and construction debris. All raceways shall be completely clear of any obstructions or debris and all cut ends shall be reamed, prior to pull. Utilize pulling compound on all runs to insure minimum friction and pulling tension.

6. Megger test all feeders prior to energizing. See section 26 08 00 for additional information.

7. Approximately balance branch circuits about the neutral conductors in panels.

8. Connections to devices from "thru-feed" branch circuit conductors to be made with pigtails, with no interruption of the branch circuit conductors.

9. Neutral conductor identified by white outer braid, with different tracers of "EZ" numbering tags used where more than one neutral conductor is contained in a single raceway.

10. Neatly arrange and "marlin" wires in panels and distribution panelboards with "T and B Ty-rap" or approved equal plastic type strapping.

11. All wire and cable shall bear the Underwriters' Label, brought to the job in unbroken packages; wire color-coded as follows:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Phasing</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>120/208</td>
<td>3PH4W</td>
<td>Black</td>
<td>Red</td>
<td>Blue</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
12. The equipment grounding conductor shall be insulated copper; where it is insulated, the insulation shall be colored green.

13. Label each wire of each electrical system in each pull box, junction box, outlet box, terminal cabinet, and panelboard in which it appears with "EZ" numbering tags indicating the connected circuit numbers.

14. Properly identify the "high leg" of 4-wire delta connected systems (in each accessible location) as required by NEC 110.15 and 230-56.

15. Provide permanently affixed adhesive labels with machine printed lettering (min. 1/8" high) at junction boxes serving fixtures that are supplied by (2) electrical sources (i.e. normal and emergency lighting). Label to read "CAUTION - This light fixture is powered by (2) separate sources. The normal power source breaker and the emergency power source breaker must be turned off before servicing this light fixture."

16. Install feeder cables in one continuous section unless splices are approved by Architect. Exercise care in pulling to avoid damage or disarrangement of conductors, using approved grips. No cable shall be bent to smaller radius than the spool on which it was delivered from the manufacturer. Color code feeder cables at terminals. Provide identifying linen tags in each pullbox.

17. Metal-clad cable, (MC) may be used in lieu of conduit and wire at concealed locations for final branch runs to devices on same circuit only. MC cable may not be used for multi-circuit branch circuit homeruns or feeders. Provide conduit and wire homeruns and feeders.

   a. The conductors shall be soft drawn annealed copper, solid or stranded as stated above. Insulation shall be type THHN. Conductor shall be cabled with fillers, taped wrapped with overall seamless corrugated aluminum sheath.

   b. Cables shall be 3 or 4 conductor type with parity sized ground wire.

D. Switches: Model numbers are Hubbell, color to be selected by architect, unless otherwise noted. All switches to utilize screw terminals for wire connections - no plug-in terminations:

1. Single Pole - No. HBL1221
2. Two Pole - No. HBL1222
3. Three Way - No. HBL1223
4. Momentary contact - No. HBL1557
5. Momentary contact Keyed - No. HBL1556L
6. Keyed, - No. HBL1221L
7. Pilot Light (on with load on) - Hubbell No. 1221-PLC
8. Motor Rated Double Pole (30A) - Hubbell No. 7832
10. Low voltage Data line switches - Refer to lighting control system (for compatability)

E. Receptacles: Mounting straps and contacts shall be one piece design, constructed of minimum .050" solid brass. Base shall be high strength, heat resistant, glass reinforced nylon. Device shall accept up to #10 wire, side or back wired with screw terminals - no plug-in terminations. Hubbell, Leviton, Pass & Seymour, or equal. Color to be selected by architect, unless otherwise noted. Numbers listed below are Hubbell:

1. 15A 3PG 125 volt duplex - No. HBL5262
2. 20A 3PG 125 volt duplex - No. HBL5362
3. 20A 3PG 125 volt ground fault interrupter receptacle; GFI receptacles shall conform to the 2006 UL requirements to a) interrupt power to the unit in the event of internal failure, or b) provide an audible or visual indication of internal failure of the GFI; No. GF20 or equal. Through wiring to down stream GFI designated receptacles is not acceptable.
4. GFI Module (blank face), no indicator light, 20A – No. GFBF20 or equal.
5. All receptacles located in exterior or wet locations shall be corrosion resistant with UV stabilized body.

F. Plates: Leviton, or equal, except as noted:

1. For flush outlet boxes, for switches, and receptacles: stainless steel, color to be selected by architect, unless otherwise noted.
2. Plates for surface-mounted outlets: stainless steel unless otherwise noted.
3. Weatherproof duplex receptacle plates for exterior locations with ground fault interrupter receptacles in type FS or FD boxes – Hubbell #WPFS26 or compatible equal. Verify cover compatibility with box type and device installed.
4. Weatherproof "in-use" cover, vertical or horizontal mount, for exterior with GFCI receptacles. Die-cast metal alloy, TayMac MX series or equal with openings to match installed devices.
5. Locking plates for duplex receptacles where noted; Pass & Seymour #WP26-L (non weather proof).

6. Locking plates for duplex exterior GFCI receptacles (or in wet or damp locations); Heavy duty cast aluminum flush cover with locking latch and key, Pass & Seymour #4600 with appropriate mounting plate for type of device installed. Coordinate backbox requirements and finished wall trim-out with wall installer prior to rough-in to insure an adequate and neat trim appearance upon completion.

G. Equipment Disconnects: All disconnects shall be located to allow proper code required clearance in each area. Locations shown on drawings are diagrammatic only. The contractor shall coordinate exact locations in the field (with other trades) prior to rough-in to insure proper clearances.

1. Motor Disconnect Switches and Safety Switches: General Electric Company Heavy Duty Type "THD", cover interlocked with operating handle so that cover cannot be opened with switch in closed position and switch cannot be closed with cover in open position. 240V or 480V rating, single or multi-pole as required or as noted on drawings, in Nema 1 enclosure indoors or Nema 3R enclosure outdoors unless otherwise noted. Provide dual element motor circuit fuses sized as recommended by equipment manufacturer (for final equipment actually installed).

2. Code required disconnects: Provide a local disconnect in addition to the branch circuit protection device for all equipment as required by code (whether shown or not). Disconnects shall consist of a motor rated switch (or disconnect) for all motor loads less than 3/4HP or other suitable disconnect sized to match branch circuit conductors and load current of equipment, with number of poles as required.

H. Lugs and Connectors: Thomas and Betts "lock-tite", for No. 4 and larger wire; 3M "Scotchlok" fixed spring screw-on type wire connectors with insulator for No. 6 and smaller wire.

1. All splices shall be made up with screw-on type connectors - no plug-in or push-in style connectors acceptable. Wires shall be solidly twisted together with electricians pliers before screw-on connector is installed to ensure a proper connection in the event of wire nut failure. No exceptions.

2. Connectors listed or labeled for “no wire twisting required” are not an acceptable substitute for actual wire twisting.

3. Utilize porcelain type connectors in all high temperature environments (above 105 degrees Celsius).

I. Splice Insulation: "Scotch" electrical tape with vinyl plastic backing or rubber tape with protective friction tape for interior work.
1. Splices in electrical cables of 600 volt insulation class in underground system duct shall be made only in accessible locations such as pullboxes, light pole handholes, etc., using a compression connector on the conductor and by insulating and waterproofing (for exterior and underground locations) by one of the following methods:

   a. Cast type splice insulation shall be provided by means of a molded casting process employing a thermosetting epoxy resin insulating material which shall be applied by a gravity poured method or by a pressure injected method. The component materials of the resin insulation shall be in a packaged form ready for convenient mixing after removing from the package. Do not allow the cables to be removed until after the splicing material has completely set.

   b. Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be applied. When the mold is in place around the joined conductors, the resin mix shall be prepared and poured into the mold. Do not allow cables to be moved until after the splicing materials have completely set.

J. Identification: Refer to Section 26 05 00.

K. Firestopping: as manufactured by 3M Fire Protection Products or equal.

1. Fire-rated and smoke barrier construction: Maintain barrier and structural floor fire and smoke resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound vibration absorption, an at other construction gaps.

2. Systems or devices listed in the UL Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetration type, annular space requirements and fire rating involved in each separate instance, and that the system be symmetrical for wall penetrations. Systems or devices must be asbestos free.

PART 3 - EXECUTION

3.1 REFER TO BASIC ELECTRICAL REQUIREMENTS - SECTION 26 05 00 FOR WORK UNDER THIS SECTION.

3.2 TESTS

    A. Testing and Inspection: See Section 26 08 00 - Testing.

END OF SECTION
SECTION 26 51 01

LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Luminaires (i.e., lighting fixtures). Refer to the Luminaire Schedule, and provide a complete and working Building Lighting System. Catalog numbers in the Luminaire Schedule are basic luminaire types. Additional features, accessories and options herein specified, described, or scheduled are to be included for all luminaires provided.

B. Lamps. Provide all lamps for all luminaires of size and type as recommended by the luminaire manufacturer and as scheduled, or specified herein.

C. Provide lamps for all existing luminaires to remain (to be re-lamped).

D. Ballasts and power supplies, including standard and dimmed fluorescent, HID, and LED.

E. Lighting controls, including occupancy sensors. See Section 26 5700 for Low Voltage Lighting Control System.

F. Exit and Emergency Egress lighting where indicated and where required.

G. Supports for outlet boxes and luminaires, including seismic restraint slack wires for recessed luminaires in suspended ceilings per code and backing in walls as required to keep luminaires secure and level.

1.2 INCORPORATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

B. Section 26 05 00 and 26 27 00 apply to all work in this section.

C. Division 03: Concrete (Bases for pole-mounted luminaires as noted in Luminaire Schedule).

D. Division 09: Painting and Finishes (cutting of holes in finished surfaces for recessed luminaires).

1.3 RELATED WORK

A. Ceiling Access panels where required for access to equipment, outlets, transformers, etc., located above suspended ceilings, sheet rock or plaster ceilings. Coordinate with the Architect and other trades.
1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00 and 26 05 00.

B. The Contractor shall furnish (6) six sets of submittals for review by the project team unless otherwise noted in these specifications. The submittals shall include the following information:

1. Product Index: The following information shall be included in the product index.
   a. Luminaire Type. The index shall call out each luminaire type per the Luminaire Schedule in the Contract Documents.
   b. Manufacturer’s Catalog Number. Outstanding information required to make a complete catalog number shall be clearly identified in the index.
   c. Lamp Data. Provide the Manufacturer’s name and Catalog Number for each lamp including wattage, color temperature, and color rendering index.
   d. LED Data. Provide the Manufacturer’s name for each LED array including wattage, color temperature, lumen output, and color rendering index.
   e. Comments. The index shall include a column for comments. The comments column shall include extraneous information required for clarity.

2. Manufacturer’s literature for every luminaire listed on the Luminaire Schedule.
   a. Catalog Information:
      1) Luminaire Data Sheet: The manufacturer’s cut sheet shall include the following:
         (a) Photometrics: Candlepower distribution curve or table with horizontal readings at 0, 22.5, 45, and 90 degrees and vertical readings from 0 to 180 degrees in 5 degree increments in accordance with the Illuminating Engineering Society published test procedures.
         (b) Catalog Number Nomenclature
         (c) Coefficient of Utilization Tables
         (d) Luminaire Line Drawing
         (e) Ballast or power supply (each type)
3. Data sheets for electronic ballasts and power supplies. Indicate luminaire types on applicable ballast/power supply data sheets.

4. Data sheets for wallbox controls and other products specified in this section.

5. Shop Drawings:
   a. Provide shop drawings of suspension details for luminaires recessed in, mounted on, or suspended from hung ceilings. Details shall clearly illustrate proposed methods for supporting luminaires independent of the suspended ceiling system.
   b. Detailed shop drawings of all cove or box mounted luminaires containing the following information:
      1) Exact field measured length (clear inside dimension) of cove pocket or box.
      2) Exact luminaire length and arrangement of luminaires in cove or box.
   c. Detailed shop drawings of pendant mounted luminaires constructed with linear metal housings containing the following information.
      1) Support mechanism, including swivel canopies.
      2) Trim details.
      3) Closure piece details.
      4) Pattern configurations.
   d. Provide shop drawings for the following luminaire types:
      1) Indicate specific luminaire types that require shop drawings.

6. Samples:
   a. Provide samples of luminaire trim where "Finish as selected by Architect" is indicated on the Luminaire Schedule. Submit two finish samples, 75 mm x 75 mm (3" x 3") minimum, of all custom color, decorative metal, or anodized aluminum finishes. Samples must be approved in writing by the Architect prior to ordering.
   b. Submit sample of custom luminaires: complete and operational, equipped with 120V, 6 foot cord and 3 prong grounded plug. Luminaire shall be fabricated and finished as specified, full size, using specified materials & equipment. Submit one luminaire to Owner's representative for review prior to production.
c. Indicate specific luminaire types that require shop drawings.

7. Schedule of spare lamps.
   a. Provide a schedule indicating the type and quantity of spare lamps to be provided to the Client at project closeout.
   b. Refer to article 3.06 below for specific lamp information.
   c. Refer to Section 01 60 00 - Product Requirements.

C. For Any Luminaires Substituted For Those Specified:
   1. Refer to section 01 60 00 - Product Requirements, for all substitution procedures.
   2. Provide independent testing laboratories, Inc., or equal, photometric test report for each Luminaire type and lamp combination listed on the Luminaire Schedule. Test reports shall be based on Illuminating Engineering Society published test procedures and shall contain polar coordinate candlepower distribution curves in five lateral planes for luminaires with asymmetric distributions and luminaire luminance data for vertical angles above 45 degrees from nadir. Test results shall indicate luminaire efficiency for the lamp and aperture assembly specified. Luminaires with efficiencies more than 2% below the values of specified luminaires are not acceptable and will be rejected.
   3. Prior approval does not guarantee final approval by the electrical engineer. The contractor shall be completely responsible for providing luminaires that meet or exceed the quality/performance of the specified products in their entirety. All deviations in quality/performance of the specified products must be listed and individually signed off by the engineer.
   4. The Owner reserves the right to reject a proposed substitution based on his agent’s professional judgment as to the utility, visual appropriateness, or finish of substitutions.

1.5 OCCUPANCY SENSORS

A. Equipment Qualification
   1. Wall switch products must be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.
   2. Contractor's work to include all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein.
3. Contractor/Supplier shall examine all general specification provisions and drawings for related electrical work required as work under Division 26.

4. Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to wiring, conduit, luminaires, HVAC systems and building management systems.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site and store in unopened cartons in protected location. Inspect products immediately and report all damage accordingly.

1.7 GUARANTEE AND WARRANTIES

A. All work performed under this section must be guaranteed to be free of defects in products or workmanship for one year after date of acceptance by Owner, unless noted otherwise in General Conditions.

B. Warranties:

1. Electronic ballasts and power supplies must be warranted against failure for at least five years after date of substantial completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide luminaires as indicated in Luminaire Schedule; if conflict exists between Luminaire Schedule and Specifications, the more stringent requirement shall take precedence.

B. Provide luminaires new and complete with mounting accessories, junction boxes, trims, and lamps.

C. Provide products with UL labels appropriate to intended installation conditions, or with labels from other testing laboratories whose results are acceptable to local inspector, showing compliance with UL standards. Labels must be concealed from normal viewing angles.

D. All products of same type by same manufacturer.

2.2 SOLID STATE LUMINAIRES

A. Housing, where applicable:

1. Steel bonderized or equal rust protected, or aluminum, rigid construction. Minimum gauge thickness shall be as follows:

a. Interior locations: No. 20-gauge steel, No. 16-gauge aluminum.
B. Finish:

C. Baked enamel finish (except when otherwise specified).
   1. Concealed interior surfaces (this applies to interior hardware, circuit boards, etc.) matte black.
   2. Concealed exterior surfaces: matte black.
   3. Visible surfaces: color and texture as specified below for each luminaire type or as selected.
   4. Exterior luminaire finish: refer to "Exterior Luminaire Finishes".

D. Light Emitting Diode (LED) requirements:
   1. Correlated color temperature (CCT) for phosphor-coated white LEDs must have one of the following designated CCT’s and fall within the following binning standards.
      a. 2700K defined as 2725 +/- 145K
      b. 3000K defined as 3045 +/- 175K
      c. 3500K defined as 3465 +/- 245K
      d. 4000K defined as 3985 +/- 275K
      e. 4500K defined as 4503 +/- 243K
      f. 5000K defined as 5028 +/- 283K
      g. 5700K defined as 5665 +/- 355K
      h. 6500K defined as 6530 +/- 510K
   2. Color spatial uniformity shall be limited to variations in chromaticity for different directions (i.e. changes in viewing angle) within 0.004 from the weighted average point on the CIE 1976 (u’,v’) diagram.
   3. Color maintenance shall be limited to a maximum change in chromaticity of 0.007 on the CIE 1976 (u’,v’) diagram over the lifetime of the product.
      a. Color rendering indexColor rendering index to be determined using ANSI C78.377-2008 and applicable IESNA standards.
      b. Laboratory tests must be produced using specific module(s)/array(s) and power supply combination that will be used in production.
c. Manufacturers must provide a test report from a laboratory accredited by NVLAP or one of its MRA signatories

4. Lumen depreciation
   a. Lumen depreciation to be measured using IESNA LM-80-08 standard for IES approved method of measuring lumen maintenance of LED light sources.
   b. Phosphor coated white LED module(s)/array(s) shall deliver at least 70% of initial lumens for a minimum of 35,000 hours when installed in-situ and operated at 100% output and the maximum specified operating temperature.
   c. Colored LED module(s)/array(s) shall deliver at least 50% of initial lumens for a minimum of 35,000 hours when installed in-situ and operated at 100% output and the maximum specified operating temperature.

5. Acceptable LED manufacturers:
   a. Cree
   b. Nichia
   c. Osram Opto Semiconductors
   d. Philips Lumileds
   e. Soraa
   f. Xicato

E. Luminaire Efficacy:
   1. Luminaire efficiency shall be measured using IESNA LM-79-08 standard for electrical and photometric measurements of solid state lighting products.
   2. Manufacturer shall provide published luminaire efficacy, which is defined as luminaire light output divided by luminaire input power measured in a 25 degree Celsius environment. Efficacy shall include power supply, thermal, optical, and luminaire losses.

F. Thermal Management:
   1. Solid state luminaire shall not exceed LED manufacturer’s maximum junction temperature requirements when operated in-situ at luminaire manufacturer’s maximum ambient operating temperature and 100% light output.
2. Solid state luminaires shall be thermally protected using one of more of the following thermal management techniques:
   a. Metal core board
   b. Gap pad
   c. Internal monitoring firmware

3. Solid state luminaire housing shall be designed to transfer heat from the LED board to the outside environment.

G. Power Supplies/Drivers:

1. Power supply shall have a power factor of 0.90 or greater for primary application

2. Power supply input current shall have Total Harmonic Distortion (THD) of less than 20%.

3. Power supply shall have a minimum operating temperature of minus 20 degrees Celsius or below when used in luminaires intended for outdoor applications.

4. Power supply output operating frequency to be equal to or greater than 120 Hz.

5. Power supply shall operate with sustained input variations of +/- 10% (voltage and frequency) with no damage to the driver.

6. Power supply shall tolerate sustained open circuit and short circuit output conditions without damage and without need for external fuses or trip devices.

7. Power supply output shall be regulated to +/- 5% across published load range.

8. Power supply shall have a Class A sound rating.

9. Power supply outputs shall have current limiting protection.

10. Power supply shall operate LEDs at constant and regulated current levels. LEDs shall not be overdriven beyond the diode manufacturer’s specified nominal voltage and current.

H. Warranty

1. Luminaires, drivers, and controllers for solid state lighting systems shall be covered by a five-year warranty against defects in workmanship or material. Warranty shall include in-warranty service program providing for payment of authorized labor charges incurred in replacement of inoperative in-warranty equipment.
2.3 LUMINAIRE CONSTRUCTION

A. Sheet metal: materials and thicknesses shall be 20 gauge (0.7 mm or 0.027\") min., free of dents, scratches, oil-can, or other defects.

B. Painted luminaires: exposed weld marks, joints, and seams shall be filled and sanded smooth before finishing.

C. All edges cleaned and dressed to remove sharp edges or burrs.

D. Extrusions: 1/10" min. wall thickness, smooth and free of tooling lines, with cast end plates that exactly match extrusion profiles.

E. Castings: smooth, free of pits, scales, gate marks, or blemishes.

F. Spinnings shall have 1/32" min. thickness, smooth, free of spinning lines or blow-back, with clean edges.

G. Welds: Follow recommendations of American Welding Society. All welds continuous and free of spatter, residue, or warping.

H. No light leaks visible in finished room. Ensure that downlight housings mounted in wood slat ceilings are not visible from below. Field paint exterior of housing with high temperature paint if necessary.

I. Exposed end plates and joiners, with concealed fasteners.

J. End-to-end mounted luminaires: Verify row configurations and provide joiners, aligning splines, and trims to suit.

K. Hardware:
   1. Steel or aluminum interior luminaires: cadmium-plated hardware.
   2. Steel or aluminum exterior luminaires: stainless steel hardware.
   4. Copper alloy luminaires: brass hardware.

L. Raceways: Where used for through wiring, luminaires must be approved for use as raceways.

2.4 RECESSED LUMINAIRE

A. Point-source luminaires: provide pre-wired junction box and thermal protection, and provide slack wires to structure at two diagonal corners.

B. Troffer luminaires: provide hold-down clip at each luminaire corner, and slack wires to structure as detailed on the drawings. The detail will take precedence.
2.5 TRIMS

A. Trims must fit tightly and be held in by gravity, spring clips, or mechanical fasteners. Trims must not drop out under normal conditions or seismic forces which do not exceed the design criteria of the building.

B. Aluminum parabolic cones shall be smooth, properly shaped, with Alzak finish in colors as indicated.
   1. No hot spots or lamp images visible at angles shallower than lamp shielding angle.
   2. Self-flange cones must bend parallel to ceiling and cover ceiling hole without additional trim ring. Unpainted flange, shall have the same finish as cone interior.
   3. Cones and louvers for fluorescent luminaires must have permanent anti-iridescence treatment.

C. Lenses, diffusers, and patterned glass: glass or virgin acrylic as noted, with patterns as noted.
   1. Finished thickness 2 mm (1/10") min. unless noted otherwise.
   2. Linear runs over 1200 mm (4'-0") long shall be in equal-length pieces.
   3. Lenses for tungsten halogen luminaires shall be tempered borosilicate glass.
   4. Lamp enclosures for metal halide lamps shall be glass or acrylic and must be capable of retaining lamp fragments in the event of non-passive lamp failure.
   5. Glass UV filters for individual accent luminaires, where indicated, shall be 3 mm (1/8") borosilicate glass filters with dichroic coating, 2% max. light transmission @ 400nm, 80% min. transmission @ >425nm, Bausch & Lomb "Optivex" or equal by Balzers.
   6. Acceptable Manufacturers:
b. Glass lenses and patterned glass: Balzers, Bausch & Lomb, Gray.

2.6 FINISHES

A. Steel Reflectors: Unless otherwise specified, the reflector surface finish shall be of synthetic white enamel or polyester powder coating. Finish shall show no indication of chipping, cracking, flaking or any other sign of loss of adhesion. The initial reflection factor shall be not less than 88 percent averaging 5 randomly selected points on the reflector. After 100 hours of exposure to the radiation of a glass enclosed carbon arc lamp, such as a Fade-O-Meters, the reflectance of the exposed portion shall not be less than 5 percent and finish shall show no appreciable color change. The carbon arc lamp shall be operated at appreciable color change. The carbon arc lamp shall be operated at 13 plus or minus 0.5 amperes at 140 volts. The reflector shall be placed ten inches from the arc and the lamp so ventilated that the temperature of the exposed portion does not exceed 105 degrees F.

B. Aluminum Reflectors: Reflecting surfaces shall be provided with either a specular or diffuse finish as indicated. Reflection factors shall be not less than 83 percent for specular reflecting surfaces. Each reflecting surface shall be protected by dense coating of oxide weighing not less than 5.0 milligrams per square inch, applied by an anodic process. The reflector shall be given a sealing treatment that will prevent staining of the reflecting surface when subjected to a stain test. All aluminum reflectors & louvers shall be a low iridescent equivalent to that provided by Coil Anodizers.

C. Non-Reflecting Surfaces: Unless otherwise specified, the finish on all non-reflecting exterior surfaces shall be aluminum oxide or aluminum; white, gray or aluminum paint on steel; nickel or chromium plating on copper alloy. Fastening devices shall be nickel, chromium, cadmium or zinc plated. All painted surfaces shall be free of tears, star marks, blisters, pinholes, chipping and any other defects that may impair appearance or serviceability.

2.7 LAMPS

A. Unless otherwise noted, lamps described in the Luminaire Schedule and in these Specifications shall be manufactured by General Electric, Osram/Sylvania, North American Philips, Venture, or approved equal.

B. Each type of lamp by only one manufacturer to maintain color consistency.

C. Relamp luminaires or replace LED boards and drivers at no cost to owner if lamps exhibit excessive lamp to lamp color variation or burn out within 90 days of substantial completion date.

D. Incandescent:

1. All incandescent lamps and tungsten-halogen lamps shall be extended life or 2,000 hour life whenever such designs are available. Par lamps: no diodes.
E. Fluorescent:

1. Long fluorescent lamps shall either be 265ma full wattage, T8; 3500 deg. K color temperature; min. CRI 82; 2ft., 3ft. & 4ft. lamps or, 170ma full wattage for standard output T5 lamps, and 460ma full wattage for high output T5 lamps, 3500 deg. K color temperature; min. CRI 85; 3ft, and 4ft lamps only. Provide TCLP compliant reduced mercury content lamps whenever such lamps are available.

2. Compact fluorescent lamps shall be 3500 deg. K color temperature, min. CRI 82, twin-tube or quad tube as noted or as required for each luminaire. Provide TCLP compliant reduced mercury content lamps whenever such lamps are available.

3. Long compact fluorescent (Biax) lamps shall be 3500 deg. K color temperature, min. CRI 82, twin tube, single ended 4-pin. Provide TCLP compliant reduced mercury content lamps whenever such lamps are available.

4. “Burn-in” all fluorescent lamps on dimmed circuits for at least 100hrs. prior to dimming.

F. LED:

1. LED quantity and wattage as specified for each LED luminaire.

2. 3500 deg. K color temperature, unless otherwise noted.

2.8 LAMPHOLDERS

A. Incandescent and HID shall be porcelain, size to accommodate specified lamps.

B. Fluorescent lampholders shall have plastic bodies with copper contacts. For horizontally-mounted lamps over 8” long, provide additional plastic clip to support glass end of lamp.

1. Provide rapid start lampholders in luminaires for all dimmed linear fluorescent lamps.

2.9 BALLASTS DRIVERS AND TRANSFORMERS

A. General:

1. Verify input voltages and match to branch circuit voltages.

2. Provide ballasts with best-made sound ratings for each type and mount securely to prevent vibration.

   a. Replace excessively noisy ballasts or transformers at no cost to Owner.
3. Remote ballasts or transformers: Provide suitable enclosures and mounting hardware, and install in accessible, ventilated locations.
   
a. Secondary wiring: provide number and size of conductors as required, with 3% max. voltage drop between transformer and last lamp.
   
b. Keep ballasts or transformers at least 300 mm (12") apart and do not stack vertically.
   
4. Ballasts must contain no PCB’s and be labeled accordingly.

B. Fluorescent Ballasts:

1. Ballasts must meet applicable energy-conservation standards.
   
2. Intwiring (for electronic ballasts):
   
a. In linear luminaires or continuous rows of individual luminaires, provide tandem wiring to operate each row of lamps independently. Provide three-lamp and four-lamp ballasts where possible, two-lamp ballasts only where needed to finish a row.
   
b. In individual one-lamp luminaire, provide two-lamp ballasts and master-slave interwiring between pairs of luminaires where possible.
   
c. In individual two-lamp luminaires, provide two-lamp ballasts and interwiring between pairs of luminaires to operate one lamp in each luminaire on each ballast.
   
d. In individual three-lamp or four-lamp luminaires, provide two-lamp ballasts and interwiring between pairs of luminaires to operate all outer lamps independently of all inner lamps.
   
e. In master/slave three-lamp or four-lamp luminaires, provide one two-lamp ballast and one four-lamp ballast and master-slave interwiring between pairs of luminaires with and interwiring between pairs of luminaires to operate all outer lamps independently of all inner lamps.

3. Electronic ballasts for long fluorescent lamps 97% min. power factor, “A” sound-rated, with UL Class P thermal protection, 85% min. ballast factor with specified types and numbers of lamps. Ballasts must operate specified lamps within lamp manufacturer’s specifications and have no effect on rated lamp life when run more than 10 hours per start.
   
a. Programmed Start operation, with starting voltage and filament current in compliance with ANSI C78-1.
   
b. Parallel-wired.
c. Provide interwiring and number of lamps per ballast as described under “Interwiring” above. Follow manufacturer’s recommendations for maximum whip length.

d. Light variation 10% max. with +/- 10% input voltage variation.

e. Electromagnetic radiation must not exceed FCC Part 18 regulations.


g. End of life protection to guard against lamp delamination.

h. Harmonic distortion: Total harmonic distortion (ratio of total harmonic RMS current to fundamental RMS current) must be less than 20% or as required to meet local utility requirements, whichever is lower.

4. Preheat ballasts for short compact fluorescent lamps shall be electronic where noted, with 95% min. power factor; HPF ballast where electronic type are not specified and where HPF will fit luminaire.

5. Acceptable Manufacturers:


   b. Short compact fluorescent: Advance, Robertson, Universal

6. LED Drivers:

   a. High power factor, thermally-protected.

   b. Compatible with LED lamps being used.

   c. Capable of dimming LED source without perceptible flicker or stroboscopic effects.


2.10 EMERGENCY LIGHTING AND EXIT SIGNS

A. Emergency lighting:

   1. Provide lighting for paths of egress as required by code.

B. Description of Systems:

   1. Auxiliary battery pack/ballasts mounted integral to luminaires shall be Bodine B50 or approved equal. Provide no less than 1400 lumen output for lamps on emergency ballast for a minimum of 90 minutes.
C. Auxiliary Battery Pack/Ballasts for Fluorescent or LED Luminaires:

1. Pure lead or nickel-cadmium, sealed and maintenance-free.

2. Automatic transfer to battery power if supply voltage drops below 75% of normal.

3. Must provide at least 87-1/2% or rated battery voltage for 90 minutes minimum.

4. Internal circuitry to provide continuous “trickle” charge and to prevent deep discharge below 80% of rated battery voltage.

5. Full recharge within 24 hours after restoration of normal power.

6. Charge indicator light visible and test switch operable without tools.

7. Concealed inside luminaire or above ceiling, but replaceable through luminaire aperture.

8. Designed to run one or two lamps per luminaire with minimum of 1400 lumen output.


D. Exit signs shall be back lit LED, surface-mounted on ceiling or wall, with integral battery packs as described above.

1. Fabricated aluminum construction, no light leaks around canopy. Plain box, with no decorative trim.

2. Letters shall be 20mm (3/4") stroke, 150 mm (6") high, with concealed knockouts for left or right arrows, brightness and evenness of illumination per code, green color.

   a. Battery pack contained in basic luminaire housing. No add-on packs or canopies.

   b. Green LED lamps located at interior perimeter for indirect illumination of stencil letters.

   c. Provide finish as specified in the Luminaire Schedule.

   d. Knock out the arrows as indicated on the plans.

2.11 OCCUPANCY SENSORS

A. General
1. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.

2. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180° coverage capability.

3. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor’s longevity.

4. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.

5. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.

6. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.

7. Passive infrared sensors shall utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion.

8. Passive infrared sensors shall utilize mixed signal ASIC which provides high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line), superior performance, and greater reliability.

9. Passive infrared sensors shall have a multiple segmented Lodif Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.

10. Where specified, passive infrared and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

11. Dual technology sensors shall be corner mounted to avoid detection outside the controlled area when doors are left open.

12. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.

13. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.

14. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within ± 0.005% tolerance, 32 kHz within ± 0.002% tolerance, or 40 kHz ± 0.002%
tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.

15. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.

16. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.

17. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

18. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

19. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

20. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

21. All sensors shall have UL rated, 94V-0 plastic enclosures.

B. Circuit Control Hardware - CU

1. Control Units - For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to a minimum of two (2) sensors.

2. Relay Contacts shall have ratings of:
   a. 13A - 120 VAC Tungsten
   b. 20A - 120 VAC Ballast
   c. 20A - 277 VAC Ballast
3. Control wiring between sensors and controls units shall be Class II, 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFON jacketed cable suitable for use in plenums, where applicable.

4. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.

C. Acceptable Manufacturers

1. The Watt Stopper, or Pre-Approved Equal: For pre-approval, provide all the information listed under “submittals” a minimum of ten (10) working days prior to initial bid date.

2. The listing of any manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the electrical contractor to ensure that any price quotations received and submittals made are for sensors that meet or exceed the specifications included herein.

3. Products

a. All products shall be Watt Stopper product numbers:


2) Wall sensors: WI-200, WS-120/277, WA-100, WD-170, WD-180, WD-270, WD-280


PART 3 - EXECUTION

3.1 PREPARATION

A. Architectural Reflected Ceiling Plans shall govern exact location and mounting conditions for all luminaires. Subcontractor shall be responsible for coordination of luminaire mounting and compatibility with ceiling construction and other trades.

B. Coordinate work with other trades. Location of lighting has priority over location of new framing (except major structural members), ducts, diffusers, sprinklers, speakers, smoke detectors, and other obstructions.

C. If obstructions are encountered which prevent installation of luminaires according to drawings, notify Architect immediately and do not proceed until conflict has been resolved.
D. Coordinate the location of luminaires in mechanical or unfinished spaces. Locations shown on Drawings may be adjusted by the Contractor to suit conditions. Install luminaires to avoid obstructions and maximize light output, 2100 mm (7'-0'') min. mounting height.

E. Coordinate the location of any exposed conduit used to feed luminaires with the Architect prior to installation.

3.2 INSTALLATION

A. General:

1. Subcontractor shall be responsible for handling and installation of luminaires including all supports, hangers and hardware necessary for a complete installation. Luminaires shall be clean, plumb, level in straight lines, without distortion. Luminaires must be installed so they do not shift during relamping or adjustment. Remedy any light leaks which may develop after installation of recessed or enclosed luminaires.

2. Install luminaires at locations and heights as indicated, in accordance with luminaire manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that luminaires fulfill requirements.

3. Point-source luminaires shall be located as dimensioned, or in center of tile or on tile joint as drawn; 6 mm (1/4'') max. off-center tolerance.

4. Linear luminaires shall have 3 mm (1/8'') max. horizontal or vertical alignment variation in any 5 m (16-ft.) portion of run.

5. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486 A and B, and the National Electrical Code.

6. Clean luminaires of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses.

7. Remove and replace luminaires that may have been damaged during construction at no additional cost to the Owner.

8. Protect installed luminaires from damage during remainder of construction period.

9. Provide equipment grounding connections for luminaires as indicated. Tighten connections to comply with tightening torques specified in UL 486 A to assure permanent and effective grounds.
10. Install luminaires, lamps, lenses, etc., after building is enclosed, weather tight and environmental conditions are nominally the same as expected for the complete spaces. All lamps, glassware, reflectors and refractors shall be clean and free of chips, cracks and scratches.

11. Lamps installed for use as temporary lighting prior to approval shall be replaced with new lamps. Replace all burn outs with specified lamp prior to project closeout.

12. All wall mounted luminaires and all ceiling mounted surface luminaires including exit lights shall be fed through a luminaire Stud/Hickey/Nipple assembly and with provisions to prevent luminaire turning.

13. Installation of exit signs shall be coordinated with other trades to ensure signs are visible as intended.

14. All junction box cover plates for the lighting branch circuit system shall be clearly marked with a permanent ink felt pen identifying the branch circuit and control relay (panel number, circuit number, lighting control cabinet designation and control relay number) contained in the box.

15. Provide permanently affixed adhesive labels with machine printed lettering (min. 1/8" high) at junction boxes serving luminaires that are supplied by (2) electrical sources (i.e. normal and emergency lighting). Label to read "CAUTION - This luminaire is powered by (2) separate sources. The normal power source breaker and the emergency power source breaker must be turned off before servicing this luminaire."

B. Recessed Luminaires:

1. The contractor shall be responsible to verify the fire rating of the ceiling system within which the luminaires are to be mounted. Where luminaires are installed in fire rated ceilings (and as required by code), provide fire rated enclosures around and over luminaires to maintain ceiling fire rating. No additional cost shall be allowed for failure to include such enclosures and installation in the bid.

2. Holes for Recessed Point-Source Luminaires: Cut holes to follow luminaire housings exactly so no gaps will be visible after trims are installed.

3. Install bottom of housing aligned with finished ceiling.

4. Keep ceiling insulation at least 75 mm (3") away from luminaires.

5. A-lamp downlights shall be installed with adjustable lampholders at proper heights for specified lamps.

6. Install trims after painting of spaces. Install trims tightly, with no gaps or light leaks.
7. Seismic restraints: Provide and install slack wires and hold-down clips per code.

8. Lamp Orientation:
   a. In situations where luminaires with horizontal lamps are aligned with each other, orient the lamps such that the axis of the lamps are in the same direction.

C. Ceiling-Mounted:
   1. Provide support for outlet boxes and suspension points so luminaires can be installed securely, including seismic supports per code.
      a. Luminaire weight less than 25 kg (50 lb.) at each suspension point: hang from strap or stud on outlet box, or at non-feed points, provide 1/4"-20 stud projecting 20 mm (3/4") below ceiling.
      b. Luminaire weight 25 kg (50 lb.) or more at each suspension point: hang directly from structure, either independent of outlet box or from stud extending through outlet box to structure.

D. Wall-Mounted Luminaires:
   1. Mounting heights shown on Drawings are measured from finished floor to centerline of outlet box or recessed housing, unless otherwise noted.
   2. Verify luminaire weights and provide backing in wall as required. Luminaires must not droop or tilt away from wall.
   3. Wet locations: install sealant between luminaire and outlet box.
   4. In circulation areas, wall-mounted luminaires must not project more than 100 mm (4") from wall if mounted above 685 mm (27") and below 2030 mm (80").

E. Re-Lamping Existing Luminaires:
   1. Provide new lamps for all existing luminaires to remain.
   2. Field verify exact lamp type, color temperature, wattage, and style, to provide proper replacements for each lamp in existing luminaires to remain.
   3. Clean all existing lenses to remain.

3.3 LIGHTING CONTROLS

A. Lighting controls to include occupancy sensors in most spaces (for local control) and relay system lighting control for larger common spaces.

B. Occupancy sensors shall initially be set as follows:
1. Maximum sensitivity.

2. Time delay for 15 minutes


4. Automatic off operation.

5. Aim all adjustable sensors to properly cover room areas.

C. Timeclock System shall initially be set to control the low voltage relays as per the Relay Panel Schedule LCP.

1. Assign all interior relays to an automatic off sweep, with flick warn (except those noted as "NL"). Off time shall be set to an owner determined time in the evening, after dark or normal business operations.

2. Assign all interior relays noted as "NL" to be on 24 hours per day. No automatic relay operation.

3. Assign "after hours" and "Weekend / Holiday" hours to match normal business calendar and times.

4. All interior relays shall be allowed to be overridden by use of the local dataline switches for a maximum of 2 hours (per Title 24) when used after hours or on Weekends / Holidays. If used during these times, automatic shut-off shall re-activate at the end of the 2-hour period.

5. All interior relays shall be allowed to be overridden by use of the local dataline switches when used during normal business hours. Standard timeclock operation shall resume with the next scheduled timeclock function for each relay.

6. Assign all exterior relays for automatic on operation with the astro-dial feature, set to 30 minutes before sunset. Latitude = 37.5 degrees North / Longitude = 122 degrees West.

7. Assign exterior relays noted as "astro-on, astro-off" for automatic off operation with the astro-dial feature, set to 30 minutes after sunrise. Latitude and Longitude as noted above.

8. Assign exterior relays noted as "astro-on, timeclock-off" for automatic off operation with the normal timeclock feature, set to an owner determined time in the late evening.

9. Assign exterior relays noted as "NL" or "On All Night" for astro-dial operation, for automatic on 30 minutes before sunset and automatic off 30 minutes after sunrise.
3.4 DELIVERY, STORAGE, & HANDLING:

A. Deliver luminaires in factory-fabricated containers or wrappings, which properly protect luminaires from damage. Inspect luminaires immediately upon delivery to ensure correct shipment without damage.

B. Store luminaires in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat and blocked off ground.

C. Handle luminaires carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new. Protection wrapping on louvered (parabolic) luminaires shall not be removed until luminaires are ready for operation.

3.5 SEQUENCING AND SCHEDULING:

A. General:

1. Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of luminaires with other work.

2. Sequence lighting installation with other work to minimize possibility of damage and soiling during remainder of construction.

B. Install controls so that all operable parts are at 48 inches (1220 mm) maximum height.

3.6 PROJECT CLOSEOUT

A. Clean luminaires and remove plaster and paint spatters.

B. Clean fingerprints and dust from downlight reflectors. Refer to manufacturer’s instructions.

C. Verify that luminaires and controls are working at time of final acceptance by Owner.

1. Relamp as required.

D. Test emergency lighting system for 90 minutes in presence of Owner’s representative, check each luminaire for proper operation at end of 90-minute test, then recharge for 24 hours and briefly test each luminaire again for proper operation.

E. Install and aim adjustable lighting as directed by Architect.

1. Provide personnel, lifts, ladders, and walkie-talkies as required.

2. Aiming will occur at night, outside of normal working hours, at times as approved by the Architect.
F. **Spare Lamps:**

1. Provide the following spare lamps to the Client for their use after project closeout. Deliver to the jobsite and store lamps as directed by the Client in a clean, dry, and protected environment.
   
a. **All lamp types:**
   
   1) Provide 5% of the total quantity of each individual lamp type on the project.
   
   2) Provide an additional 5% of the total quantity of each T5 type lamp on the project.

G. Prepare two copies of a Lighting Systems Maintenance Manual consisting of the following in a hardcover binder. Deliver to Architect. After review, Architect will deliver one copy to Owner.

1. One complete set of approved submittals, including product data and shop drawings.

2. List of lamps used in Project, cross-referenced to luminaire types, with specific manufacturer's names and ordering codes.

3. Relamping instructions for lamps that require special precautions (tungsten halogen, metal halide, etc.).

4. Luminaire cleaning instructions, including chemicals to be used or avoided.

5. Instructions for code-required testing and maintenance of emergency lighting system.

6. Identification of lighting products that contain hazardous materials or that require special disposal techniques (large quantities of fluorescent lamps, etc.)

**END OF SECTION**
SECTION 26 57 00
LOW VOLTAGE LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

A. Furnish all labor, materials, apparatus, tools, equipment transportation, temporary construction and commissioning services as indicated on the Drawings or described in these Specifications and as required to make a complete working facility lighting control system.

B. Integrated Low Voltage Lighting Control System:
   1. The low voltage lighting control system shall consist of relay panels and low voltage momentary switches.
   2. The system shall accept program changes from a integral time-clock for date and time, location, event scheduling, and group programming.

C. Install a lighting control system consisting of relay/contactor panel(s), low voltage switches, analog occupancy sensors and photocells. The devices are connected by low voltage cable. The general operation of lighting and controlled loads shall include:
   1. Interior lighting: Manual switch and occupancy sensor control on/off with automatic time scheduled shut off.
   2. Scheduled on/off loads: Time on, time off by automatic time schedule with after hour override capability and shutoff.
   3. Exterior lighting: Astronomic on/time off, time on/Astronomic off.

D. Requirements are indicated in Section 26 27 00 for raceways and electrical boxes and fittings required for installation of control equipment and wiring.

E. Provide CBC 2013 compliant seismic installation. See Section 26 05 00 for all certification and submittal requirements.

1.2 INCORPORATED DOCUMENTS

A. Sections 26 05 00, 26 27 00, 26 51 01 and 26 56 01, apply to all Work in this Section.

B. Refer to Section 26 51 01 for fluorescent dimming ballasts.

C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer Qualifications: Installer shall be one who is experienced in performing the Work of this Section, and who has specialized in installation of Work similar to that required for this project.

C. Component Pre-testing: All components and assemblies are to be factory pre-tested prior to installation.

D. System Support: Factory applications engineers shall be available for telephone support.

E. NEC Compliance: Comply with NEC as applicable to electrical wiring Work.

F. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

G. UL Approvals: Remote panels are to be UL listed under UL 916 Energy Management Equipment.

H. CSA Approvals: Remote panels are to be CSA listed.

I. FCC Emissions: All assemblies are to be in compliance with FCC emissions Standards specified in Part 15 Subpart J for Class A application.

J. All System components shall be California Title 24 compliant, where applicable.

1.4 SUBMITTALS

A. Submit under provisions of Sections 01 33 00 and 26 05 00.

1. Bill of Materials: Complete list of all parts needed to fully install selected System components.

2. Shop Drawings: Submit dimensional Drawings of all lighting control system components and accessories.

3. One Line Diagram: Submit a one-line diagram of the system configuration.

4. Typical Wiring Diagrams: Submit typical wiring diagrams for all components including, but not limited to, relay panels, relays, low voltage switches, analog occupancy sensors and photocell controls.
1.5 MANUFACTURERS

A. Low Voltage Lighting Control System:

1. The basis of the specified system is the Watt Stopper LP8 or LP24. Any other system to be considered must submit descriptive information 10 days prior to bid.

B. Prior approval does not guarantee final approval by the electrical engineer. The contractor shall be completely responsible for providing a system meeting this specification in its entirety. All deviations from this specification must be listed and individually signed off by the engineer.

C. The Owner reserves the right to reject a proposed substitution based on his agent’s professional judgment as to the utility, visual appropriateness, or finish of substitutions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials in Manufacturer’s original, unopened, undamaged packages with intact identification labels.

B. Storage and Protection: Store materials away from exposure to harmful weather conditions and at temperature and humidity conditions recommended by Manufacturer.

1.7 GUARANTEE AND WARRANTIES

A. All Work performed under this Section must be guaranteed to be free of defects in products or workmanship for one year after date of acceptance by Owner, unless noted otherwise in General Conditions.

PART 2 – PRODUCTS

2.1 WATT STOPPER LP8 / LP24 LIGHTING CONTROL RELAY PANEL

A. Description

1. Lighting Control Panels shall be UL listed and consist of the following:

2. Enclosure Tub: NEMA 1, NEMA 3R, or NEMA 4 as indicated on the drawings, sized to accept an interior with 1-8 relays and (12) four pole contactors.

3. Cover: Surface or Flush as required, hinged and lockable and with restricted access to line voltage section. A final typed wiring schedule directory card shall be affixed to the cover’s back.

4. Interior: Barrier included for separation of high voltage (class 1) and low voltage (class 2) wiring. The interior shall include intelligence boards, power supply,
mechanically latched control relays and multi-pole contactors. The interiors will include the following features:

a. Screwless, removable, plug-in connections for all low voltage terminations.

b. Each relay shall be capable of individual ON/OFF control by a low voltage

c. switch and/or occupancy sensor input.

d. The system shall monitor true relay status; the relay status will be displayed at the onboard pilot LED and monitored by the system electronics.

e. Stagger the On and OFF sequence of the relays.

f. Heavy Duty Relays – Mechanically latching contacts with single moving part design for improved reliability. Relays to have the following characteristics:

1) 30 amp NEMA 410 electronic ballast rated and 20 amp tungsten, rated for 50,000 ON/OFF cycles at full load. Support #12-#14 AWG solid or stranded wire and rated for 120 and 277 volts; 20 amp NEMA 410 electronic ballast rated and 20 amp tungsten 347 volts.

2) 30 VAC isolated contacts for status feedback and pilot light indication.

3) 14,000 amp short circuit current rating.

g. Contactors shall be DIN rail mounted, four pole standard, normally open or normally closed, electrically held with 120 or 277 volt coil voltage to match panel control power voltage. Contactors shall be compatible with all lighting, ballast and HID loads and be rated for 277 volt 20 amp tungsten and 600 volt 30 amp ballast loads.


2.2 GROUP, CHANNEL, SCHEDULE AND PATTERN CONTROL

A. Description

1. The lighting control panel shall support schedule, group, and photocell control.

2. Group Status: Each group pushbutton shall include an LED status indication. The LED will be ON whenever all of the relays within the group are ON; and shall go OFF when all of the relays within the group go OFF.
a. Features

1) Individual relays may be assigned to more than one channel, and the channel status will be annunciated appropriately.

2) Each channel shall also have an input for connecting switch or dry contacts for controlling a channel. Inputs shall accept 2 or 3-wire maintained or momentary inputs, and groups may be controlled by: an on-board group pushbutton switch, low voltage switch, photocell, or time of day.

3) Screwless, removable, plug-in terminals will be provided for all low voltage wiring connections.

2.3 NETWORK CLOCK

A. Description

1. Integral system clock shall provide scheduling capabilities for stand alone individual panels.

2. The clock capability of each panel shall support the time-based energy saving requirements of applicable local energy codes.

3. The clock capability of each panel shall employ non-volatile memory and shall retain user programming and time for a minimum of 10 years.

4. Schedules programmed into the clock shall be capable of executing local panel schedules or Dark/Light (photocell or Astro) events.

5. The clock capability shall operate on a basis of ON/OFF or Normal Hours/After Hours messages to automation groups that implement pre-configured control scenarios. Scenarios shall include:

   a. Scheduled ON / OFF

   b. Manual ON / Scheduled OFF

   c. Astro ON / OFF (or Photo ON / OFF)

   d. Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF)

B. Features

1. Runs event-based schedule routines independently (does not require BAS or Segment Manager).

2. Supports astronomical, time-based event types
2.4 LOW VOLTAGE DEVICES

A. Eight universal switch inputs; compatible with 3-wire momentary or maintained, 2-wire momentary or maintained, or 24 VDC input device.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Description

1. The relay panels shall be mounted in electrical closets as indicated on the Drawings. The numbered relays in the panel shall be wired to control the power to each load as indicated on the Panel Wiring Schedules included in the Drawings. All power wiring shall be identified with the circuit breaker number controlling the load. If multiple circuit breaker panels are feeding into a relay panel, wires shall clearly indicate the originating panel’s designation.

3.2 PROGRAMMING

A. Set / program lighting controls per relay schedules on drawings, with input from owner for exact times required for each operation.

B. All programming shall comply with Title 24 requirements (i.e. automatic control and override limits).

C. For relays controlling halogen and metal halide lamps, a minimum 15 minute off period is required per day to mitigate potential for non-passive end of life failure. Review programming schedules and program this off-cycle for relays otherwise scheduled for continuous operation. Coordinate timing of off-cycle with Owner.

D. Test all programming for proper operation of each relay at scheduled times.

3.3 SYSTEM STARTUP AND TRAINING

A. Electrical Contractor is responsible for commissioning of the system, and to confirm proper installation and operation of all system components. If necessary, the Electrical Contractor is responsible for providing a factory authorized technician to preform the system commissioning as well as to provide the necessary End User Training.

B. Contractor shall provide system documentation after the equipment has been installed:

1. Lighting control operational summary sheet.

2. Programming record sheet.

3. System Installation and Operation Manual shall be provided to the owner.
3.4 TESTS

A. Test under provisions of Section 26 05 00 and 26 08 00.

B. The Owner shall be notified at least three working days in advance of the Contractor's proposed date of the tests to permit scheduling, and to permit witnessing of the tests. The Contractor shall furnish the Owner with three copies of the results of the tests.

C. Circuits: The Contractor shall test each circuit, all controllers, and components of the system for proper operation. The Contractor shall furnish the Owner with three copies of the test results.

D. Operating Test: Contractor shall operate the system in the presence of the Owner proving the proper operation of the system and all components.

END OF SECTION
SECTION 28 31 01
FIRE ALARM SYSTEM

GENERAL

1.1 DESCRIPTION:

A. This project shall include the furnishing, installation, connection, programming, commissioning, and testing of minimal expansion of an existing conventional, manual fire alarm system.

B. Alarms/troubles at each building shall activate the local notification devices (or report troubles) at the respective building panel only and report the alarms/troubles to the Main FACP, but shall not activate other building notification devices.

1.2 SCOPE:

A. This specification outlines the requirements for a conventional system. The system and components shall be supplied by one manufacturer of established reputation and experience who shall have produced similar apparatus for a period of at least five (5) years and who shall be able to refer to similar installations in public buildings rendering satisfactory service.

B. The work described in this specification consists of all labor, materials, equipment and services necessary and required to complete and test the manual fire alarm system. Any material not specifically mentioned in this specification or not shown on drawings but required for proper performance and operation shall be furnished, installed, and connected complete.

C. The work shall include all required programming to allow network operation between each control panel, for central monitoring from the Main FACP.

1.3 REQUIREMENTS:

A. This installation shall be made in accordance with the drawings, specification and the following:

1. National Electrical Code Article 760
2. NFPA Standard 72
3. Local Codes and Authorities Having Jurisdiction
4. ADA requirements and regulations.

1.4 RELATED WORK:

A. Division 26: Basic materials and methods
B. Division 21: Fire protection systems
C. Division 23: HVAC systems

1.5 FIRE DETECTION SYSTEM DESCRIPTION:

A. Provide notification and other devices as per specifications and indicated on drawings.
B. Indicate alarms, supervisory, and trouble signals on the main fire alarm control panel.
C. Transmit alarm signals to off-site reporting agency via a digital communicator at each building panel, with specific building address ID.
D. The fire alarm system shall function as follows when any workflow switch or manual station initiating device operates:
   1. Operate required audible/visual and visual devices as shown on the Drawings.
   2. Automatically notify off-site reporting agency.
   3. Indicate at the control panel alphanumeric display the number and location of the alarmed device.
   4. Light an indicating lamp on the smoke detector initiating the alarm.
   5. Light an indicating lamp on the remote annunciator indicating the location alarmed as well as the type of device alarmed (area smoke detector, duct detector, manual pull station, workflow switch, ansul system panel, valve supervisory switch, etc.).
E. Provide additional system features and capacities as indicated in Part 2 of this Section of the Specifications.

1.6 GUARANTY:

A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance.

1.7 SUBMITTALS:

A. Submit fire alarm shop drawings and product data sheets in accordance with Division 01 and Section 26 05 00.
B. This Contractor shall submit the completed Fire Alarm Shop Drawings, with associated equipment cut sheets and CSFM listings, to the local Fire Department and submit for a separate Fire Alarm System Permit as required by the local authority. Final Fire Alarm System approval (by the AHJ) and Permit shall be based on the shop drawings.
submitted and completed by the Contractor. The design drawings are for overall system requirements and layout only.

C. Shop Drawings shall indicate the following: building floor plan, location and type of devices, conduit and wire quantities, power requirements, complete wiring point-to-point diagrams, details, and locations of fire alarm and remote annunciator panels. Submittal shall include a system 1-line riser diagram with all devices and equipment and interconnections shown.

D. Submit manufacturer's installation instructions including back-box requirements for each piece of equipment.

E. Submit manufacturer's operating instructions and maintenance data.

F. Submit voltage drop and battery calculations.

1.8 APPLICABLE PUBLICATIONS:

The publications listed below form a part of this specification.

A. National Fire Protection Association (NFPA) - USA:

No. 70- National Electrical Code (NEC)

No. 72 - National Fire Alarm Code

No. 101 Life Safety Code

B. Underwriters Laboratories Inc. (UL) - USA:

No. 464 Audible Signaling Appliances

No. 1971 Visual Signaling Appliances

No. 38 Manually Actuated Signaling Boxes

No. 346 Waterflow Indicators for Fire Protective Signaling Systems

C. Local and State Building Codes.

D. All requirements of the Authority Having Jurisdiction (AHJ).

1.9 APPROVALS:

A. The control panel and all peripherals shall have proper listing and/or approval from Underwriters Laboratory (UL) and be California State Fire Marshall listed and approved.
PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL:

A. All equipment and components shall be new, and the manufacturer's current model.

B. The system shall be UL 864 (9th Edition) listed.

C. Acceptable System Manufacturers: ADT, Gentex to match existing.

D. The system design is based on the products listed on the Fire Alarm Equipment List and has been approved by DSA as such. Deviations from the approved design (for manufacturer or device layouts) may be allowed with approval by the engineer, however, it shall be the Contractors responsibility to redesign and resubmit the plans to DSA for re-approval.

E. All equipment and components shall be installed in strict compliance with manufacturers' recommendations.

F. All Equipment shall be attached to and ceiling/floor assemblies and shall be held firmly in place. (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2 CONDUIT, BOXES, AND WIRE:

A. All conduit and wire shall comply with section 26 27 00 of these specifications.

B. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.

2. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.

3. Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760-29.

4. Conduit shall be 3/4 inch minimum.

C. Wire:

1. All fire alarm system wiring shall be new and installed in conduit.

2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760). Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 16 AWG for initiating device circuits and signaling line circuits, and 12 AWG for Notification device circuits.
D. Terminal Boxes, Junction Boxes and Cabinets:

1. All boxes and cabinets shall be UL listed for their use and purpose.

2.3 INITIATION DEVICES:

A. Manual Stations, (conventional) shall be single action and semi-flush or surface mounted as indicated on the drawings.

1. The manual station shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring.

2.4 BATTERIES

A. Batteries shall be 12 volt, sealed Gell-Cell type, with combined Amp-Hour ratings as required by code.

B. Battery shall have a minimum sufficient capacity to power the fire alarm system for not less than twenty-four hours in standby mode, plus 5 minutes of full system alarm upon a normal AC power failure.

C. The batteries are to be completely maintenance free, no liquids required. Fluid level checks, refilling, spills and leakage shall not be required.

2.5 NOTIFICATION DEVICES:

A. Horn/Strobe combinations shall be provided as indicated on drawings. The horn / strobe combination shall be Wheelock or equal, ADA and UL 1971 compliant (candela values as required) - White finish.

B. Strobe Lights shall be provided as indicated on drawings. The strobe lights shall be wall mounted at +80" AFF or 6" below the ceiling level, whichever is lower, Wheelock or equal, ADA and UL 1971 compliant (candela values as required) - White finish.

C. Refer to Part 3 below for required synchronization of strobes when located in the same field of view.

EXECUTION

3.1 INSTALLATION:

A. Installation shall be performed by current factory-authorized contractor of the specified system.

B. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

C. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed.
prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

D. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

E. Provide identification labeling on all devices to identify loop and device number/address. Labeling shall consist of min. 3/8" black lettering on white background P-Touch style adhesive labels with machine printing, Helvetica font or similar.

F. At the final inspection a factory trained representative of the manufacturer of the major equipment shall perform the tests in Section 3.2 TESTS.

G. WIRING:

1. All circuits shall be in conduit, minimum 3/4".

2. Notification circuits shall be 12 AWG minimum for strobes, but not to exceed manufacturers wire capacity for modules. Control power circuits shall be 14 AWG minimum or as required.

3. When (3) or more visual notification devices are located within the same field of view and are less than 55 feet apart (within the field of view), all devices within that field of view shall be synchronized to provide the same flash rate and frequency. Provide all required sync modules and compatible strobe devices to provide a synchronized output.

3.2 TESTING:

A. Provide the service of a competent, factory trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Each building shall be separately tested as completed and the entire networked system tested just prior to project completion. Include contractor pre-test for each building prior to the final AHJ testing to insure a suitable final test result.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

2. Close each sprinkler system flow valve and verify proper supervisory alarm at the respective FACP and/or annunciator.

3. Verify activation of all flow switches.

4. Open initiating device circuits and verify that the trouble signal actuates at the respective FACP and/or annunciator.
5. Open and short all notification appliance circuits and verify that trouble signals actuate at the respective FACP and/or annunciator.

6. Ground circuits and verify response of trouble signals at the respective FACP and/or annunciator.

7. Check presence and audibility of tone at all alarm notification devices.

8. Check installation, supervision, and operation.

9. Verify that each initiating device alarm is properly received and processed by the respective FACP and annunciator (Walk Test).

10. Conduct tests from each FACP to verify trouble indications for common mode failures, such as alternating current power failure.

B. Test reports shall include, but not be limited to:

1. A complete list of equipment installed indicating proper operations as listed above.

3.3 FINAL INSPECTION:

A. Final acceptance will require the contractor to deliver to the Owner the following;

1. Three (3) copies of the operating instructions and system maintenance manuals.

2. Three (3) set of record drawings.

3. Three (3) copies of the final test reports.

4. Three (3) copies indicating the name and phone number of person to contact in the event of equipment failure, and date when system warranty will be terminate.

5. Three (3) sets of data sheets for each piece of equipment supplied.

B. The fire alarm system subcontractor or manufacturer shall offer for the owners consideration at the time of system submittal a priced inspection, maintenance, testing and repair contract in full compliance with the requirements of NFPA 72.

1. The services offered under this contract shall be performed at no charge during the first year after system acceptance and the owner shall have the option of renewing for single or multiple years, up to five years, at the price quoted in bid.
2. The contractor performing the contract services shall be qualified and listed to maintain ongoing certification of the completed system to the UL for specific installed system listing.

3.4 WARRANTY

A. The fire detection system shall be warranted for a period of one year from date of acceptance. The warranty shall cover parts, labor, and travel to and from the site.

3.5 INSTRUCTION:

A. Provide complete instruction manuals and training to the building personnel. "Hands-on" demonstrations of the operation of all system components and the entire system shall be provided.

END OF SECTION
Contra Cost County Community College District
Diablo Valley College
PAC RESTROOMS

DSA
Fire Alarm Cut Sheets

NOTE: All CSFM listing sheets were compiled with the latest available versions from the OSFM as of September 14, 2016.
LISTING No.  7150-0075:0148

CATEGORY:  7150 -- FIRE ALARM PULL BOXES

LISTEE:  FIRE-LITE ALARMS INC. One Fire-Lite Place, Northford, CT 06410-1653
Contact: Vladimir Kireyev (203) 484-7161 Fax (203) 484-7309
Email: vladimir.kireyev@Honeywell.com

DESIGN:  Models BG-8 and BG-8SP manual pull stations. Refer to listee's data sheet for additional
detailed product description and operational considerations.

INSTALLATION:  In accordance with listee's printed installation instructions, applicable codes and ordinances
and in a manner acceptable to the authority having jurisdiction.

MARKING:  Listee's name, product designation, electrical rating and UL label.

APPROVAL:  Listed as manual pull stations for use with separately listed electrically and functionally
compatible fire alarm control units.

* These manual pull boxes meet the requirements of UL Standard 38, 1999 Edition and
California amendments.

XLF:  7150-0028:0003

*Updated 09-08-2009 fm

This listing is based upon technical data submitted by the applicant. CSFM Fire Engineering staff has reviewed
the test results and/or other data but does not make an independent verification of any claims. This listing is not
an endorsement or recommendation of the item listed. This listing should not be used to verify correct
operational requirements or installation criteria. Refer to listee's data sheet, installation instructions and/or other

Date Issued:  July 01, 2016

Authorized By:  DAVID CASTILLO, Program Coordinator

Fire Engineering Division

Listing Expires  June 30, 2017
BG-12 Series
Manual Fire Alarm Pull Stations

General
The Fire-Lite BG-12 Series is a cost-effective, feature-packed series of non-coded manual fire alarm pull stations. It was designed to meet multiple applications with the installer and end-user in mind. The BG-12 Series features a variety of models including single- and dual-action versions. The BG-12 Series provides Fire-Lite Alarm Control Panels (FACPs), as well as other manufacturers' controls, with a manual alarm initiating input signal. Its innovative design, durable construction, and multiple mounting options make the BG-12 Series simple to install, maintain, and operate.

Features
- Aesthetically pleasing, highly visible design and color.
- Attractive contoured shape and light textured finish.
- Meets ADA 5 lb. maximum pull-force.
- Meets UL 38, Standard for Manually Actuated Signaling Boxes.
- Easily operated (single- or dual-action), yet designed to prevent false alarms when bumped, shaken, or jarred.
- PUSH IN/PULL DOWN handle latches in the down position to clearly indicate the station has been operated.
- The word "ACTIVATED" appears on top of the handle in bright yellow, further indicating operation of the station.
- Operation handle features white arrows showing basic operation direction for non-English-speaking persons.
- Braille text included on finger-hold area of operation handle and across top of handle.
- Multiple hex- and key-lock models available.
- U.S. patented hex-lock needs only a quarter-turn to lock/unlock.
- Station can be opened for inspection and maintenance without initiating an alarm.
- Product ID label viewable by simply opening the cover; label is made of a durable long-life material.
- The words "NORMAL" and "ACTIVATED" are molded into the plastic adjacent to the alarm switch (located inside).
- Four-position terminal strip molded into backplate.
- Terminal strip includes Phillips combination-head captive 8/32 screws for easy connection to Initiating Device Circuit (IDC).
- Terminal screws backed-out at factory and shipped ready to accept field wiring (up to 12 AWG/3.1 mm²).
- Terminal numbers are molded into the backplate, eliminating the need for labels.
- Switch contacts are normally open.
- Can be surface-mounted (with SB-10 or SB-I/O) or semi-flush mounted. Semi-flush mount to a standard single-gang, double-gang, or 4" (10.16 cm) square electrical box.
- Backplate is large enough to overlap a single-gang backbox cutout by 1/2" (1.27 cm).
- Optional trim ring (BG12TR).
- Spanish versions (FUEGO) available (BG-12LSP BG-12LPSP).
- Designed to replace the Fire-Lite legacy BG-10 Series.
- Models packaged in attractive, clear plastic (PVC), clam-shell-style, Point-of-Purchase packages. Packaging includes a cutaway dust/paint cover in shape of pull station.

Construction
- Cover, backplate and operation handle are all molded of durable polycarbonate material.
- Cover features white lettering and trim.

Operation
The BG-12 manual pull stations provide a textured finger-hold area that includes Braille text. In addition to PUSH IN and PULL DOWN text, there are arrows indicating how to operate the station, provided for non-English-speaking people. Pushing in and then pulling down on the handle activates the normally-open alarm switch. Once latched in the down position, the word "ACTIVATED" appears at the top in bright yellow, with a portion of the handle protruding at the bottom as a visible flag. Resetting the station is simple: insert the key, twist one quarter-turn, then open the station's front cover, causing the spring-loaded operation handle to return to its original position. The alarm switch can then be reset to its normal (non-alarm) position manually (by hand) or by closing the station's front cover, which automatically resets the switch.
## Specifications

**PHYSICAL SPECIFICATIONS:**

<table>
<thead>
<tr>
<th></th>
<th>pull station</th>
<th>SB-I/O</th>
<th>SB-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>5.5 inches (13.97 cm)</td>
<td>5.601 inches (14.23 cm)</td>
<td>5.5 inches (13.97 cm)</td>
</tr>
<tr>
<td>Width</td>
<td>4.121 inches (10.47 cm)</td>
<td>4.222 inches (10.72 cm)</td>
<td>4.121 inches (10.47 cm)</td>
</tr>
<tr>
<td>Depth</td>
<td>1.39 inches (3.53 cm)</td>
<td>1.439 inches (3.66 cm)</td>
<td>1.375 inches (3.49 cm)</td>
</tr>
</tbody>
</table>

**ELECTRICAL SPECIFICATIONS:**

*Switch contact ratings:* gold-plated; rating 0.25 A @ 30 VAC or VDC.

**ENGINEERING/ARCHITECTURAL SPECIFICATIONS**

Manual Fire Alarm Stations shall be non-code, with a key- or hex-operated reset lock in order that they may be tested, and so designed that after actual Emergency Operation, they cannot be restored to normal except by use of a key or hex. An operated station shall automatically condition itself so as to be visually detected as activated. Manual stations shall be constructed of red colored LEXAN (or polycarbonate equivalent) with clearly visible operating instructions provided on the cover. The word **FIRE** shall appear on the front of the stations in white letters, 1.00 inches (2.54 cm) or larger. Stations shall be suitable for surface mounting on matching backbox SB-10 or SB-I/O; or semi-flush mounting on a standard single-gang, double-gang, or 4" (10.16 cm) square electrical box, and shall be installed within the limits defined by the Americans with Disabilities Act (ADA) or per national/local requirements. Manual Stations shall be Underwriters Laboratories listed.

**NOTE:** The words "FIRE/FUEGO" on the BG-12LSP shall appear on the front of the station in white letters, approximately 3/4" (1.905 cm) high.

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## Agency Listings and Approvals

The listings and approvals below apply to the BG-12 Series pull stations. In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- UL/CSA: S711
- FM Approved
- CSFM: 7150-0075:184
- MEA: 67-02-E

## Product Line Information

**BG-12S:** Single-action pull station with pigtail connections, hex lock.

**BG-12SL:** Same as BG-12 with key lock.

**BG-12:** Dual-action pull station with SPST N/O switch, screw terminal connections, **hex lock.**

**BG-12L:** Same as BG-12 with key lock.

**BG-12LSP:** Same as BG-12L with English/Spanish (FIRE/FUEGO) labeling.

**BG-12LOB:** Same as BG-12L with "outdoor use" listing. Includes outdoor listed backbox, and sealing gasket.

**BG-12LO:** Same as BG-12L with "outdoor use" listing. Does not include backbox.

**BG-12LA:** Same as BG-12L with auxiliary contacts.

**BG-12LPS:** Dual-action pull station with pre-signal option.

**BG-12LPS:** Same as BG-12LPS with English/Spanish (FIRE/FUEGO) labeling.

**SB-10:** Surface-mount backbox, metal.

**SB-I/O:** Surface-mount backbox, plastic. (Included with BG-12LOB.)

**BG12TR:** Optional trim ring for semi-flush mounting.

**17003:** Keys, set of two. (Included with key-lock pull stations.)

**17007:** Hex lock, 9/64". (Included with hex-lock pull stations.)

**NOTE:** For addressable BG-12LX models, see data sheet DF-52013.

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LISTING No.  7300-0785:0132
CATEGORY:  7300 – FIRE ALARM CONTROL UNIT ACCESSORIES/MISC. DEVICES

LISTEE:  Cooper Wheelock Inc. 7246 16th St. E., Ste. 105, Sarasota, FL 34243
        Contact: Tom Conover (941) 487-2336
        Email: thomas.conover@cooperindustries.com

DESIGN:  Models SM-12/24, SMX-12/24, DSM-12/24 and DSMX-12/24 Synchronized Control Modules.
         Models SM-12/24 and DSM-12/24 may be followed by -R, -W, -X or -S. Refer to listee's data
         sheet for additional detailed product description and operational considerations.

RATING:  8-33 VDC*

INSTALLATION:  In accordance with listee's printed installation instructions, applicable codes & ordinances
               and in a manner acceptable to the authority having jurisdiction.

MARKING:  Listee's name, model number, electrical rating and UL label.

APPROVAL:  Listed as signaling appliances accessory for use with separately listed synchronized strobe
            lights. For indoor use only.

*Rev. 05-26-10 bh

This listing is based upon technical data submitted by the applicant. CSFM Fire Engineering staff has reviewed
the test results and/or other data but does not make an independent verification of any claims. This listing is not
an endorsement or recommendation of the item listed. This listing should not be used to verify correct
operational requirements or installation criteria. Refer to listee's data sheet, installation instructions and/or other

Date Issued:  July 01, 2016  Listing Expires  June 30, 2017

Authorized By:  DAVID CASTILLO, Program Coordinator
                Fire Engineering Division
Description
The Wheelock Series DSM Sync Modules are utilized with the Series Exceder, Series AS/AH, Series RSS, Series RSSP, Series SLM and selected strobe applications with other Wheelock combination appliances.

When used with Series AS Audible Strobes and/or Series Exceder Horn Strobes, the DSM Sync Modules provide independent operation of synchronized temporal pattern (code 3) horn and synchronized strobe flash, as well as the ability to silence the horn while maintaining the strobe flash, while using only a single pair of wires. The DSM-12/24 Sync Modules control either a Class A or two (2) Class B NAC circuits.

Features
- Approvals include: UL Standard 1971, ULC, New York City (MEA), California State Fire Marshal (CSFM) and Chicago (BFP)
- Uniquely designed to accept an independent strobe and audible input from the FACP and convert to a single output that connects to Wheelock’s Series AS or Series NS family of audible strobes
- Series DSM Sync Modules can also be used to synchronize Wheelock’s Series Exceder, RSS, RSSP and SLM Sync Strobes
  - 3 ampere per circuit current handling at 12 or 24 VDC
  - Low operating current draw
  - Compatible with all standard fire alarm control panels
  - Meets the NFPA-72 requirement for Temporal Pattern when used with the Series AS/AH and/or Series Exceder
  - 3 year warranty
Table 1: Sync Module (DSM) Current Requirements (AMPS)

<table>
<thead>
<tr>
<th>UL Voltage</th>
<th>ULC Voltage</th>
<th>Rated Average Current</th>
<th>Rated Peak Current</th>
<th>Rated Inrush Current</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>In1/ln2 Audible</td>
<td>In1/ln2 Audible</td>
<td>In1/ln2 Audible</td>
</tr>
<tr>
<td>8.0 VDC</td>
<td>10.5 VDC</td>
<td>0.019 0.004</td>
<td>0.055 0.004</td>
<td>0.150 0.016</td>
</tr>
<tr>
<td>12.0 VDC</td>
<td>12.0 VDC</td>
<td>0.020 0.004</td>
<td>0.064 0.004</td>
<td>0.170 0.019</td>
</tr>
<tr>
<td>24.0 VDC</td>
<td>24.0 VDC</td>
<td>0.035 0.008</td>
<td>0.080 0.008</td>
<td>0.342 0.030</td>
</tr>
<tr>
<td>33.0 VDC</td>
<td>33.0 VDC</td>
<td>0.045 0.010</td>
<td>0.090 0.010</td>
<td>0.470 0.040</td>
</tr>
<tr>
<td>8.0 VRMS</td>
<td>8.0 VRMS</td>
<td>0.028 0.005</td>
<td>0.107 0.008</td>
<td>0.210 0.016</td>
</tr>
<tr>
<td>12.0 VRMS</td>
<td>12.0 VRMS</td>
<td>0.030 0.006</td>
<td>0.103 0.009</td>
<td>0.240 0.019</td>
</tr>
<tr>
<td>24.0 VRMS</td>
<td>24.0 VRMS</td>
<td>0.048 0.010</td>
<td>0.145 0.015</td>
<td>0.480 0.033</td>
</tr>
<tr>
<td>33.0 VRMS</td>
<td>31.0 VRMS</td>
<td>0.062 0.012</td>
<td>0.175 0.022</td>
<td>0.685 0.056</td>
</tr>
</tbody>
</table>

NOTE: All CAUTIONS and WARNINGS are identified by the symbol ▲. All warnings are printed in bold capital letters.

▲ WARNING: PLEASE READ THESE SPECIFICATIONS AND INSTALLATION INSTRUCTIONS CAREFULLY BEFORE USING, SPECIFYING OR APPLYING THIS PRODUCT. FAILURE TO COMPLY WITH ANY OF THESE INSTRUCTIONS, CAUTIONS AND WARNINGS COULD RESULT IN IMPROPER APPLICATION, INSTALLATION AND/OR OPERATION OF THESE PRODUCTS IN AN EMERGENCY SITUATION, WHICH COULD RESULT IN PROPERTY DAMAGE, AND SERIOUS INJURY OR DEATH TO YOU AND/OR OTHERS.

▲ WARNING: MAKE SURE THAT THE TOTAL CURRENT REQUIRED BY ALL APPLIANCES THAT ARE CONNECTED TO A SM OR DSM DOES NOT EXCEED 3.0A OR EXCEED THE RATING OF THE FIRE ALARM CONTROL PANEL’S PRIMARY AND SECONDARY POWER SOURCES AND NAC CIRCUITS. OVERLOADING THESE SOURCES COULD RESULT IN LOSS OF POWER AND FAILURE TO ALERT OCCUPANTS DURING AN EMERGENCY, WHICH COULD RESULT IN PROPERTY DAMAGE AND SERIOUS INJURY OR DEATH TO YOU AND/OR OTHERS.

When calculating the total current, use Tables 1 & 2 to determine the highest value of "Rated Average Current" for the SM or DSM (across the listed voltage range), then add this value to the total current for any other appliances powered by the same source and include any required safety factors. Refer to Instruction Sheet for additional information.

▲ WARNING: MAKE SURE THAT ALL FUSES USED ON NAC CIRCUITS ARE RATED TO HANDLE THE MAXIMUM INRUSH OR PEAK CURRENT FROM ALL APPLIANCES ON THOSE CIRCUITS. FAILURE TO DO THIS MAY RESULT IN LOSS OF POWER TO THE NAC CIRCUIT AND THE FAILURE OF ALL APPLIANCES ON THAT CIRCUIT TO OPERATE, WHICH COULD RESULT IN PROPERTY DAMAGE AND SERIOUS INJURY OR DEATH TO YOU AND/OR OTHERS.

Table 3: Current Consumption DSM Modules

<table>
<thead>
<tr>
<th>Output Circuit Description of SM/DSM Module</th>
<th>SM Module</th>
<th>DSM Module</th>
<th>Ref. Fig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class &quot;B&quot; with Audible Silence (dual circuit)</td>
<td>Y</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Class &quot;B&quot; with No Audible Silence (dual circuit)</td>
<td>Y</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Class &quot;A&quot; with Audible Silence (single circuit)</td>
<td>Y</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Class &quot;A&quot; with No Audible Silence (single circuit)</td>
<td>Y</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Note: DSM Dual Sync Modules are rated for 3.0 amperes per circuit. The maximum number of interconnected DSM modules is twenty (20).

▲ CAUTION: Use DSM Sync Modules only on NAC circuits with continuously applied voltage. Do not use DSM Sync Modules on coded or interrupted NAC circuits in which the applied voltage is cycled on and off.

▲ CAUTION: Power Boosters may be used in conjunction with the DSM Sync Modules only in the order shown below. Only one DSM Sync Module shall be allowed on a NAC circuit. Do not connect Power Booster to the NAC circuit after the one DSM Sync Module. Exception: The Wheelock Power Booster can be connected either before or after the DSM Sync Module. Refer to Power Booster instruction manual for proper application and installation.
FIG. 1 DUAL CLASS "B" CIRCUIT WITH AUDIBLE SILENCE FEATURE

FIG. 2 DUAL CLASS "B" CIRCUIT WITH NO AUDIBLE SILENCE FEATURE

FIG. 3 SINGLE CLASS "A" CIRCUIT WITH AUDIBLE SILENCE FEATURE

FIG. 4 SINGLE CLASS "A" CIRCUIT WITHOUT AUDIBLE SILENCE FEATURE

Notes
1. Non-Sync Appliances can be installed before or after a DSM. If the Non-Sync appliance requires audible silence, four wire connection is necessary with the strobe circuit connected before the DSM NAC circuit, and the audible leads connected to a silenceable NAC circuit from the FACP.
2. The audible appliance produces a momentary interruption (approximately 25ms) each time the strobes flash.
3. Circuit #2 may be omitted if only 1 circuit is required when using the DSM.
4. Non-Sync Audible Appliances can be installed on the audible NAC. Be aware of the current requirement for the SM or DSM module. See table 3.

Specifications and Ordering Information

<table>
<thead>
<tr>
<th>Model</th>
<th>Order Code</th>
<th>Input Voltage VDC</th>
<th>Average Current @ 12 or 24 VDC</th>
<th>UL Max*</th>
<th>Mounting Options**</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSM-12/24-R***</td>
<td>6374</td>
<td>12</td>
<td>0.020</td>
<td>0.026</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24</td>
<td>0.035</td>
<td>0.055</td>
<td>W</td>
</tr>
</tbody>
</table>

R = Red

* RMS current ratings are per UL average RMS method. UL max current rating is the maximum RMS current within the listed voltage range (16-33v for 24v units). For strobes the UL max current is usually at the minimum listed voltage (16v for 24v units). For audibles the max current is usually at the maximum listed voltage (33v for 24v units). For unfiltered FWR ratings, see installation instructions.

Refer to Data sheet # S7000 for Mounting Options.

*** The maximum number of interconnected DSM modules is twenty (20).

The total distance from the first to the last DSM shall not exceed 1,000 feet of #18 AWG wire. Use only #18 AWG wire.
Wheelock products must be used within their published specifications and must be PROPERLY specified, applied, installed, operated, maintained and operationally tested in accordance with their installation instructions at the time of installation and at least twice a year or more often and in accordance with local, state and federal codes, regulations and laws. Specification, application, installation, operation, maintenance and testing must be performed by qualified personnel for proper operation in accordance with all of the latest National Fire Protection Association (NFPA), Underwriters’ Laboratories (UL), National Electrical Code (NEC), Occupational Safety and Health Administration (OSHA), local, state, county, province, district, federal and other applicable building and fire standards, guidelines, regulations, laws and codes including, but not limited to, all appendices and amendments and the requirements of the local authority having jurisdiction (AHJ).

**WARNING:** CONTACT WHEELOCK FOR “INSTALLATION INSTRUCTIONS” (P83177-DSM) AND “GENERAL INFORMATION” SHEET ON THESE PRODUCTS. These documents do undergo periodic changes. It is important that you have current information on these products. These materials contain important information that should be read prior to specifying or installing these products including:

- **TOTAL CURRENT REQUIRED BY ALL APPLIANCES CONNECTED TO SYSTEM SECONDARY POWER SOURCES.**
- **FUSE RATINGS ON NAC CIRCUITS TO HANDLE MAXIMUM INRUSH OR PEAK CURRENTS FROM ALL APPLIANCES ON THOSE NAC CIRCUITS.**
- **COMPOSITE FLASH RATE FROM MULTIPLE STROBES WITHIN A PERSON’S FIELD OF VIEW.**
- **THE VOLTAGE APPLIED TO THESE PRODUCTS MUST BE WITHIN THEIR RATED IN PUT VOLTAGE RANGE.**
- **INSTALLATION IN OFFICE AREAS AND OTHER SPECIFICATION AND INSTALLATION ISSUES.**
- **USE STROBES ONLY ON NAC CIRCUITS WITH CONTINUOUSLY APPLIED OPERATING VOLTAGE. DO NOT USE STROBE ON CODED OR INTERRUPTED NAC CIRCUITS IN WHICH THE APPLIED VOLTAGE IS CYCLED ON AND OFF AS THE STROBE MAY NOT FLASH.**

### Architects and Engineers Specifications

The sync modules shall be Wheelock Series DSM Sync Modules. Series DSM Sync Modules shall be the master controllers for Wheelock Series Exceder, AS/AH, RSS, RSSP and appliances where a synchronized audible/visual audible or visual only appliance is specified. All modules shall be UL listed under Standard 464. Series DSM modules shall be designed to interface with Series AS Audible Strobe Appliances and Horn Strobe Appliances to produce a synchronized temporal (Code 3) horn as well as synchronized strobe flash on a two-wire alarm circuit. Other synchronized products are the Wheelock Series Exceder, RSS, RSSP, SLM visual only appliances and Series AH and Exceder Horn Appliances.

DSM modules shall provide an additional strobe circuit input/output for control of either two Class “B” NAC circuits or a single Class “A” NAC circuit. Upon activation of the audible silence function at the Fire Alarm Control Panel, the audible signal component of Series AS Audible Strobe and/or the Series NS Horn Stobe may be silenced while maintaining strobe activation.

DSM module shall be DSM-12/24 for control of either Class A two (2) Class B NAC circuits. The DSM dual circuit version shall provide the additional capability of “daisy-chaining”, that is, the ability to interconnect multiple DSM’s for synchronous horn and strobe operation on multiple NAC circuits. Interconnection capability shall be for a maximum of 40 NAC circuits. All modules shall operate on either 12 or 24 VDC. The DSM 12/24 shall be .020 amperes @ 12 VDC and .035 amperes @ 24 VDC. The dual circuit DSM Sync Module shall be capable of handling a load of 3 amperes per NAC circuit at 12 or 24 VDC.

All versions shall be polarized for DC supervision and shall incorporate screw terminals for in/out field wiring of #18 to #12 AWG wire size. DSM Sync modules shall mount to a 4-11/16” x 2-1/8” deep backbox.

NOTE: Due to continuous development of our products, specifications and offerings are subject to change without notice in accordance with Wheelock Inc. standard terms and conditions.

**WE ENCOURAGE AND SUPPORT NICET CERTIFICATION**

**3 YEAR WARRANTY**

S3000 DSM 06/11

**NJ Location**

273 Branchport Ave.
Long Branch, NJ 07740
P: 800-631-2148
F: 732-222-8707
www.coopernotification.com
LISTING No.  7125-0785:0141

CATEGORY:    7125 -- FIRE ALARM DEVICES FOR THE HEARING IMPAIRED

LISTEE:     Cooper Wheelock Inc. 7246 16th St. E., Ste. 105, Sarasota, FL 34243
Contact:    Tom Conover (941) 487-2336
Email:      thomas.conover@cooperindustries.com

DESIGN:    Synchronized or non-synchronized Strobe Lights. Models are as follows:

<table>
<thead>
<tr>
<th>RSS-#W</th>
<th>RSSP-#W</th>
<th>RSS-#C</th>
<th>RSSP-#C</th>
<th>RSS-#CR</th>
<th>RSSP-#CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2415</td>
<td>2415</td>
<td>2415</td>
<td>2415</td>
<td>2415</td>
<td>2415</td>
</tr>
<tr>
<td>2475</td>
<td>2475</td>
<td>2430</td>
<td>2430</td>
<td>2430</td>
<td>2430</td>
</tr>
<tr>
<td>2415/75</td>
<td>2415/75</td>
<td>2475</td>
<td>2475</td>
<td>2475</td>
<td>2475</td>
</tr>
<tr>
<td>2430</td>
<td>2430</td>
<td>*2495</td>
<td>*2495</td>
<td>*2495</td>
<td>*2495</td>
</tr>
<tr>
<td>24110</td>
<td>24110</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1215</td>
<td>1215</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1215/75</td>
<td>1215/75</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


RATING:    Electrical    12 = 8-17.5VDC/FWR OR 24 = 16-33VDC/FWR

Candela    15=5cd,1575=15/75cd on axis,30=30cd,75=75cd,110=110cd(Wall) RSS-24MCW, RSSP-24MCW, *ZRS-MCC: Selectable 15cd, 30cd, 75cd, or 110cd

or 110cd

RSS-24MCC, RSS-24MCCR, RSSP-24MCC, *ZRS-MCC: Selectable 15cd, 30cd, 75cd, and 95cd


RSS-24MCCH, RSS-24MCCHR, RSSP-24MCCH, *ZRS-MCC: Selectable 115cd, 177cd

Flash rate    60 flashes/minute

INSTALLATION:   In accordance with listee’s printed installation instructions, applicable codes and ordinances and in a manner acceptable to the authority having jurisdiction. Models with suffix -W, wall mount only. Models with suffix -C, ceiling mount only. All models are for indoor use only.

MARKING:   Listee’s name, model number, electrical/candela rating, and UL label.

APPROVAL:   Listed as strobe light suitable for the hearing impaired when used with separately listed electrically compatible fire alarm control units. For synchronization strobes, Models

*Rev. 12-13-2006 jw

Date Issued:  July 01, 2016

Listing Expires  June 30, 2017

Authorized By:  DAVID CASTILLO, Program Coordinator

Fire Engineering Division
SM-12/24, SMX-12/24, DSM-12/24 or DSMX-12/24 Sync Control Module (CSFM Listing No. 7300-0785:132) must be used. Refer to listee’s Installation Instruction Manual for details.

Date Issued: July 01, 2016  Listing Expires  June 30, 2017

Authorized By: DAVID CASTILLO, Program Coordinator
Fire Engineering Division

*Rev. 12-13-2006 jw
Wheelock RSS and RSSP Strobes and Strobe Plates

Description

The Wheelock patented RSS Strobe appliances and RSSP Strobe Plates by Eaton have lower current draw while maintaining outstanding performance, reliability and cost effectiveness. These versatile appliances will satisfy virtually all requirements for indoor, wall or ceiling mount applications.

Strobe options include the Wheelock Patented MCW multi-candela strobe with field selectable candela settings of 15/30/75/110cd or the high intensity MCWH strobe with field selectable 135/185cd. Ceiling mount models include the patented MCC multi-candela ceiling strobe with field selectable intensities of 15/30/75/95cd or the high intensity MCCH strobe with field selectable 115/177cd.

All models may be synchronized using the Wheelock DSM Sync Modules, Wheelock Power Supplies or other manufacturers panels incorporating the Wheelock Patented Sync Protocol. Synchronized strobes can eliminate possible restrictions on the number of strobes in the field of view. Wheelock’s synchronized strobes offer an easy way to comply with ADA recommendations concerning photosensitive epilepsy as well as meeting the requirements of NFPA 72.

The Wheelock Series RSS Strobes employ a Patented Integral Strobe Mounting Plate that can be mounted to a single gang, double gang, 4” square, 100mm European backboxes or the SHBB surface backbox. If the flush backbox has side or top space between it and the finished wall, the NATP (Notification Appliance Trimplate) may be used. It provides an additional .65” of trim for the Appliance. An attractive cover plate is provided for a clean, finished appearance on all models.

The RSSP Multi-Candela Strobe Plates are a cost effective way to retrofit required wall strobe appliances to bells, horns, chimes, multitone or speakers and easily mounts to standard 4” backboxes or for surface mount use with the Wheelock SBL2 surface backbox.
Features

- Approvals include: UL Standard 1971, New York City (MEA), California State Fire Marshal (CSFM), Factory Mutual (FM), and Chicago (SEP) See approvals by model in Specifications and Ordering information.
- Wall mount Multi-Candela models are available with Field Selectable Candela Settings of 15/30/75/110cd or 135/185cd.
- Strobes produce 1 flash per second over the regulated voltage range.
- 12 and 24 VDC models with wide UL “Regulated Voltage” using filtered (DC) or unfiltered VRMS input voltage.
- Synchronize using the Wheelock sync modules or panels with built-in Wheelock Patented Sync Protocol.
- Fast installation with IN/OUT screw terminals using #12 to #18 AWG wire.

Note: All CAUTIONS and WARNINGS are identified by the symbol ▲. All warnings are printed in bold capital letters.

⚠️ WARNING

PLEASE READ THESE SPECIFICATIONS AND ASSOCIATED INSTALLATION INSTRUCTIONS CAREFULLY BEFORE USING, SPECIFYING OR APPLYING THIS PRODUCT. VISIT WWW.EATON.COM/M% NOTIFICATION OR CONTACT EATON FOR THE CURRENT INSTALLATION INSTRUCTIONS. FAILURE TO COMPLY WITH ANY OF THESE INSTRUCTIONS, CAUTIONS OR WARNINGS COULD RESULT IN IMPROPER APPLICATION, INSTALLATION AND/OR OPERATION OF THESE PRODUCTS IN AN EMERGENCY SITUATION, WHICH COULD RESULT IN PROPERTY DAMAGE, AND SERIOUS INJURY OR DEATH TO YOU AND/OR OTHERS.

Audibles/Speakers for RSSP

<table>
<thead>
<tr>
<th>Product</th>
<th>Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multitone Appliances</td>
<td>AMT, MT</td>
</tr>
<tr>
<td>Horns</td>
<td>AH, NH, HS</td>
</tr>
<tr>
<td>Motor Bells</td>
<td>MB-66/G10</td>
</tr>
<tr>
<td>Speakers</td>
<td>ET-1010/1080, E70, ET70</td>
</tr>
<tr>
<td>Chimes</td>
<td>CH70</td>
</tr>
</tbody>
</table>

General Notes

- Strobes are designed to flash at 1 flash per second minimum over their “Regulated Voltage Range.” Note that NFPA-72 specifies a flash rate of 1 to 2 flashes per second and ADA Guidelines specify a flash rate of 1 to 3 flashes per second.
- All candela ratings represent minimum effective Strobe intensity based on UL 1971.
### Table 1. Maximum RMS Current

<table>
<thead>
<tr>
<th>RSS/RSSP Strobos</th>
<th>UL/ULC MAX CURRENT a</th>
<th>24VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>Regulated Voltage Range VDC</td>
<td>1575</td>
</tr>
<tr>
<td>121576W</td>
<td>16.0-33.0</td>
<td>0.255</td>
</tr>
<tr>
<td>24MCW</td>
<td>16.0-33.0</td>
<td>0.060</td>
</tr>
<tr>
<td>24MCWH</td>
<td>16.0-33.0</td>
<td></td>
</tr>
<tr>
<td>24MCC</td>
<td>16.0-33.0</td>
<td>0.065</td>
</tr>
<tr>
<td>24MCCH</td>
<td>16.0-33.0</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2. Specification & Ordering Information

<table>
<thead>
<tr>
<th>Model</th>
<th>Order #</th>
<th>Strobe Candela</th>
<th>Red</th>
<th>White</th>
<th>Wall</th>
<th>Ceiling</th>
<th>Non-Sync</th>
<th>Mounting Options b</th>
<th>Square or Round</th>
<th>UL</th>
<th>MEA</th>
<th>CSFM</th>
<th>FM</th>
<th>BFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSS-24MCW-FR</td>
<td>9400</td>
<td>15/30/75/110</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>B,D,E,F,G,H,J,N,O,R,X</td>
<td>square</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSS-24MCW-FW</td>
<td>9401</td>
<td>15/30/75/110</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>B,D,E,F,G,H,J,N,O,R,X</td>
<td>square</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSS-24MCW-AR</td>
<td>9773</td>
<td>15/30/75/110</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>B,D,E,F,G,H,J,N,O,R,X</td>
<td>square</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSS-121575W-FV</td>
<td>7468</td>
<td>15 (75 on Axis)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>B,D,E,F,G,H,J,N,O,R,X</td>
<td>square</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSS-24MCAC-FW</td>
<td>3158</td>
<td>15/30/75/95</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>B,D,E,F,G,H,J,N,O,R,X</td>
<td>square</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSS-24MCAC-FR</td>
<td>3157</td>
<td>15/30/75/95</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>B,D,E,F,G,H,J,N,O,R,X</td>
<td>square</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSS-24MCW-FR</td>
<td>9013</td>
<td>180@ 77F</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>B,D,E,F,G,H,J,N,O,R,X</td>
<td>square</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSSWP-2475W-FR</td>
<td>3034</td>
<td>180@ 77 F</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>B,D,E,F,G,H,J,N,O,R,X</td>
<td>square</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSSWP-2475W-FV</td>
<td>3034</td>
<td>180@ 77 F</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>B,D,E,F,G,H,J,N,O,R,X</td>
<td>square</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSSWP-2475W-FR</td>
<td>3034</td>
<td>180@ 77 F</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>B,D,E,F,G,H,J,N,O,R,X</td>
<td>square</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSSWP-121575W-FR</td>
<td>7798</td>
<td>15 (75 on Axis)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>D,E</td>
<td>square</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSS-24MCW-FR</td>
<td>9402</td>
<td>15/30/75/110</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>B,D,E,F,G,H,J,N,O,R,X</td>
<td>square</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3. Specifications

**Physical**

<table>
<thead>
<tr>
<th>Material</th>
<th>Red or white textured UV stabilized, colored impregnated engineered plastic. Exceeds 94V-0 UL flammability rating.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>RSS Strobe: 0.40 lbs (0.181 kg)</td>
</tr>
<tr>
<td>Lens</td>
<td>GE Lexan 943A</td>
</tr>
<tr>
<td>Dimensions</td>
<td>RSS Strobe: 4.75” W x 4.75” H x 2.58”D</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>Indoor: 33.8°F to 120.2°F (0°C to 49°C) and maximum humidity of 93%</td>
</tr>
<tr>
<td>Wire Connections</td>
<td>#12 through #18 AWG</td>
</tr>
</tbody>
</table>

**Power & General**

| Operating voltage | 25/70 VRMS                                                                                           |
| Strobe Output Rating | UL 1971                                                                                           |
| Strobe Flash Rate | Strobos are designed to flash at 1 flash per second                                                 |

**Synchronization Models**

Strobos can be synchronized with Wheelock’s DSM Sync Modules, Power Supplies or SAFEPATH products, using Wheelock patented sync protocol

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a RMS current ratings are per UL maximum RMS method. UL max current rating is the maximum RMS current within the listed voltage range (16-33v for 24v units). For strobes the UL max current is usually at the minimum listed voltage (16v for 24v units). For audibles the max current is usually at the maximum listed voltage (33v for 24v units). For unfiltered PWR ratings, see installation instructions.

b For information on mounting options, refer to specification sheet TD450028EN.
Architects and Engineers Specifications

The visual notification appliances shall be Wheelock RSS Strobe appliances or approved equals. The Series RSS shall meet and be listed for UL Standard 1971 (Emergency Devices for the Hearing-Impaired) for Indoor Fire Protection Service. The strobe shall be listed for indoor use and shall meet the requirements of FCC Part 15 Class B. The strobe appliances shall produce a flash rate of one (1) flash per second over the Regulated Voltage Range and shall incorporate a Xenon flash tube enclosed in a rugged Lexan® lens. All inputs shall be compatible with standard reverse polarity supervision of circuit wiring by a Fire Alarm Control Panel (FACP). When Strobe Plates are to be installed, they shall be the Wheelock Series RSS Strobe Plate and shall have the same electronic circuitry as the Wheelock Series RSS.

The RSS Strobe shall be of low current design. Where Multi-Candela appliances are specified, the strobe intensity shall have field selectable settings and shall be rated per UL Standard 1971 at 15/30/75/110/cd or 135/185/cd for wall mount and 15/30/75/95/cd or 115/177/cd for ceiling mount. The selector switch for selecting the candela shall be tamper resistant.

When synchronization is required, the appliance shall be compatible with Wheelock’s DSM Sync Modules, Wheelock Power Supplies or other manufacturers panels with built-in Wheelock Patented Sync Protocol. The strobes shall not drift out of synchronization at any time during operation. If the sync module or Power Supply fails to operate, (i.e., contacts remain closed), the strobe shall revert to a non-synchronized flash rate. The strobes shall be designed for indoor surface of flush mounting.

The RSS Strobe appliances shall incorporate a Patented, Integral Strobe Mounting Plate that shall allow mounting to single gang, double-gang, 4-inch square, 100mm European type backboxes, or the SHBB Surface Backbox. If required, an NATP (Notification Appliance Trimplate) shall be provided. An attaching cover plate shall be provided to give the Appliance and attractive appearance. The Appliance shall not have any mounting holes or screw heads visible when the installation is completed.

The RSSP Multi-Candela or single candela Strobe Plate shall mount to either a standard 4 inch square backbox for flush mounting, or the Wheelock SBL2 boxback for surface mounting.

All notification appliances shall be backward compatible.

UL, MEA, CSFM, BFP, FM

Note: Due to continuous development of our products, specifications and offerings are subject to change without notice in accordance with Wheelock Inc., dba Eaton standard terms and conditions.
LISTING No. 7125-0785:0160

CATEGORY: 7125 – FIRE ALARM DEVICES FOR THE HEARING IMPAIRED

LISTEE: Cooper Wheelock Inc. 7246 16th St. E., Ste. 105, Sarasota, FL 34243
Contact: Tom Conover (941) 487-2336
Email: thomas.conover@cooperindustries.com

DESIGN: Model AMT-241575W, AMT-2475W, and *AMT-24MCW may be followed by -NYC, followed by two alphanumeric characters indicating lettering and product color. Model AMT have a high and low output and provide a selectable setting for one tone of nine possible tones. Model number may be followed by two alpha/numeric characters indicating lens orientation, lettering and color. Refer to listee's data sheet for additional detailed product description and operational considerations.

RATING: Electrical: 24V = 16 - 33 VDC
Strobe Candela: 1575W = 15cd with 75cd on axis, 75W = 75cd, wall mount only
MCW=15cd, 30cd, 75cd or 110cd
Flash rate: 60 flashes per minute

INSTALLATION: In accordance with listee's printed installation instructions, applicable codes and ordinances and in a manner acceptable to authority having jurisdiction. Models with -W are intended for wall mount only.

MARKING: Listee's name, model number, electrical/candela rating, and UL label.

APPROVAL: Listed as audible/visual signal devices suitable for the hearing impaired when used in conjunction with separately listed electrically compatible fire alarm control units. For indoor use only. For synchronization, Sync Modules SM-12/24 or SMX-12/24, Dual Sync Modules DSM-12/24 or DSMX-12/24 (CSFM Listing No. 7300-0785:132) must be used. Refer to listee's Installation Instruction Manual for details.

These appliances can produce a distinctive three pulse Temporal Pattern Fire Alarm Evacuation Signal (for total evacuation) in accordance with NFPA 72, 2002 Edition.

*Rev. 06-13-06

This listing is based upon technical data submitted by the applicant. CSFM Fire Engineering staff has reviewed the test results and/or other data but does not make an independent verification of any claims. This listing is not an endorsement or recommendation of the item listed. This listing should not be used to verify correct operational requirements or installation criteria. Refer to listee's data sheet, installation instructions and/or other

Date Issued: July 01, 2016
Listing Expires June 30, 2017

Authorized By: DAVID CASTILLO, Program Coordinator
Fire Engineering Division
Series AMT Multitone and AMT Multitone Strobe Appliances

Description:
The Wheelock Series AMT Multiple Input Electronic Appliances provide the industry with a UL Standard 1971 and UL Standard 464 combination audible/visual device that simplifies installation and offers three (3) distinct prioritized audible signals from three isolated inputs. Priority (1) will override all other commands upon activation.

The AMT offers a choice of eight (8) self-prioritized sound combinations for suppression releasing systems, combination security and emergency evacuation systems and high risk installations as well as many other applications.

The AMT Strobes are designed for ADA applications while meeting or exceeding the latest requirements of NFPA 72 (the National Fire Alarm Code), ANSI 117.1 (the American National Standard For Accessible and Usable Buildings and Facilities) and UL Standard 1971 (Standard for Signaling Devices for the Hearing Impaired).

Each AMT Audible and AMT Strobe appliance has two user selective sound output levels: STANDARD dBA and HIGH dBA. The AMT Audible provides 12VDC or 24VDC operation, filtered or FWR. The AMT Strobe Electronic Appliances operate at 24VDC and may be used with filtered or unfiltered (full-wave-rectified) input voltages. Separate supervised sets of input terminals are available for each prioritized input. Jumper plugs are provided to enable both tone and strobe to operate simultaneously for all inputs.

The AMT Multitone Strobe Appliances are UL Listed for indoor use, wall mount, under Standard 1971 for Signaling Devices for the Hearing Impaired and Standard 464 for Audible Signal Appliances, and use a Xenon flashtube with solid state circuitry enclosed in a rugged Lexan® lens to provide maximum reliability for effective visible signaling.

All models may be synchronized using the Wheelock DSM Sync Modules, Wheelock Power Supplies or other manufacturers panels incorporating the Wheelock Patented Sync Protocol.

Features:
- Approvals include: UL Standard 1971 and UL Standard 464, FCC, ULC, Factory Mutual (FM), California State Fire Marshal (CSFM), New York City (MEA) and Chicago (BFP) See approvals by model in Specifications and Ordering Information.
- Compliance with RFI limits in FCC Part 15, Class B for compatibility with sensitive detection and communication circuits.
- Designed to meet or exceed NFPA/ANSI Standards and ADA Accessibility Guidelines. Meets OSHA 29 Parts 1910.165.
- Three separate prioritized inputs that will activate three isolated signals.
- All inputs are supervised.
- Code-3 Horn and Tone meet ANSI/NFPA/ISO temporal pattern.
- Two power taps for high dBA and standard dBA @ 10 feet.
- Low current draw with low temperature compensation to reduce power consumption and wiring costs.
- AMT Strobe models are available with Wheelock patented MCW Multi-Candela strobes with field selectable candela settings at 15/30/75/110cd or with single candela 1575cd strobes.
- AMT with strobe can be wired to flash independently or in unison with all audible signals.
- Strobes synchronize using the Wheelock Sync Modules or panels with built-in Wheelock Patented Sync Protocol.
- Selectable input voltage (12 or 24 VDC) for non-strobe applications.
- Polarized inputs for compatibility with standard reverse polarity type supervision of circuit wiring by an alarm panel.
- Low cost installation via standard electrical boxes. Attractive flush or surface mounting options.
- No additional trimplate required for flush mounting. Fast installation with In/Out screw terminals using #12 to #18 AWG.
General:
Wheelock’s AMT Appliances are unique multitone alarm signals with separate input terminals for each sound. They are the ideal choice for suppression systems and emergency signaling systems where distinctive multiple alarm conditions are required. Eight groups of three self-prioritized sound outputs are provided with separate electrically isolated input terminals for each sound (see Table 1 and Table 5 for sound selections). Sound output can be field set to provide either HIGH (HI) dBA or STANDARD (STD) dBA sound output level.

All AMT Multitone Strobe models are designed for use with either filtered or unfiltered Full-Wave-Rectified (FWR) input voltage. The AMT Multitone Strobe Appliances have separate input terminals for alarm tone activation and strobe activation. The strobes can be easily field programmed to operate independently or in unison with all of the audible alarms. All inputs are polarized for compatibility with standard reverse polarity supervision of circuit wiring by a fire Alarm Control Panel (F.A.C.P.). In the event that three simultaneous commands occur, priority one will activate. If priority 2 + priority 3 exist, priority 2 will activate.

<table>
<thead>
<tr>
<th>Table 1: dBA Ratings for AMT Multitone Audible Signals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tone</strong></td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>Horn</td>
</tr>
<tr>
<td>Bell</td>
</tr>
<tr>
<td>March Time Horn</td>
</tr>
<tr>
<td>Code-3 Horn</td>
</tr>
<tr>
<td>Code-3 Tone</td>
</tr>
<tr>
<td>Slow Whoop</td>
</tr>
<tr>
<td>Siren</td>
</tr>
<tr>
<td>HI/LO</td>
</tr>
<tr>
<td>Vibrating Chime</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2: RMS Current Ratings for AMT Multitone Audible Portion*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RMS Current (amps)</strong></td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td><strong>Tone</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Horn</td>
</tr>
<tr>
<td>Bell</td>
</tr>
<tr>
<td>March Time Horn</td>
</tr>
<tr>
<td>Code-3 Horn</td>
</tr>
<tr>
<td>Code-3 Tone</td>
</tr>
<tr>
<td>Slow Whoop</td>
</tr>
<tr>
<td>Siren</td>
</tr>
<tr>
<td>HI/LO</td>
</tr>
<tr>
<td>Vibrating Chime</td>
</tr>
</tbody>
</table>

Add strobe current from Table 3 (ordering information) to audible current from Table 2 to obtain total current for each unit, if the strobe and audible are wired to operate in unison on a single circuit. Refer to Installation Instruction Sheet (P84158) for peak and inrush current across the UL listed voltage range for both filtered and unfiltered full-wave-rectified voltage.

The Series AMT Multitone Strobe Appliances are UL Listed under Standard 1971 for Emergency Devices for the Hearing Impaired and UL Standard 464 for Audible Signal Appliances. They are listed for indoor only use with the backboxes specified in these instructions. AMT models without strobes are UL 464 Listed for indoor or outdoor use (see mounting options).

<table>
<thead>
<tr>
<th>Table 3: Strobe RMS Current Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RMS Current (amps)</strong></td>
</tr>
<tr>
<td><strong>Model</strong></td>
</tr>
<tr>
<td>Candela</td>
</tr>
<tr>
<td>@24VDC</td>
</tr>
<tr>
<td>UL max*</td>
</tr>
</tbody>
</table>

* RMS current ratings are per UL average RMS method. UL max current rating is the maximum RMS current within the listed voltage range (16-33v for 24v units). For strobes the UL max current is usually at the minimum listed voltage (16v for 24v units). For audibles the max current is usually at the maximum listed voltage (33v for 24v units). For unfiltered FWR ratings, see installation instructions.
### Table 4: Specification and Ordering Information

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Order Code</th>
<th>Input Voltage</th>
<th>Candela</th>
<th>Mounting Options**</th>
<th>Agency Approvals</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMT-12/24-R</td>
<td>5887</td>
<td>12/24</td>
<td>-</td>
<td>D,E,F,L,M,N,O,P,R</td>
<td>X X X X X</td>
</tr>
<tr>
<td>AMT-12/24-W</td>
<td>5893</td>
<td>12/24</td>
<td>-</td>
<td>D,E,F,L,M,N,O,P,R</td>
<td>X X X X X</td>
</tr>
<tr>
<td>AMT-241575W-FR</td>
<td>9463</td>
<td>24</td>
<td>15 (75 on axis)</td>
<td>D,E,F,L,M,N,O,P,R</td>
<td>X X X X</td>
</tr>
<tr>
<td>AMT-241575W-NW</td>
<td>3047</td>
<td>24</td>
<td>15 (75 on axis)</td>
<td>D,E,F,L,M,N,O,P,R</td>
<td>X X X</td>
</tr>
<tr>
<td>AMT-241575W-FW</td>
<td>9466</td>
<td>24</td>
<td>15 (75 on axis)</td>
<td>D,E,F,L,M,N,O,P,R</td>
<td>X X X</td>
</tr>
<tr>
<td>AMT-24MCW-FR</td>
<td>3300</td>
<td>24</td>
<td>15/30/75/110</td>
<td>D,E,F,L,M,N,O,P,R</td>
<td>X - X -</td>
</tr>
<tr>
<td>AMT-24MCW-FW</td>
<td>3302</td>
<td>24</td>
<td>15/30/75/110</td>
<td>D,E,F,L,M,N,O,P,R</td>
<td>X - X -</td>
</tr>
<tr>
<td>AMT-12/24-R-NYC</td>
<td>7920</td>
<td>12/24</td>
<td>-</td>
<td>D,E,F,L,M,N,O,P,R</td>
<td>X X X</td>
</tr>
</tbody>
</table>

** Mounting Options: Refer to Data Sheet S7000 or current catalog for mounting options.

The UL Listed voltage range is 16-33 VDC for 24 VDC and 8-17.5 VDC for 12 VDC using either filtered (DC) or unfiltered full-wave-rectified (FWR) voltage. Check the minimum and maximum output of the power supply and standby battery and subtract the voltage drop from the circuit wiring resistance to determine the applied voltage to the notification appliance.

AMT Multitone strobe models are Listed for indoor use with a temperature rate of 32°F to 120°F (0°C to 49°C) and maximum humidity of 93%.

**NOTE:** All CAUTIONS and WARNINGS are identified by the symbol ▲. All warnings are printed in bold capital letters. ▲WARNING: PLEASE READ THESE INSTRUCTIONS CAREFULLY BEFORE USING THIS PRODUCT. FAILURE TO COMPLY WITH ANY OF THE FOLLOWING INSTRUCTIONS, CAUTIONS AND WARNINGS COULD RESULT IN IMPROPER APPLICATION, INSTALLATION AND/OR OPERATION OF THESE PRODUCTS IN AN EMERGENCY SITUATION, WHICH COULD RESULT IN PROPERTY DAMAGE, SERIOUS INJURY OR DEATH TO YOU AND/OR OTHERS. REFER TO CURRENT INSTALLATION INSTRUCTION SHEET P84158.
▲ WARNING: MAKE SURE THAT THE TOTAL CURRENT REQUIRED BY ALL APPLIANCES THAT ARE CONNECTED TO THE SYSTEM'S PRIMARY AND SECONDARY POWER SOURCES AND NAC CIRCUITS DOES NOT EXCEED THEIR RATED CURRENT. OVERLOADING THESE SOURCES COULD RESULT IN LOSS OF POWER AND FAILURE TO ALERT OCCUPANTS DURING AN EMERGENCY.
▲ WARNING: MAKE SURE THAT ALL FUSES USED ON NAC CIRCUITS ARE RATED TO HANDLE THE MAXIMUM INRUSH OR PEAK CURRENT FROM ALL APPLIANCES ON THOSE CIRCUITS. FAILURE TO DO THIS MAY RESULT IN LOSS OF POWER TO THE NAC CIRCUIT AND THE FAILURE OF ALL APPLIANCES ON THAT CIRCUIT TO OPERATE.
▲WARNING: THE STROBES ARE DESIGNED TO FLASH AS SPECIFIED WITH CONTINUOUS (NON-CODED) APPLIED VOLTAGE. THE STROBES MAY NOT FLASH IF USED IN CODED SYSTEMS.

AMT Multitone Strobe Appliances are field set for any one of eight groups of self-prioritized tones by setting a four position switch (SW1) as shown in Table 5. Use SW1 POS 2,3,4 to select the desired alarm tones. Note: The prioritized tones contained in each group is factory pre-set which can not be changed.

### Table 5

<table>
<thead>
<tr>
<th>Tones</th>
<th>Switch Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRI 1 Horn</td>
<td>PRI 2 Bell</td>
</tr>
<tr>
<td>Code 3 Horn</td>
<td>Siren</td>
</tr>
<tr>
<td>Slow Whoop</td>
<td>March Time Horn</td>
</tr>
<tr>
<td>March Time Horn</td>
<td>HI/LO</td>
</tr>
<tr>
<td>Code 3 Horn</td>
<td>Bell</td>
</tr>
<tr>
<td>Siren</td>
<td>Horn</td>
</tr>
<tr>
<td>Bell</td>
<td>March Time Horn</td>
</tr>
<tr>
<td>Code 3 Tone</td>
<td>HI/LO</td>
</tr>
</tbody>
</table>

Note: The **Code-3 Horn** and **Code-3 Tone** (set on HIGH dBA) incorporate the temporal pattern specified by ANSI/NFPA for standard emergency evacuation signaling. They should be used only for fire evacuation signaling and not for any other purpose. The Horn and Bell Tones can be used on coded systems with a minimum On-Time of 1/4 second if the audible and strobe are wired to operate independently. All other tones are recommended for use only on continuous (non-coded) systems.
Architects and Engineers Specifications

When notification appliances are required for applications with more than one function, an appliance with multiple inputs and capable of being programmed shall be used. The notification appliance shall be capable of accepting three (3) individual DC signals and providing three (3) distinct audible signals. In the event the signals are simultaneous, the priority shall be as follows: Highest priority = PRI1, Second priority = PRI2 and the Third priority = PRI3. With the addition of the Strobe, the appliance shall operate with an independent input DC voltage to the strobe terminals. When it is desired to operate the strobe with all of the audible signals, only a set of jumpers shall be required.

The notification appliance shall be a Wheelock Series AMT audible/visual appliance or equivalent. Notification appliance shall be electronic and use solid state components. Electromechanical alternatives are not approved. Tone selection shall be by durable dip switch assembly and not clips or jumpers. The audible and the strobe shall be able to operate from a single NAC circuit while producing any of these tones. The appliances shall provide two output sound levels: STANDARD and HIGH dBA. The HIGH anechoic dBA measurement at 10 feet at the alarm HORN SETTING shall be 98 dBA for AMT and 98 dBA for AMT Strobes, at nominal voltage. Operating voltages shall be either 12VDC (Audible only) or 24VDC using filtered power or unfiltered power supply (full-wave-rectified). All models shall have provisions for standard reverse polarity type supervision and IN/OUT field wiring using terminals that accept #12 to #18 AWG wiring. When synchronization is required, the appliance shall be compatible with Wheelock’s DSM Sync Modules, Wheelock Power Supplies or other manufacturers panels with built-in Wheelock Patented Protocol.

Combination audible/visual appliances shall incorporate a Xenon flashtube enclosed in a rugged Lexan lens or equivalent with solid state circuitry. Strobe shall meet UL 1971 and produce a flash rate of one (1) flash per second minimum over the Listed input voltage (16VDC-33VDC) range. The Series AMT-241575W shall be specified when 15 candela UL 1971 Listing with 75 candela intensity near-axis is required. The AMT-24MCW shall be specified when field selectable 15/30/75/110 candela ratings are required. All UL Standard 1971 Listed strobe appliances shall be verified to meet FCC Part 15, Class B. Strobe activation shall be via independent input or from the same input circuit as the audible.

The combination audible/visual appliances may be installed indoors and surface or flush mounted. They shall mount to standard electrical hardware requiring no additional trimplate or adapter. The aesthetic appearance shall not have any mounting holes or screw heads visible when the installation is completed. The appliance shall be finished in a textured red color.

The audible appliance may be installed indoor or outdoor with the proper backbox.

Wiring Diagrams (for all models)
- Isolated inputs are provided for independent supervision and actuation of the three audible inputs.
- In case of simultaneous inputs, the three audible outputs are self-prioritized as follows: 1st priority = PRI 1; 2nd priority = PRI 2; 3rd priority = PRI 3. (See table 4 for tone selection).
- Leave any unused inputs disconnected.
- For applications not requiring supervision: connect all positive (+) terminals to the power source. The negative (-) terminal for each signal will actuate the device.

1. AMT Multitone appliances have in-out wiring terminals that accept two #12 to #18 American Wire Gauge (AWG) wires at each screw terminal. Strip leads 3/8 inches and connect to screw terminals.

2. Break all in-out wire runs on supervised circuits to assure integrity of circuit supervision as shown on left. The polarity shown in the wiring diagram is for operation of the appliance. The polarity is reversed by the F.A.C.P. during supervision.

WE ENCLOSE AND SUPPORT NICET CERTIFICATION
3 YEAR WARRANTY

S4000 AMT 06/11

NJ Location
273 Branchport Ave.
Long Branch, NJ 07740
P. 850-631-2118
F. 732-222-8707
www.cooperntfication.com
SECTION 31 10 00
SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Comply with rules and regulations of State of California, California Code of Regulations, Title 8, Industrial Relations, Chapter 4, Subchapter 4, “Construction Safety Order.”

C. Comply with applicable local and state agencies having jurisdiction.

D. Comply with governing EPA notification regulations.

1.2 SUMMARY

A. Section includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities.
8. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

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

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction as indicated on Drawings.

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.

2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Topsoil stripping and stockpiling program.

C. Rock stockpiling program.

D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.
B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner’s property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by District Representative.

C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner’s premises where indicated.

D. Utility Locator Service: Notify Call Before You Dig (1.800.227.2600) before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

F. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection," and as directed by the Project Arborist or District Representative.

G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.
B. Antitrust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #23 (surface-tolerant, anticorrosive metal primer), or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."

C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
1. Arrange with utility companies to shut off indicated utilities.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify District Representative not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without District Representative's written permission.

D. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction as approved by District Representative.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. Grind down stumps and remove roots larger than 3 inches in diameter, obstructions, and debris to a depth of eighteen inches below exposed subgrade.

3. Use only hand methods or air spade for grubbing within protection zones.

4. Chip removed tree branches and stockpile in areas approved by District Representative.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of eight inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth in a manner to prevent intermingling with underlying subsoil or other waste materials.
1. Remove subsoil and non-soil materials from topsoil, including clay lumps, gravel, and other objects larger than two inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

   1. Limit height of topsoil stockpiles to seventy-two inches.

   2. Do not stockpile topsoil within protection zones.

   3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

3.7 STOCKPILING ROCK

A. Remove from construction area naturally formed rocks that measure more than one foot across in least dimension. Do not include excavated or crushed rock.

   1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than two inches in diameter; trash, debris, weeds, roots, and other waste materials.

B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.

   1. Limit height of rock stockpiles to thirty-six inches.

   2. Do not stockpile rock within protection zones.

   3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.

3.8 SITE IMPROVEMENTS

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

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer’s written instructions. Keep paint off surfaces that will remain exposed.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner’s property in compliance with the District, City, County, and State regulations.

B. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION
SECTION 31 20 00
EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Comply with State of California Business and Transportation Agency, Department of Transportation (Caltrans) latest edition of "Standard Specifications." (CSS)

C. Comply with State of California Code of Regulations (CCR).


1.2 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.

2. Preparing subgrades for slabs-on-grade, walks, pavements, turfs and grasses

3. Excavating and backfilling for buildings and structures.

4. Drainage course for concrete slabs-on-grade.

5. Subbase course for concrete walks and pavements.

6. Subbase course and base course for asphalt paving.

7. Subsurface drainage backfill for walls and trenches.

8. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:

1. Section 013233 "Photographic Documentation" for recording pre-excavation and earth-moving progress.

2. Section 033053 "Miscellaneous Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
3. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.

4. Section 312319 "Dewatering" for lowering and disposing of ground water during construction.

5. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

6. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated in compliance with Section 19 of the Caltrans Standard Specifications.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by District Representative. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in work.
   2. Bulk Excavation: Excavation more than ten feet in width and more than thirty feet in length.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by District Representative. Unauthorized excavation, as well as remedial work directed by District Representative, shall be without additional compensation.
G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed one cubic yard for bulk excavation or three-quarters of a cubic yard for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom.

2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket.

I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material three-quarters of a cubic yard or more in volume that exceed a standard penetration resistance of one hundred blows per two inches when tested by a geotechnical testing agency, according to ASTM D 1586.

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

M. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct pre-excavation conference at the Project Site

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.

3. Geofoam.

4. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

   1. Geotextile: twelve inches by twelve inches

   2. Warning Tape: twelve inches long; of each color.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

   1. Classification according to ASTM D 2487.

   2. Laboratory compaction curve according to ASTM D 1557.

C. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

D. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

   1. Do not proceed with work on adjoining property until directed by District Representative.
C. Utility Locator Service: Notify Call Before You Dig (1.800.227.2600) for area where Project is located before beginning earth-moving operations.

D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 311000 "Site Clearing" are in place.

E. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

F. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487 or a combination of these groups; free of rock or gravel larger than two-and-a-half inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Construction of the subgrade shall also conform to Section 25-1.03, "Subgrade" of the Caltrans Standard Specifications.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve. Construction of subbase shall also conform to Section 25, "Aggregate Subbases", of the Caltrans Standard Specifications and in conformance with the lines, grades and dimensions shown on the Drawings and typical cross-sections.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2944; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve. Construction of the base course shall also comply with Section 26, "Aggregate Bases", of the Caltrans Standard Specifications and in conformance with the lines, grades and dimensions shown on the Drawings and typical cross-sections.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve. Engineered fill shall also comply with the provisions of Section 19-3.06 of the Caltrans Standard Specifications.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.

J. Sand: ASTM C 33; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Apparent Opening Size: No. 70 (0.212-mm) sieve, maximum; ASTM D 4751.

3. Permittivity: 0.1 per second, minimum; ASTM D 4491.

4. UV Stability: 50 percent after 500 hours’ exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting, low-density, flowable concrete material produced from the following:

1. Portland Cement: ASTM C 150, Type II.

2. Fly Ash: ASTM C 618, Class C or F.

3. Normal-Weight Aggregate: ASTM C 33, three-quarters of an inch nominal maximum aggregate size. Aggregates shall be free from deleterious coatings, clay balls, roots, bark, sticks, and other extraneous material and shall be in accordance with Section 90 “Portland Cement Concrete,” of the Caltrans Standard Specifications.

   a. Gradation shall be Combined Aggregate Grading in accordance with Section 90 “Portland Cement Concrete,” of the Caltrans Standard Specifications.

4. Class 2 Aggregate Bases and Sub-bases shall be in accordance with Caltrans Standard Specifications Section 25 and 26.

B. Produce low-density, controlled low-strength material with the following physical properties:

1. As-Cast Unit Weight: 30 to 36 pounds per cubic foot at point of placement, when tested according to ASTM C 138.

2. Compressive Strength: 80 psi, when tested according to ASTM C 495.

2.4 GEOFOAM

A. Extruded-Polystyrene Board Insulation: ASTM C 578.

B. Molded-Polystyrene Board Insulation: ASTM C 578.


D. Connectors: Geofoam manufacturer’s multibarbed, galvanized-steel sheet connectors
2.5 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on
prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water
accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to
accumulate in excavations. Do not use excavated trenches as temporary drainage
ditches.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of
surface and subsurface conditions encountered. Unclassified excavated materials may
include rock, soil materials, and obstructions. No changes in the Contract Sum or the
Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil
materials and rock, replace with satisfactory soil materials.

2. Remove rock to lines and grades indicated to permit installation of permanent
construction without exceeding the following dimensions:

a. 24 inches outside of concrete forms other than at footings.

b. 12 inches outside of concrete forms at footings.

c. 6 inches outside of minimum required dimensions of concrete cast against
grade.

d. Outside dimensions of concrete walls indicated to be cast against rock without
forms or exterior waterproofing treatments.

e. 6 inches beneath bottom of concrete slabs-on-grade.

f. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe
or 42 inches wide.

B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be
classified as earth and rock. Do not excavate rock until it has been classified and cross
sectioned by District Representative. The Contract Sum will be adjusted for rock excavation
according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.
   
a. Intermittent drilling; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
   
a. 24 inches outside of concrete forms other than at footings.
   
b. 12 inches outside of concrete forms at footings.
   
c. 6 inches outside of minimum required dimensions of concrete cast against grade.
   
d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
   
e. 6 inches beneath bottom of concrete slabs-on-grade.
   
f. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus one inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus one inch. Do not disturb bottom of excavations intended as bearing surfaces.
B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations. Trench excavation and backfill shall conform to the provisions in the Caltrans Trenching and Shoring Manual and the Caltrans Standard Specifications.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."
3.8 SUBGRADE INSPECTION

A. Notify District Representative when excavations have reached required subgrade.

B. If District Representative determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.

2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by District Representative, and replace with compacted backfill or fill as directed.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by District Representative, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by District Representative.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by District Representative.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."

D. Trenches under Roadways: Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
   a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.
G. Final Backfill:
   1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
   2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

H. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL
A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
B. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use engineered fill.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill.
   5. Under footings and foundations, use engineered fill.
C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL
A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS
A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 6 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent and to least 2 percent above optimum moisture content.

2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent and to least 2 percent above optimum moisture content.

3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent and to least 2 percent above optimum moisture content.

4. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent and to least 2 percent above optimum moisture content.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus one inch.

2. Walks: Plus or minus one inch.

3. Pavements: Plus or minus one-half inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of one-half inch when tested with a 10-foot straightedge.
3.17 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Section 334600 "Subdrainage."

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
   1. Place base course material over subbase course under hot-mix asphalt pavement.
   2. Shape subbase course and base course to required crown elevations and cross-slope grades.
   3. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
   4. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
   5. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
   1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
   2. Place drainage course 6 inches or less in compacted thickness in a single layer.
   3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.20 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections as required by the Owner.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed as required by the District.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.21 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by District Representative; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by District Representative.
1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner’s property.

END OF SECTION
SECTION 31 23 19

DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Comply with rules and regulations of State of California, California Code of Regulations, Title 8, Industrial Relations, Chapter 4, Subchapter 4, “Construction Safety Order.”

C. Comply with applicable local and state agencies having jurisdiction.

D. Comply with governing EPA notification regulations.

1.2 SUMMARY

A. Section includes construction dewatering.

B. Related Requirements:

1. Section 312000 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.

2. Section 334600 "Subdrainage" for permanent foundation wall, underfloor, and footing drainage.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

1. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

2. Review condition of site to be dewatered including coordination with temporary erosion-control measures and temporary controls and protections.

3. Review geotechnical report.

4. Review proposed site clearing and excavations.

5. Review existing utilities and subsurface conditions.

6. Review observation and monitoring of dewatering system.
1.4 ACTION SUBMITTALS

A. Shop Drawings: For dewatering system, prepared by or under the supervision of a qualified professional engineer.
   1. Include plans, elevations, sections, and details.
   2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
   3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
   4. Include written plan for dewatering operations including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Field quality-control reports.
C. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.
D. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.

1.7 FIELD CONDITIONS

A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.
   1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
2. The geotechnical report is referenced elsewhere in Project Manual.

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.

2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.

3. Prevent surface water from entering excavations by grading, dikes, or other means.

4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.

5. Remove dewatering system when no longer required for construction.

B. Regulatory Requirements: Comply with governing EPA notification regulations and District requirements before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.

2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
B. Install dewatering system to ensure minimum interference with roads, 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 Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 015000 "Temporary Facilities and Controls," during dewatering operations.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.

2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.

C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
3. Maintain piezometric water level a minimum of 24 inches below bottom of excavation.

C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

3.4 FIELD QUALITY CONTROL

A. Observation Wells: Provide observation wells or piezometers, take measurements, and maintain at least the minimum number indicated; additional observation wells may be required by authorities having jurisdiction.

1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.

2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.

3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Survey-Work Benchmarks: Resurvey benchmarks regularly during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

C. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

D. Prepare reports of observations.

3.5 PROTECTION

A. Protect and maintain dewatering system during dewatering operations.

B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION
SECTION 32 13 13

PEDESTRIAN & VEHICULAR CONCRETE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDE:

A. Pedestrian path
B. Final subgrade preparation and paving base
C. Concrete paving, Walkways, Pedestrian & Vehicular Rated Concrete.
D. Concrete paving with integral color finish.

1.2 RELATED SECTIONS:
A. Section 31 23 00 Excavation and Fill
B. Section 32 80 00 Irrigation
C. Section 03 30 00 Cast in Place Concrete

1.3 COORDINATION: Coordinate work fully with all other trades involved. Including but not limited to items of other trades to be furnished and set in place. Such portions of their work as is all or in part embedded, built-in, attached to, or supported by the work shall be executed by them in ample time that progress of the work is not delayed. Any cutting or patching made necessary to comply with this injunction shall be done at the General Contractor’s expense. Contractor shall be responsible for the proper installation of all accessories embedded in the concrete and for the provision of holes, openings, etc., necessary to the execution of the work of the trades.

1.4 REFERENCE:

A. Perform work in accordance with all applicable laws, codes and regulation required by the School District.
B. Reference to “Standard Specifications” shall mean the current Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, CALTRANS.

1.5 QUALITY ASSURANCE:

A. Materials and methods of construction shall comply with the following standards:
   2. American Concrete Institute, (ACI).
B. Maintain field records of time, date of placing, curing and removal of forms of concrete in each portion of work.

1.6 GENERAL REQUIREMENTS:

A. All concrete work shall be true to line and grade as indicated on the drawings.

B. Anchor plates, inserts and other items embedded in concrete shall be accurately secured so that they will not be displaced during placement of concrete.

C. Surface Tolerance: Finished paving surfaces shall not vary more than 1/4 in. measured with a 10 ft. metal straightedge, except at grade changes. No birdbaths or other surface irregularities will be permitted. Correct irregularities to the satisfaction of Architect.

D. Finished paving surfaces shall not vary more than 1/8 in. measured with a 10 ft. metal straightedge. No birdbaths or other surface irregularities will be permitted. Correct irregularities to the satisfaction of Architect.

E. The Architect will select a qualified testing laboratory to take samples for testing during the course of the work as considered necessary. Costs of such tests will be paid for by the Owner. Contractor shall cooperate in making tests and shall be responsible for notifying the designated laboratory in sufficient time to allow taking samples at time of pour.

F. Should tests show that concrete is below specified strength, Contractor shall remove all such concrete, as directed by Architect. Full cost of removal of low strength concrete, its replacement with concrete of proper specified strength and testing shall be borne by the Contractor.

1.7 SUBMITTALS:

A. Submit concrete mix designs in accordance with section 01 33 00. Obtain approval before placing concrete.

B. Product data:
   1. Submit complete materials list of items proposed for the work. Identify materials source.
   2. Submit admixture, curing compound, retarder, and accessory item product data, if used.
   3. Submit material certificates for aggregates, reinforcing, and joint fillers, bonding agent or epoxy adhesive.
   4. Submit samples of concrete color to be used.
   5. Submit samples of expansion joint material and colors to be used.

C. Submit concrete delivery tickets. Show the following:
1. Batch number.

2. Mix by class or sack content with maximum size aggregate.

3. Admixtures.

4. Slump.

5. Time of loading.

D. Submit concrete test reports.

1.8 SAMPLES:

A. Flatwork: Save and match previously approved poured in place samples 4' X 4' X 4" sample of each concrete finish and color at job site. The approved samples shall be standards for finishes and color in concrete work. The samples shall be kept on site until the pedestrian and vehicular concrete has been completed.

B. Sealant: Furnish on site actual product sample in proposed color(s) for approval from Landscape Architect.

1.9 DELIVERY, STORAGE AND HANDLING:

A. Work notification: Notify A/E of Record at least 24 hours prior to installation of concrete.

B. Establish and maintain required lines and grade elevations. All concrete shall slope to drain with no ponding of water.

C. Do not install concrete work over wet, saturated, muddy, or frozen subgrade.

D. Do not install concrete when air temperature is below 40 degrees F. Use of calcium chloride, salt, or any other admixture to prevent concrete from freezing is prohibited.

E. Protect adjacent work.

F. Provide temporary barricades and warning lights as required for protection of project work and public safety.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Portland Cement: ASTM C150, Type 1, natural color, unless otherwise noted.

B. Aggregate: Provide ASTM C33 normal weight aggregates, 3/4" maximum size, clean, uncoated crushed stone or gravel coarse aggregate free of materials which cause staining or rust spots; fine aggregate shall be clean natural sand.
C. Water: Clean, fresh, and potable.
D. Water-reducing admixture: ASTM C494.
E. L.M. Scofield Company integral color

2.2 CONCRETE MIXES:

A. Provide Class A ready-mixed concrete. Batch mixing at site not acceptable.
   For all other site concrete: Use Portland Cement Concrete as determined by either laboratory trial mixtures or field experience.
   1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
   2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Indicate water added to mix at job site on each delivery ticket. Show quantity of water added. Site water tempered mixes exceeding specified slump range will be rejected as not complying with specification requirements.

C. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash or Pozzolan: 25 percent.
   2. Slag Cement: 50 percent.
   3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

D. Add air-entraining admixture at manufacturer's prescribed rate.

E. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

F. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

G. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate.

H. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
I. Concrete Mixtures: Normal-weight concrete.
   3. Compressive Strength (28 Days): 3000 psi for Pedestrian Concrete and 4000 psi for Vehicular
   4. Maximum W/C Ratio at Point of Placement: 0.50
   5. Slump Limit: 4 inches, plus or minus 1 inch.

2.3 ACCESSORIES:

A. Granular base: Class II Aggregate Base.

J. Forms: Wood or metal of sufficient strength to resist concrete placement pressure and to maintain horizontal and vertical alignment during concrete placement. Provide forms straight, free of defects and distortion, and height equal to full depth of concrete work.
   1. Provide 2" nominal thickness, surfaced plank wood forms for straight sections. Use flexible metal, 1" lumber or plywood forms to form radius bends.

K. Premolded Joint Filler: To be "Sonoflex-F" a closed cell plastic joint filler, as manufactured by Sonneborn-Contech, Building Products Division, Contech, Inc., or approved equal.

D. Joint Sealants: Two-components polysulfide or polyurethane elastomeric type complying with FS TT-S-00227, self-leveling, designed for foot traffic.

E. Integral color: Chromix Porcelain Gray 3987 by L.M. Scofield Company for Vehicular and Pedestrian concrete paving as shown on the plans.

F. Reinforcing steel: ASTM A615, A616, or A617, Grade 60, new domestic deformed steel bars.


H. Form release agent: Non-staining chemical form release agent free of oils, waxes, and other materials harmful to concrete.

I. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

J. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine subgrades and installation conditions. Do not start concrete work until unsatisfactory
conditions are corrected.

3.2 PREPARATION:

A. Proof roll the subgrade and do all necessary rolling and compacting to obtain firm, even subgrade surface. Fill and consolidate depressed areas. Remove uncompactable materials; replace with clean fill and compact base per the Geotechnical soils report recommendations.

B. Provide depth of compacted base material per the Landscape Drawings. Compact base to 95% of the maximum dry density in accordance with ASTM D1557.

L. Remove loose material and debris from base surface before placing concrete.

M. Install, align, and level forms. Stake and brace forms in place. Maintain following grade and alignment tolerances:

1. Top of form: Maximum 1/8" in 10'-0".
2. Vertical face: Maximum ½" in 10'-0".

E. Coat form surfaces in contact with concrete with form release agent. Clean forms after each use and coat with form release agent as necessary to assure separation from concrete without damage.

F. Install, set, and build-in work furnished under other specification sections. Provide adequate notification for installation of necessary items.

G. Install pipe sleeves for irrigation system furnished under Section 02810. Stake location of irrigation sleeves.

H. Secure subgrade compaction test results from certified lab. Compaction to comply with Geotechnical recommendations. Certificate of compliance to be reviewed by the Landscape Architect, prior to commencing with concrete work.

3.3 STEEL REINFORCEMENT:


C. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

D. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

E. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
F. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

G. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963.

H. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.4 INSTALLATION:

A. Concrete placement:

1. Comply with ACI 304 “Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete”, and as specified.

1. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing. In cold weather comply with ACI 306, “Recommended Practice for Cold Weather Concreting”. In hot weather comply with ACI 305, “Recommended Practice for Hot Weather Concreting”.

2. Moisten base to provide a uniform dampened condition at the time concrete is placed. Verify structures are at required finish elevation and alignment before placing concrete.

3. Place and spread concrete to the full depth of the forms. Use only square-end shovels or concrete rakes for hand-spooling and consolidating operations to prevent segregation of aggregate and dislocation of reinforcement.

5. Place concrete in a continuous operation between expansion joints.

6. Place concrete as indicated on the plans in one course, monolithic construction, for the full width and depth of concrete work.

7. Strike-off and bull-float concrete after consolidating. Level ridges and fill voids. Check surface with a 10'-0" straightedge. Fill depressions and refloat repaired areas. Darby the concrete surface to provide a smooth level surface ready for finishing.

B. Joints: Provide expansion joints using premolded joint filler at concrete work abutting curbs, walls, structures, walks, and other fixed objects.

1. Locate expansion joints as indicated.

2. Install joint fillers full-width and depth of joint. Recess top edge below finish grade for joint sealants.
3. Provide joint fillers in single lengths for the full slab width, whenever possible. Fasten joint filler sections together when multiple lengths are required.

4. Protect the top edge of the joint filler during concrete placement.

5. Brooming. After the curing period, expansion joints shall be carefully cleaned and filled with approved joint sealant to just below adjacent paved surface in such a manner as to avoid spilling on paved surfaces or overflow from joint.

C. Finishes

1. Finish: Medium Broom finish perpendicular to direction of travel.

D. Score Joints: saw-cut joints applied into the finished concrete. Refer to Landscape drawings for location and depth of joints.

E. Expansion Joints: Expansion joints shall be formed provided at the location and intervals as shown on the plans, and at all locations where concrete paving abuts buildings, curbs, or other structures. Approved joint material shall be placed with top edge 1/4 inch below the paved surface, and shall be securely held in place to prevent movement. Joint and other edges shall be formed in the fresh concrete using and edging tool to provide a smooth uniform impression. All edges shall be struck before and after brooming. After the curing period, expansion joints shall be carefully cleaned and filled with approved joint sealant to just below adjacent paved surface in such a manner as to avoid spilling on paved surfaces or overflow from joint.

F. Curing: Cure concrete with a clear, non-staining liquid membrane-forming compound. Spray apply in accordance with manufacturer’s recommended coverage rate. Apply curing compound immediately after completing surface finish.

3.5 TESTING: Provide slump test on first load of concrete delivered each day and whenever requested due to changes in consistency or appearance of concrete.

3.6 PROTECTION: Protect concrete work from damage due to construction and vehicular traffic until Final acceptance. Exclude construction and vehicular traffic from concrete pavements for at least 14 days.

3.7 CLEANING AND PATCHING:

A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair damage resulting from concrete operations.

B. Any defective concrete work which after corrective patching, rubbing, etc., fails to duplicate the appearance of unpatched work and/or conform to the standards set forth in these specifications shall be removed in its entirety and replaced at no additional cost to the contract.

C. Sweep concrete sidewalks and pavement, wash free of stains, discoloration, dirt, and other foreign material immediately prior to final acceptance.
SECTION 32 13 73

CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Cold-applied joint sealants.
   2. Hot-applied joint sealants.
   3. Cold-applied, fuel-resistant joint sealants.
   5. Joint-sealant backer materials.
   6. Primers.

B. Related Requirements:
   1. Section 079200 "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Paving-Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.

1.5 INFORMATIONAL SUBMITTALS
A. Qualification Data: For Installer.
B. Product Certificates: For each type of joint sealant and accessory.

1.6 QUALITY ASSURANCE
A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
B. Product Testing: Test joint sealants using a qualified testing agency.

1.7 FIELD CONDITIONS
A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL
A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS
A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D 5893, Type NS.
B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D 5893, Type SL.
C. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.

D. Single Component, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Use T.

E. Multicomponent, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade P, Class 25, for Use T.

2.3 HOT-APPLIED JOINT SEALANTS

A. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I or Type II.

2.4 COLD-APPLIED, FUEL-RESISTANT JOINT SEALANTS

A. Fuel-Resistant, Single-Component, Pourable, Modified-Urethane, Elastomeric Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Use T.

B. Fuel-Resistant, Multicomponent, Pourable, Modified-Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade P, Class 12-1/2 or 25, for Use T.

2.5 HOT-APPLIED, FUEL-RESISTANT JOINT SEALANTS

A. Hot-Applied, Fuel-Resistant, Single-Component Joint Sealants: ASTM D 7116, Type I or Type II.

2.6 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.7 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer’s written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer’s written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint-sealant backings.

2. Do not stretch, twist, puncture, or tear joint-sealant backings.

3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:
1. Place joint sealants so they fully contact joint substrates.

2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.5 PAVING-JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Joints within concrete paving.

1. Joint Location:

   a. Expansion and isolation joints in concrete paving.

   b. Contraction joints in concrete paving.

   c. Other joints as indicated.

2. Joint-Sealant Color: Manufacturer's standard or as indicated on Drawings.
B. Joint-Sealant Application: Joints within concrete paving and between concrete and asphalt paving.

1. Joint Location:
   a. Joints between concrete and asphalt paving.
   b. Joints between concrete curbs and asphalt paving.
   c. Other joints as indicated.


3. Joint-Sealant Color: Manufacturer's standard or as indicated on Drawings.

C. Joint-Sealant Application: Fuel-resistant joints within concrete paving.

1. Joint Location:
   a. Expansion and isolation joints in concrete paving.
   b. Contraction joints in concrete paving.
   c. Other joints as indicated.

2. Joint-Sealant Color: Manufacturer’s standard or as indicated on Drawings.

END OF SECTION
SECTION 32 14 13

CONCRETE PAVERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete Paver Units (manually installed)
B. Bedding and Joint Sand.
C. Edge Restraints.
D. Geotextiles.
E. Bedding and Joint Sand.

1.2 RELATED SECTIONS

A. Section: 31 23 00 Excavation and Filling.
B. Section: 32 11 00 Base Courses.
C. Section: 32 16 13 Concrete Curbs and Gutters.
D. Section: 33 40 00 Storm Drainage Utilities.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):
   3. C 140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
   5. C 936, Standard Specification for Solid Concrete Interlocking Paving Units.
   7. C 1645, Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.
   8. D 698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,000 ft-lbf/ft3 (600 kN-m/m3)).
   9. D 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
10. D 2940, Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports.


1.4 SUBMITTALS

A. In accordance with Conditions of the Contract and as specified below.

B. Manufacturer’s drawings and details: Indicate perimeter conditions, relationship to adjoining materials and assemblies, concrete paver layout, installation and setting details.

C. Sieve analysis per ASTM C 136 for grading of bedding and joint sand.

D. Concrete pavers:
   1. One (1) representative full-size sample of each paver type, thickness, color, finish that indicate the range of color variation and texture expected in the finished installation. Please have Landscape Architect review on-site prior to installation.
   2. Accepted samples become the standard of acceptance for the work.
   3. Test results from an independent testing laboratory for compliance of concrete pavers with ASTM C 936.
   4. Manufacturer’s catalog product data, installation instructions, and material safety data sheets for the safe handling of the specified materials and products.
   5. LEED-NC Sustainable Sites (SS) and Materials & Resources (MR) Credits:
      a. SS Credit 7.1: Heat Island Effect, Nonroof – Test results indicating a minimum solar reflectance index of 29.
      b. SS Credit 7.2: Heat Island Effect, Roof – Test results indicating a minimum solar reflectance index of 29 for paving units on low-sloped roofs < 2:12 (15%) and/or 78 for steep-sloped roofs >2:12 (15%).
      c. MR Credit 3: Materials Reuse – Manufacturer letter certifying that 5% or 10% of paver content consists of recycled, crushed concrete, based on cost.
      d. MR Credit 4: Recycled Content – Manufacturer letter certifying that 10% or 20% of recycled content by weight consists of the sum of post-consumer recycled materials and 5% of pre-consumer recycled materials. The recycled fraction of the pavers shall be multiplied by its cost to determine the total value of the recycled content and percentage of recycled content.
      e. MR Credit 5: Regional Materials – Manufacturer letter certifying that a minimum of 10% or 20% (based on cost) of aggregates, cement, and concrete pavers extracted and manufactured within 500 miles (800 km) of the project site.

E. Paver Installation Subcontractor:
   1. Job references from projects of a similar size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.
1.5 QUALITY ASSURANCE

A. Paving Subcontractor Qualifications:
   1. Utilize an installer having successfully completed concrete paver installation similar in design, material, and extent indicated on this project.

B. Review the manufacturers’ quality control plan, paver installation subcontractor’s Method Statement and Quality Control Plan with pre-construction meeting of representatives from the manufacturer, paver installation subcontractor, general contractor, engineer and/or owner’s representative.

C. Mock-Ups:
   1. Install a 7 ft x 7 ft (2 x 2 m) paver area.
   2. Use this area to determine surcharge of the bedding sand layer, joint sizes, lines, laying pattern(s), color(s) and texture of the job. Pattern as shown on Plans.
   3. This area will be used as the standard by which the work will be judged.
   4. Subject to acceptance by owner and Landscape Architect, mock-up may be retained as part of finished work.
   5. If mock-up is not retained, remove and properly dispose of mock-up.
   6. Owner and Landscape Architect to accept before continuing the work.

1.6 DELIVERY, STORAGE & HANDLING

A. General: Comply with Conditions of Contract.

B. Comply with manufacturer’s ordering instructions and lead-time requirements to avoid construction delays.

C. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged container packaging with identification tags intact on each paver bundle.
   1. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
   2. Deliver concrete pavers to the site in steel banded, plastic banded or plastic wrapped packaging capable of transfer by forklift or clamp lift.
   3. Unload pavers at job site in such a manner that no damage occurs to the product or existing construction.

D. Storage and Protection: Store materials in protected area such that they are kept free from mud, dirt, and other foreign materials.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install in rain.
1.8 MAINTENANCE

A. Extra Materials: Provide 10% additional material for use by owner for maintenance and repair.
B. Pavers shall be from the same production run as installed materials.

PART 2 PRODUCTS

CONCRETE PAVERS: Solid interlocking paving units complying with ASTM C 936 made from 2.1 normal-weight aggregates.

A. Basis-of-Design Products: The design for concrete pavers is based on Hanover Architectural Products: 5000 Hanover Road, Hanover, PA 17331 (800) 426-4242
1. Paving Type 1:
   a. Hanover Architectural Products, Prest Brick or approved equal.
   b. Thickness: Refer to Plans
   c. Face Size and Shape: 8 inches square.
   d. Color: Refer to plans
   e. Finish: Tudor
2. Paving Type 2:
   a. Hanover Architectural Products, Prest Brick Pavers or approved equal.
   b. Thickness: Refer to Plans
   c. Face Size and Shape: 6 inches Square
   d. Color: Refer to Plans
   e. Finish: Tumbled
   f. Edge: Square

2.2 PRODUCT SUBSTITUTIONS

A. Substitutions: Approved Equal only as determined by the Landscape Architect.

2.3 BEDDING AND JOINT SAND

A. Provide bedding and joint sand as follows:
   1. Washed, clean, non-plastic, free from deleterious or foreign matter, symmetrically shaped, natural or manufactured from crushed rock.
   2. Do not use limestone screenings, stone dust, or sand for the bedding sand material that does not conform to conform to the grading requirements of ASTM C 33.
   3. Do not use mason sand or sand conforming to ASTM C 144 for the bedding sand.
   4. Sieve according to ASTM C 136.
   5. Bedding Sand Material Requirements: Conform to the grading requirements of ASTM C 33 with modifications as shown in Table 1.
Table 1
Grading Requirements for Bedding Sand
ASTM C 33

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 in.(9.5 mm)</td>
<td>100</td>
</tr>
<tr>
<td>No. 4 (4.75 mm)</td>
<td>95 to 100</td>
</tr>
<tr>
<td>No. 8 (2.36 mm)</td>
<td>85 to 100</td>
</tr>
<tr>
<td>No. 16 (1.18 mm)</td>
<td>50 to 85</td>
</tr>
<tr>
<td>No. 30 (0.600 mm)</td>
<td>25 to 60</td>
</tr>
<tr>
<td>No. 50 (0.300 mm)</td>
<td>10 to 30</td>
</tr>
<tr>
<td>No. 100 (0.150 mm)</td>
<td>2 to 10</td>
</tr>
<tr>
<td>No. 200 (0.075 mm)</td>
<td>0 to 1</td>
</tr>
</tbody>
</table>

6. Joint Sand Material Requirements: Conform to the grading requirements of ASTM C 144 as shown with modifications in Table 2 below:

Table 2
Grading Requirements for Joint Sand

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>ASTM C 144 Natural Sand</th>
<th>ASTM C 144 Manufactured Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4 (4.75 mm)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>No. 8 (2.36 mm)</td>
<td>95 to 100</td>
<td>95 to 100</td>
</tr>
<tr>
<td>No. 16 (1.18 mm)</td>
<td>70 to 100</td>
<td>70 to 100</td>
</tr>
<tr>
<td>No. 30 (0.600 mm)</td>
<td>40 to 75</td>
<td>40 to 100</td>
</tr>
<tr>
<td>No. 50 (0.300 mm)</td>
<td>10 to 35</td>
<td>20 to 40</td>
</tr>
<tr>
<td>No. 100 (0.150 mm)</td>
<td>2 to 15</td>
<td>10 to 25</td>
</tr>
<tr>
<td>No. 200 (0.075 mm)</td>
<td>0 to 1</td>
<td>0 to 5</td>
</tr>
</tbody>
</table>

2.4 ACCESSORIES

A. Provide accessory materials as follows:

1. Edge Restraints
   a. Steel Edge Restraints: Galvanized steel angle, 3 inch by 3 inch 3/16 inch thick, bolt holes per drawings.

2. Geotextile:
   a. Per detail.

PART 3 EXECUTION
3.1 ACCEPTABLE INSTALLERS

A. Installers with 5 years or more installing similar paving systems.

3.2 EXAMINATION

A. Acceptance of Site Verification of Conditions:
   1. General Contractor shall inspect, accept and certify in writing to the paver installation subcontractor that site conditions meet specifications for the following items prior to installation of concrete pavers.
      a. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
      b. Verify that geotextiles have been placed according to drawings and specifications.
      c. Verify that subgrade preparation, thickness, compacted density, surface tolerances and elevations conform to specified requirements.
      d. Provide written density test results for soil subgrade and aggregate base materials to the Owner, Landscape Architect, General Contractor and paver installation subcontractor.
      e. Verify location, type, and elevations of edge restraints, utility structures, and drainage pipes and inlets.
   2. Do not proceed with installation of bedding sand and concrete pavers until subgrade soil and base conditions are installed correctly.

3.3 PREPARATION

A. Verify base is dry, certified by General Contractor as meeting material, installation and grade specifications.

B. Verify that base and geotextile is ready to support sand, edge restraints, and, pavers and imposed loads.

C. Edge Restraint Preparation:
   1. Install edge restraints per the drawings and manufacturer’s and the elevations required to provide proper elevation of Finished Grade of Pavers.
   2. Mount directly to finished base. Do not install on bedding sand.

3.4 INSTALLATION

A. General
   1. Any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities shall be removed before application of the Geotextile per Geotechnical Report and subbase materials.
   2. Keep area where pavement is to be constructed free from sediment during entire job. Geotextiles per Geotechnical Report Base and bedding materials contaminated with sediment shall be removed and replaced with clean materials.
3. Do not damage drainpipes, overflow pipes, observation wells, or any inlets and other drainage appurtenances during installation. Report any damage immediately to the project engineer.

4. The minimum slope of the soil subgrade should be 0.5%. Actual slope of soil subgrade will depend on the drainage design and exfiltration type. All drainpipes, observation wells, overflow pipes, geotextile (if applicable) and impermeable liner (if applicable) should be in place per the drawings prior to or during placement of the subbase and base, depending on their location. Care must be taken not to damage drainpipes during compaction and paving. No mud or sediment can be left on the base or bedding aggregates. If they are contaminated, they must be removed and replaced with clean materials.

B. Edge Retention
   1. Install edge retention per manufacturer’s specifications, and in locations as shown on the plans.

C. Geotextiles
   1. Place on bottom and sides of soil subgrade. Secure in place to prevent wrinkling from vehicle tires and tracks.
   2. Overlap a minimum of 0.3m (12 in.) in the direction of drainage.

D. Sub Base and Base
   1. Moisten, spread and compact the subbase in 4 to 6 in. (100 to 150 mm) lifts without wrinkling or folding the geotextile. Place subbase to protect geotextile from wrinkling under equipment tires and tracks.
   2. In-place density of the base and subbase may be checked per ASTM D 4254. Compacted density should be 90% of the laboratory index density established for the subbase and base stone.

E. Bedding Layer
   1. Spread bedding sand evenly over the base course and screed per thickness shown on plans. Spread bedding sand evenly over the base course and screed rails, using the rails and/or edge restraints to produce specified thickness, allowing for specified variation in the base surface.
      a. Do not disturb screeded sand.
      b. Screeded area shall not substantially exceed that which is covered by pavers in one day.
      c. Do not use bedding sand to fill depressions in the base surface.

F. Concrete pavers and join/opening fill material
   1. Place units hand tight without using hammers. Make horizontal adjustments to placement of laid pavers with rubber hammers and pry bars as required.
   2. Provide joints between pavers between 1/8 in. and 3/16 in. (4 and 5 mm) wide.
   3. Joint (bond) lines shall not deviate more than ±1/2 in. (±15 mm) over 50 ft. (15 m) from string lines.
4. Fill gaps at the edges of the paved area with cut pavers or edge units, unless otherwise shown on plans.
5. Cut pavers to be placed along the edge with a double blade paver splitter or masonry saw.
6. Keep skid steer and forklift equipment off newly laid pavers that have not received initial compaction and joint sand.
7. Use a low-amplitude plate compactor capable of at least minimum of 4,000 lbf (18 kN) at a frequency of 75 to 100 Hz to vibrate the pavers into the sand. Remove any cracked or damaged pavers and replace with new units.
8. Simultaneously spread, sweep and compact dry joint sand into joints continuously until full. This will require at least 4 to 6 passes with a plate compactor. Do not compact within 6 ft (2 m) of unrestrained edges of paving units.
9. All work within 6 ft. (2 m) of the laying face must shall be left fully compacted with sand-filled joints at the end of each day or compacted upon acceptance of the work. Cover the laying face or any incomplete areas with plastic sheets overnight if not closed with cut and compacted pavers with joint sand to prevent exposed bedding sand from becoming saturated from rainfall.
10. Remove excess sand from surface when installation is complete.
11. Surface shall be broom clean after removal of excess joint sand.
3.5 FIELD QUALITY CONTROL

A. After sweeping the surface clean, check final elevations for conformance to the drawings.
B. Lippage: No greater than 1/8 in. (3 mm) difference in height between adjacent pavers.
C. The minimum slope of the finished pavement surface should be 1%. The surface of the pavers may be 1/8 to 1/4 in. (3 to 6 mm.) above the final elevations after compaction. This helps compensate for possible minor settling normal to pavements.
D. The surface elevation of pavers shall be 1/8 to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.

3.6 PROTECTION

A. After work in this section is complete, the General Contractor shall be responsible for protecting work from sediment deposition and damage due to subsequent construction activity on the site.

END OF SECTION 32 14 13
SECTION 32 17 26

TACTILE WARNING SURFACING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Current versions of CalDAG, California Title 24, and ADA standards.

1.2 SUMMARY

A. Section Includes:

   1. Detectable warning mats.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of exposed finish requiring color selection.

C. Samples for Verification: For each type of tactile warning surface, in manufacturer’s standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

   1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1.7 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Adhesive Application:

1. Apply adhesive only when ambient temperature is above 50 degrees Fahrenheit and when temperature has not been below 35 degrees Fahrenheit for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.

C. Weather Limitations for Mortar and Grout:


2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 degrees Fahrenheit and higher.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Deterioration of finishes beyond normal weathering and wear.

   b. Separation or delamination of materials and components.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

A. Accessibility Requirements: Comply with applicable provisions in the California Disabled Accessibility Guidebook, Division of State Architect, U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities, and California Title 24 for tactile warning surfaces.

1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.
B. Source Limitations: Obtain each type of tactile warning surfacing from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 DETECTABLE WARNING PAVERS

A. Product: HANOVER Architectural Products, Detectable Warning Pavers or approved equivalent.

1. 240 Bender Road
   Hanover, PA 17331
   Tel. (717) 637-0500
   Fax (717) 637-7145

B. Paver Dimensions: 11 inches by 11 inches by 2 inches thick.

C. Detectable warning domes: Manufactured in accordance with the requirements set forth in the Americans with Disabilities Act and Division of the State Architect.

1. In-line, 2.35 inches on center, domes 0.9 inches at base, 0.45 inches at top diameter, 0.2 inches thick.

D. Color: Standard Charcoal

E. Composition and Materials: High density, hydraulically pressed concrete units, a homogeneous mix of Portland Cement, fine and coarse aggregates, manufactured to plus or minus 1/8 inch tolerances.

F. Pavers shall meet the following requirements set forth in ASTM C-936, Standard Specification for Interlocking Concrete Paving Units:

1. Average compressive strength of 8,000 psi with no individual unit under 7,200 psi.

2. Average absorption of 5% with no unit greater than 7% when tested in accordance with ASTM C-140.

3. Resistance to 50 freeze-thaw cycles when tested in accordance with ASTM C-67.

G. Pigment in concrete pavers shall conform to ASTM C-979.

H. Visual Inspection

1. All units shall be sound and free of defects that would interfere with the proper placing of unit or impair the strength or permanence of the construction.
2. Minor cracks incidental to the usual methods of manufacture, or chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection.

I. Sampling and Testing

1. Manufacturer shall provide testing backup data showing manufactured products that meet and exceed ASTM 936-82 when tested in compliance with ASTM C-140.

2. Test units in accordance with ASTM for compressive strength, absorption and dimensional tolerance. A minimum of three (3) specimens per test required for an average value. Testing of full units is preferred.

2.3 LATEX BASED THICK MORTAR SETTING BED

A. Mortar: non-staining, cement/lime mortar, complying with ASTM C-270, using specified materials. Mortar shall be Type S.

1. Cement: Provide white cement as follows:

   a. Portland cement ASTM C-150, complying with the staining requirements of ASTM C-91 for not more than 0.03% water soluble alkali. Furnish Type 1, except Type III may be used for setting stonework in cold weather.

   b. Masonry cement: ASTM C-91, non-staining.

2. Hydrated lime: ASTM C-207, Type S.

3. Sand: ASTM C-144, clean, sharp, washed mason's sand. Sand must be dry or free-flowing so that its use with the latex emulsion will not produce a very wet, unstable material.

   a. Mortar setting and spots: Mason sand conforming to ASTM C-144 for mortar bed and ASTM C-33 concrete sand bagged 30-60 mesh silica for slurry bond coat.

4. Water: Clean, potable, and free from injurious amounts of acids, alkalis, organic materials or other harmful substances.

5. Liquid admixture for setting bed and joints: Liquid latex mortar additive with a compression strength of 4000 psi, bond strength of 500 psi, and a water absorption of 4% maximum. Subject to compliance with requirements, provide Laticrete 3701, manufactured by Laticrete International, Inc., or equal. Admixture to be styrenebutadiene; polyvinyl acetate is not to be substituted.
a. Bond coat mortar admixture: High strength liquid latex mortar additive with a compressive strength of 5000 psi, bond strength of 500 psi, tensile strength of 500 psi, and water absorption of 4% maximum. Subject to compliance with requirements, provide Laticrete 4237, manufactured by Laticrete International, Inc., or approved equivalent.

B. Mixes

1. General: Mix mortars and grouts to comply with latex additive manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, pot life and other procedures needed to produce mortar and grout or uniform quality and with optimum performance characteristics.

a. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, anti-freeze compounds, or other admixtures, unless otherwise indicated. Do not use calcium chloride.

b. Grout color is to match paver color.

2. Latex additives: Adjust liquid quantity for proper consistency per manufacturer's written recommendations; do not add water unless specifically recommended by additive manufacturer.

3. Setting mortar shall be of the following proportions:

a. One part Portland Cement

b. Three cubic feet of course aggregate sand

c. 5-gallon latex additive. Adjust quantity of liquid to obtain proper consistency.

2.4 DETECTABLE WARNING MATS

A. Surface-Applied Detectable Warning Mats: Accessible truncated-dome detectable warning resilient mats, UV resistant, manufactured for adhering to existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of mat, and beveled outside edges.

1. Material: Modified rubber compound, UV resistant.

2. Color: As indicated by manufacturer's designations.

3. Shapes and Sizes:

a. Rectangular panel, 36 inches wide, minimum.

5. Mounting: Adhered to pavement surface with adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.

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

3.2 INSTALLATION OF TACTILE WARNING SURFACING

A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.

B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of Americans with Disabilities Act and Division of the State Architect.

3.3 INSTALLATION OF DETECTABLE WARNING MATS

A. Lay out detectable warning mats as indicated and mark concrete pavement at edges of mats.

B. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.

C. Apply adhesive to back of mat in amounts and pattern recommended by manufacturer, and set mat in place. Firmly seat mat in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to mat to ensure full contact with adhesive.

D. Install anchor devices through face of mat and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with mat surface.

E. Mask mat perimeter and adjacent concrete, and apply sealant in continuous bead around perimeter of mat.

F. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning mat and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.

G. Protect installed mat from traffic until adhesive has set.
3.4 CLEANING AND PROTECTION

A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.

B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION
SECTION 32 80 00

IRRIGATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General and Supplementary Conditions and General Requirements apply to the work herein specified.

1.2 DESCRIPTION:

A. Contractor shall furnish all labor, tools, equipment, product, materials and transportation and perform all operations necessary to properly execute and complete all work in accordance with the Drawings and these Specifications. The intent is to accomplish the work of installing an irrigation system, which will operate in an optimum manner. This intention is to be met foregoing any deficiency in setting a complete detailed description of the work to be done.

B. Related Work Specified Elsewhere:

1. Earthwork and Site Grading
2. Section 32 90 00: Landscape Planting
3. Mechanical
4. Electrical

1.3 QUALITY ASSURANCE:

A. Reference Standards:

1. ASTM: American Society for Testing and Materials

2. NSF: National Sanitation Foundation

B. Drawings:

1. For purposes of clarity and legibility, drawings are essentially diagrammatic to the extent that many offsets, bend, unions, special fittings, and exact locations of items are not indicated, unless specifically dimensioned.

2. Exact routing of piping, etc., shall be governed by structural conditions, obstructions. Contractor shall make use of data in Contract Documents.
3. The contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that unknown obstructions, grade difference or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differences shall be brought to the attention of the irrigation consultant. In the event this notification is not performed, the contractor shall assume full responsibility for any revision necessary.

1.4 VISIT TO THE SITE:

The contractor shall visit the construction site and shall take all measurements and obtain any other information as may be necessary for a complete and conclusive bid.

1.5 SUBMITTALS:

A. Substitutions:

Prior to installation, any proposed substitution from the plans or these specifications is to be forwarded, in writing, to the irrigation consultant for approval.

B. Record Drawings:

Provide record drawings as follows:

1. The contractor shall maintain in good order in the field office one complete set of prints of all sprinkler drawings, which form a part of this contract. In the event any work is not installed as indicated on the drawings, such work shall be indicated and dimensioned accurately on record drawings as changes occur. Dimension from two permanent points of reference, building corner, sidewalk, road intersections, etc., the location of the following items.

   a. Connection to existing water lines
   b. Connection of existing electrical power
   c. Routing of pressure lines (dimension max. 100 feet lone along routing)
   d. Electrical control valves
   e. Routing of control wires
   f. Quick-coupling valves
   g. Underground stub-outs
   h. Other related equipment as directed by the irrigation consultant

2. Upon completion of the work, obtain reproducible sepias from the landscape architect and neatly correct the plans (to be done by a competent draftsperson) to show the as-built conditions. After the as-builts are reviewed and approved by the irrigation consultant, obtain reduced copies of "as-built" sepias (8-1/2" x 11" sheets or to the smallest readable size), and laminate with weather proofing coating.

C. Operation and Maintenance Manuals:

1. Prior to the final inspection of the irrigation system, furnish two (2) individually bound Service Manuals to the owner. The manuals shall contain the following:
a. Index sheet indicating the contractor's name, address, and phone number.

b. A copy of the completed guarantee-following the form in these specifications.

c. Certificate of insurance verifying coverage for completed operations.

d. List of equipment with names, addresses and telephone numbers of all local manufacturer's representatives.

e. Copies of equipment warranties and certificates.

f. Complete operating and maintenance instructions of all equipment including exploded drawings and spare parts list.

D. Hardware Items:

1. Two (2) sets of matching Q.C.V. keys and hose swivels.

2. Two (2) keys to each controller box.

3. Two (2) sets of any special tool required for the maintenance of each type of component used in the sprinkler system.

1.6 PROJECT COORDINATION:

A. Sequencing and Scheduling:

Coordinate irrigation installation work with the installation of other site improvements, including utility installation work and landscape installation.

B. Environmental Conditions:

Site work such as trenching and backfilling shall not be performed during wet, muddy or frozen conditions.

C. Rules and Regulations:

All work and materials shall be in full accordance with the latest rules and regulations of the National Electric Code; the Uniform Plumbing Code and other applicable state or local laws or regulations. Nothing in these drawings or specifications is to be construed to permit work not conforming to these codes.

1. The contractor shall furnish any additional material and labor required to comply with these rules and regulations, though the work is not mentioned in these particular specifications or shown on the drawings.

2. When the specifications call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, the provision of the specifications shall take precedence over the requirements of the said rules and regulations.
D. Safety:

1. The contractor shall erect and maintain barricades, guards, warning signs, and lights as required for the protection of the public and workmen.

2. All work shall be performed in a safe manner. All regulations, all OSHA requirements and other authoritative agencies shall be followed.

3. Prior to commencement of work, locate all underground utilities so that proper precautions may be taken not to damage such improvements.

E. Maintaining Traffic:

It is the responsibility of the contractor to ensure adequate protection and controls for pedestrian and vehicular traffic in the vicinity of the project areas. The contractor shall provide all signs, barricades, flagmen, etc., necessary to meet all traffic requirements for this project at his own expense.

F. Permits and Fees:

The contractor shall obtain all permits and pay all required fees to any governmental agency having jurisdiction over the work and arrange for inspections specified by local ordinances during the course of construction as necessary.

PART 2 - PRODUCTS

2.1 PRODUCT DELIVERY, STORAGE AND HANDLING:

Handling of pipe and fittings: The contractor is cautioned to exercise care in handling, loading, unloading, and storing of pipe and fittings. Cracks can occur from sudden impact. Protect all plastic products from excessive exposure to sunlight. Any section of pipe that has been dented or damaged shall be removed from the site and, if installed, shall be replaced with new undamaged piping.

2.2 MATERIALS:

A. PVC non-pressure lateral line piping and fittings:

1. Pressure main line piping: PVC Schedule 40.

2. Pipe shall be made from NSF approved, Type 1, Grade 1 PVC compound conforming ASTM D1784. All pipe shall meet requirements set forth in ASTM D2441 with an appropriate standard dimension ratio.

3. All PVC pipe shall bear the following markings:

   a. Manufacturer’s name
   b. Nominal pipe size
   c. Schedule or class
   d. Pressure rating in PSI
   e. NSF
f. Date of extrusion

4. All fittings shall bear the manufacturer’s name or trademark, material designation, size, applicable I.P.D. schedule and NSF seal of approval.

B. PVC non-pressure lateral line piping and fittings:

1. Non-pressure buried lateral line piping shall be PVC 1120 Class 200 with solvent-weld joints.

2. Pipe shall be made from NSF approved, Type 1, Grade 1 PVC compound conforming to ASTM D1784. All pipe shall meet requirements set forth in ASTM D2441 with an appropriate standard dimension ratio.

3. Except as heretofore specified, all requirements for non-pressure lateral line pipe and fittings shall be the same as for solvent-weld pressure main line pipe and fittings as specified.

C. Slewing and Conduit: Material shall be polyvinyl chloride (PVC) Schedule 40, type 1120/1220 with solvent weld.

D. Galvanized steel pipe shall be Schedule 40; ASTM (A120) and steel fittings shall be Schedule 40 hot dipped, double banded malleable steel.

E. PVC Schedule 80 nipples shall be used with molded threads. Machined threaded nipples will not be allowed.

F. Connections between supply line and R.C.V.'s shall be as specified or detailed on the drawings.

G. Riser assemblies shall be as specified or detailed on the drawings.

H. Controller, valves, and sprinkler heads shall be specified and/or detailed on the drawings.

I. Control wire shall be copper wire as scheduled by valve manufacturer or larger and shall be UL-approved for direct burial in ground. Common ground wire shall have white insulating jacket. All other control wire shall have jacket of color other than white.

J. Miscellaneous installation materials:

1. Solvent weld joints shall be of make and type approved by manufacturer(s) of pipe and fittings. Solvent cement shall be a proper consistency throughout use. Mixing thinner with solvent will not be allowed.

2. Pipe joint compound shall be non-hardening, non-toxic materials designed specifically for use on threaded connections in water carrying pipe.

3. Wire connections shall be 3M #3750 Scotch Lok Seal Packs.

K. Control or Valve Boxes:
1. Provide 14 x 19 inch plastic rectangular control valve box for each electrical control valve. Lids shall be engraved with controller station number, typical, with bolt down lid.

2. For ball valves and quick coupling valves: Use 9-inch plastic round box. Add extensions for gate valves as required.

PART 3 - EXECUTION

3.1 GENERAL:

A. Irrigation system shall be installed in accordance with all applicable local and state codes and ordinances by a licensed landscape contractor.

B. Follow manufacturer's direction except as shown or specified.

3.2 INSPECTION OF SITE CONDITIONS:

A. All scaled dimensions are approximate. The contractor shall check and verify all size dimensions prior to proceeding with work under this Section.

B. Exercise extreme care in excavating and working near existing utilities. Contractor shall be responsible for damages to utilities, which are caused by his operations or neglect. Check existing utilities drawings for existing utility locations.

C. Coordinate installation of irrigation materials, including pipe, so there shall be no interference with utilities or other construction or difficulty in planting trees, shrubs, and groundcover.

D. Avoid trenching within drip line of trees where possible. When not possible, all damaged roots over 1-1/2" in diameter shall be cut leaving clean face, seal cuts with tree seal, then immediately install pipe, wire, etc., refill trench and soak.

E. The contractor shall carefully check all grades to satisfy himself that he may safely proceed before starting work on the irrigation installation.

F. Coordinate the work of this Section with that of other Sections for the location of pipe sleeves through walls, paving, etc.

G. The landscape contractor shall verify water pressure and available gallonage prior to construction. If deficiencies are noted that will hinder the system's performance, notify the irrigation consultant for directions to correct deficiencies.

H. The design is diagrammatic. All piping, valves, etc., shown within paved areas is design clarification only. Install piping, valves, etc., in planting areas.

3.3 PREPARATION - LAYOUT OF WORK:

Prior to installation, stake out all pressure supply lines, routing and location of sprinkler heads and notify irrigation consultant for reviewing layout when area or grade differences or obstructions are not as indicated on the plans.
3.4 INSTALLATION:

A. Trenching:

1. Dig trench straight and support pipe continuously on bottom of trench. Lay pipe to an even grade. Trenching excavation shall follow layout shown on drawings.

2. Provide for a minimum of 18 inches cover for all pressure supply lines.

3. Provide for a minimum cover of 12 inches for all non-pressure lines to spray heads.

4. Provide for a minimum cover of 18 inches for all control wiring.

5. Provide a minimum cover of 24 inches over pipe and wiring under asphalt pavement.

B. Backfilling:

1. In accordance with requirements of SECTION 02215, "EXCAVATION AND BACKFILLING".

2. Do not backfill trenches until all required tests are performed. Carefully backfill trenches with specified excavated materials for backfilling, consisting of earth, loam, sandy clay, sand, or other acceptable materials, free from large clods of earth or stones. Backfill shall be mechanically compacted in landscaped areas to a dry density equal to adjacent undisturbed soil in planting areas. Backfill shall conform to adjacent grades without dips, sunken areas, humps or other surface irregularities.

3. Surround pipe with sand in rocky terrain with a 4" bed and 4" cover.

4. Backfill in proposed asphalt paved areas shall have sand covering pipe with a 6" minimum depth.

C. Pipe and Fitting Installation and Connections:

1. Install no multiple assemblies on plastic lines. Provide each assembly with its own outlet.

2. Install all assemblies specified herein in accordance with details shown on drawings.

3. Thoroughly clean PVC pipe and fittings of dirt, dust and moisture before installation. Installation and solvent welding methods shall be as recommended by the pipe and fitting manufacturer.

4. On PVC to metal connections, the contractor shall work the metal connections first. Use Teflon tape, or equal, on all threaded PVC to PVC, and on all tressed PVC to metal joints.
5. Install piping under existing walks by boring whenever possible. Where any cutting or breaking of sidewalks and/or concrete is necessary, it shall be done and replaced at no increase in contract sum. Obtain permission to cut or break sidewalks and/or concrete from the architect before proceeding. No hydraulic driving will be permitted under concrete paving.

D. Line clearance:

All lines shall have a minimum clearance of 6 inches from each other and from lines of other trades. Parallel lines shall not be installed directly over one another.

E. Automatic Controller:

1. Locate controller in general location shown with exact placement to be determined at job site by the irrigation consultant or School District representative.

2. Connect control lines to controller in sequential arrangement according to assigned identification number on plans.

3. Controller shall be properly grounded per Article 250 of the National Electric Code and conform to local regulations.

F. Remote Control Valves:

Install where shown on drawings. When grouped together, allow at least 12 inches between valves. Install each remote control valve in a separate valve box. Locate boxes in groundcover areas whenever possible, and a minimum of 12 inches from paving or curbs. Each valve shall have a plastic tag identifying the controller station number.

G. Control Wiring:

1. Make connections between existing automatic controls and electrical control valves with direct burial copper wire. Common wires shall be white. Install in accordance with valve manufacturer’s specifications and wire charts.

2. Wiring shall occupy the same trench and shall be installed along the same route as pressure supply or lateral lines wherever possible. When not possible, house wiring in PVC conduit as described in "Sleeving and Conduit" section.

3. Where more than one wire is placed in a trench the wiring shall be taped together at intervals of 10 feet.

4. Provide 2-foot expansion coil at each wire connection and at least every 100 feet of wire length on runs more than 100 feet in length. Form expansion coils by wrapping at least five turns of wire around a 1-inch diameter pipe, then withdrawing the pipe.

5. Splicing on runs shall be placed in junction boxes. Indicate all splices on the As-Built Plan.
6. All below grade wire connections shall be made by using heat shrink tubing with interwall sealer following manufacturers recommended procedures.

7. Install separate common wire for each controller. Install extra control wire of different color through all valve boxes to controller.

H. Sleeving and Conduit:

1. Control wiring passing under proposed concrete and paving shall pass through Schedule 40 PVC conduit-size as required.

2. Sleeving and conduit shall extend six (6") beyond farthest edge of pavement or curb.

3. Provide removable non-decaying plug at ends of sleeves and conduits to prevent entrance of earth.

I. Flushing of System:

1. After all new pipelines and risers are in place and connected, all necessary diversion work has been completed, and prior to installation of sprinkler heads, open control valves and use a full head of water to flush out the system.

2. Install sprinkler head only after flushing of system has been accomplished.

J. Sprinkler Heads:

1. Install sprinkler heads as shown on Drawings.

2. Spacing of heads shall not exceed maximum shown on Drawings. In no case shall spacing exceed maximum recommended by manufacturer.

3.5 FIELD QUALITY CONTROL:

A. Adjustment of the System:

1. Flush and adjust all bubblers for optimum performance and to prevent overspray onto walks, roadways and buildings.

2. If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, the contractor shall make such adjustments prior to planting. Adjustments may also include changes in nozzles sizes and degrees of arc as required.

3. Lowering raised sprinkler heads by the contractor shall be accomplished within ten days after notification.

B. Testing of Irrigation System:

1. Notify the irrigation consultant at least three (3) days in advance of testing.

2. Test to be done at no extra cost to the Owner.
3. Center load piping with sufficient amount of backfill to prevent arching or slipping under pressure. No fitting shall be covered.

4. Testing of pressure main lines shall occur prior to installation of electrical control valves.

5. Pressure Test for Solvent Weld Pipes:
   a. Apply test for welded plastic pipe joints have cured at least 4 hours or more it manufacturer of solvent cement requires.
   b. Test supply lines per ASTM-F690 as follows: (1) add water slowly to pipe to avoid water hammer damage, (2) bleed system to insure all air is out of pipes, (3) pressurize system to 125% of design operating pressure for one hour. Visually inspect for leaks while system is holding pressure constant. Note – use hydraulic pump or other safe method – do not use air compressor.
   c. Test sprinkler lines at line pressure and visually inspect for leaks.

6. When the irrigation system is completed, perform a coverage test to determine if the water coverage for planting areas is complete and adequate. Furnish all materials and perform all work required to correct any inadequacies of coverage due to deviation from drawings. This test shall be accomplished before any plant material is planted.

7. Upon completion of each phase of work, test and adjust entire system to meet site requirements.

3.6 CLEAN-UP:

Clean-up shall be made as each portion of work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be broomed or washed down, and any damage sustained on the work of others shall be repaired to original conditions.

3.7 FINAL REVIEW PRIOR TO ACCEPTANCE:

A. Operate each system in its entirety at time of final review. Any items deemed not acceptable shall be reworked to the satisfaction of the irrigation consultant.

B. Final review shall take place after submission of all specified lists, record drawings, and manuals.

3.8 INSPECTIONS:

The contractor shall be subject to inspections at any and all times by authorized representatives of the Owner.

3.9 MAINTENANCE:

The contractor is to make all repairs and maintain the entire sprinkler system from the time of installation through the landscape maintenance period.
GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM

WE HEREBY GUARANTEE THAT THE SPRINKLER IRRIGATION SYSTEM WE HAVE FURNISHED AND INSTALLED IS FREE FROM DEFECTS IN MATERIALS AND WORKMANSHIP, AND THE WORK HAS BEEN COMPLETED IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS. WE AGREE TO REPAIR OR REPLACE ANY DEFECTS IN MATERIAL OR WORKMANSHIP, ANY SETTLING OF BACKFILLED TRENCHES, WHICH MAY DEVELOP DURING THE PERIOD OF ONE YEAR FROM DATE OF ACCEPTANCE AND ALSO TO REPAIR OR REPLACE ANY DAMAGE CAUSED BY ANY DEFECTS IN THE IRRIGATION SYSTEM OR RESULTING FROM THE REPAIRING OR REPLACING OF SUCH DEFECTS AT NO ADDITIONAL COST TO THE OWNER. ORDINARY WEAR AND TEAR, UNUSUAL ABUSE OR NEGLECT ARE EXCEPTED. WE SHALL MAKE SUCH REPAIRS OR REPLACEMENTS, INCLUDING COMPLETE RESTORATION OF ALL DAMAGED PLANTING, PAVING, OR OTHER IMPROVEMENTS OF ANY KIND, WITHIN A REASONABLE TIME, AS DETERMINED BY THE OWNER, AFTER RECEIPT OF WRITTEN NOTICE. IN THE EVENT OF OUR FAILURE TO MAKE SUCH REPAIRS OR REPLACEMENTS WITHIN A REASONABLE TIME AFTER RECEIPT OF WRITTEN NOTICE FROM THE OWNER, WE AUTHORIZE THE OWNER TO PROCEED TO HAVE SAID REPAIRS OR REPLACEMENTS MADE AT OUR EXPENSE AND WE WILL PAY THE COSTS AND CHARGES THEREFORE UPON DEMAND.

PROJECT: ________________________________________________

LOCATION: ______________________________________________

CONTRACTOR: ____________________________________________

LICENSE NO: ____________________________________________

ADDRESS: ______________________________________________

TELEPHONE: ______________________________________________

GUARANTEE TO: __________________________________________

________________________________________________________

________________________________________________________

DATE OF ACCEPTANCE: ____________________________________

AUTHORIZED REPRESENTATIVE: ______________________________

END OF SECTION 32 80 00
SECTION 32 90 00

LANDSCAPE PLANTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and place topsoil, fertilizer, organic materials, and all other materials incidental to planting work.

B. Furnish all plant materials (trees, shrubs, seed, ground covers, and plant labels).

C. Furnish all labor, equipment and materials necessary for the installation of plant materials according to these Specifications.

1.2 RELATED SECTIONS:

A. Irrigation: Irrigation system shall be installed and operative before beginning planting operation.

B. Drainlines and Utilities: Contractor shall fully acquaint himself with the existing conditions particularly in reference to underground piping. Any damage caused by the Contractor to work of other trades shall be repaired by him at no cost to the Owner.

C. Earthwork: Close coordination shall be maintained with those Contractors performing rough grading operations and installing utilities and pavement to insure proper timing of the work.

1.3 REQUIREMENTS OF REGULATORY AGENCIES:

A. Perform work in accordance with all applicable laws, codes, and regulations required by the State of California and any other authorities having jurisdiction over such work. Provide for all inspections and permits required by Federal, State, and local authorities in furnishing, transporting, and installing materials.

B. Certificates of inspection required by law for transportation shall accompany invoice for each shipment of plants. File copies of certificates with Owner's Representative after acceptance of material. Inspection by Federal or State Governments at place of growth does not preclude rejection of plants at project site.

1.4 QUALITY ASSURANCE:

A. Personnel: All planting work shall be performed by personnel familiar with planting procedures under the supervision of a qualified foreman.
B. Codes and Standards: Nursery stock shall meet the standards of the current edition of the "Agricultural Code of California" and the "Regulations of the Director of Agriculture Pertaining to Nursery Stock" as to grading and quality. They shall be true to type and name in accordance with "Standardized Plant Names", Second Edition.

C. Substitutions: Substitutions of plant materials will not be permitted unless authorized in writing by Owner's Representative. If proof is submitted that any plant specified is not obtainable, a proposal will be considered for use of the nearest equivalent size or variety with corresponding adjustment of Contract price. Such proof shall be substantiated and submitted in writing to Owner's Representative at least 30 days prior to start of work under this Section. These provisions shall not relieve Contractor of the responsibility of obtaining specified materials in advance if special growing conditions or other arrangements must be made in order to supply specified materials.

The Landscape Architect reserves the right to require the Contractor to replace at the Contractor's cost any plants which the Contractor has installed without the Landscape Architect's approval.

D. Plants shall be subject to inspection and approval of the Landscape Architect at place of growth or upon delivery for conformity to specifications. Such approval shall not impair the right of inspection and rejection during progress of the work. Wherever the terms "approve", "approval" or "approved" are used herein they mean approval of the Landscape Architect in writing.

E. Plant Certification: All plants must meet specifications of Federal, State, and County laws requiring inspection for plant disease and insect infestations. Inspection certifications required by law shall accompany each shipment, invoice and order for stock.

1.5 Submittals:

A. Furnish 6 copies of manufacturers' literature for the following items:

1. Fertilizer
2. Mulch

B. Provide analysis from an approved testing laboratory for:

1. Existing site soil
2. Proposed topsoil, imported or from project stockpile
3. Proposed Organic Amendment

C. Submit one (1) quart sample each of mulch and organic amendment.

D. All submittal data shall be forwarded in a single package to the Landscape Architect within 27 days of award of the contract.

1.6 Samples and Tests:
A. Owner's Representative reserves the right to take and analyze samples of materials for conformity to specifications at any time. Contractor shall furnish samples upon request by Owner's Representative. Rejected materials shall be immediately removed from the site at Contractor's expense. Cost of testing of materials not meeting specifications shall be paid by Contractor.

1.7 SELECTION AND TAGGING OF PLANT MATERIAL:

A. Plants shall be subject to inspection and approval by Landscape Architect at place of growth if the Landscape Architect so chooses, and upon delivery for conformity to specifications. Such approval shall not impair the right of inspection and rejection during progress of the work. Submit written request for inspection of plant material at place of growth to Landscape Architect. Written request shall state the place of growth and quantity of plants to be inspected. Landscape Architect reserves right to refuse inspection at this time if, in his judgment, a sufficient quantity of plants is not available for inspection.

1.8 JOB CONDITIONS:

A. Delivery:

1. Deliver standard products to site in original unopened containers bearing manufacturer's guaranteed chemical analysis, name, trade mark and conformance to state law.

2. Deliver plants with identification labels.
   a. Labels should state correct name and size.
   b. Use durable, water-proof labels with water resistant ink that will remain legible for at least 60 days.

3. Protect plant materials during transport to prevent damage to rootball or desiccation of leaves.

4. Remove unacceptable plant materials immediately from job site.

B. Storage:

1. Contractor shall maintain the plant material properly between delivery and planting. This includes protection from animals and vandals, proper watering, and feeding if necessary.

2. Shade plants shall be stored in the shade, and sun plants shall be stored in the sun.

C. Timing: Under no circumstances shall any work be performed if the temperature exceeds 90 degrees or is below 40 degrees. No planting shall be done with the soil saturated with water.

PART 2 - PRODUCTS

2.1 SOIL AMENDMENTS:
A. The following organic amendments, soil amendments, and fertilizer rates and quantities are to be used for bid basis only. Site soil sample was taken and sent by the Landscape architect to an accredited soils laboratory for analysis’s. The soils lab report w/ recommendations was not received in time to include as part of the project Planting specifications. The Soils Lab report recommendations will be issued to all bidders as an addendum during the bidding period.

B. Topsoil: Provide topsoil as required to complete landscape work for the Administration Courtyard, as noted on the planting plans. Topsoil to be sandy loam type and shall be fertile and friable, possessing characteristics of representative productive soils on the site. It shall not contain toxic substances which may be harmful to plant growth. If herbicide contamination is suspected then a radish/rye grass growth trial must be performed. Consult with Landscape Architect prior to decision to test. It shall be uniformly textured and free of all objectionable foreign materials, oil, or chemicals which may be injurious to plant growth. Natural topsoil shall possess a pH factor between 5.5 and 7.5, a sodium adsorption ratio (SAR) of less than 8, a boron concentration of the saturation extract of less than 1 ppm, and salinity of the saturation extract at 25 degrees C. of less than 4.0 milliohms per centimeter.

Obtain topsoil from naturally well-drained sites where topsoil occurs in a depth of not less than 4 inches; do not obtain from bogs or marshes. Topsoil from the project stockpile which meets the requirements is acceptable.

C. Imported Topsoil: Topsoil shall be tested by an approved soils laboratory for compatibility with existing on-site soils and fertility. Contractor shall submit soil laboratory’s analysis and amendment recommendations. Imported topsoil shall be subject to inspection by Landscape Architect at the project site. Remove rejected topsoil immediately at Contractor’s expense.

D. Organic Amendment:

1. Organic Gro mulch bark having a minimum organic content of 94% and a nitrogen content of 0.8% minimum to 1.2% maximum on a dry weight basis. Mulch shall be shredded to pass a 1/4” mesh screen. Six cubic yards per 1,000 square feet.

E. Fertilizer:

1. Groundcover areas:

   a. 6N-20P-20K, 25 lbs. per 1,000 square feet.
   b. Starting one month after planting, on a monthly basis, 21N-0P-0K Ammonium sulfate. 5 lbs. per 1,000 square feet.
   c. Do not apply Fertilizer for Native Arctostaphylos, juncus and carex groundcover plants.

2. Shrubs and trees:

   a. 21 gram 20N-10P-5K slow release fertilizer tablets as manufactured by Agriform. Apply according to Manufacturer’s instructions.
   b. After planting: 21N-0P-0K Ammonium sulfate 5 lbs. per 1,000 square feet.
   c. Do not fertilize California Native Shrubs and Trees.

2.2 TOP MULCH: Fir bark chips having a maximum size of 1” diameter and 2” in length. Topdress planting areas with a 3” layer of bark chips. Screened Arborists mulch

Produced on site by chipping existing trees cut down during the project Demolition

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Landscape Planting
phase is acceptable. Arborist Mulch shall be screened and free of twigs and conform to the maximum size of 1” diameter and 2” in length

2.3 GROUNDCOVERS, TREES, AND SHRUBS:

A. All plant materials shall be nursery grown in accordance with the best known horticulture practices and under climatic conditions similar to those in the locality of the project. Container stock shall have grown in the containers in which delivered for at least six (6) months, but not over two years. No container plants that have cracked or broken balls of earth when taken from container shall be planted except upon special approval by Landscape Architect.

B. Plants shall be vigorous and shall have a normal habit of growth. Plants shall be free of damage by insects, pests, diseases or wind; burns from insecticides or fertilizer; and stunted growth due to lack of water, lack of food, diseases, or other causes. Plants shall be in conformity with the sizes shown on the drawings.

C. Trees: Unless otherwise specified, tree trunks shall be straight with leader intact, undamaged, and uncut. All old abrasions and cuts are acceptable only if completely callused over.

D. Quantities: Quantities necessary to complete the work as shown on the drawings shall be furnished.

E. Root Systems: All shrubs and trees shall have a normal root system. No plants with roots that have encircled themselves will be accepted. In case of any unsatisfactory root system, a total group of plants may be rejected.

F. Balled and Burlapped Trees: Plants shall be true to species and variety and shall conform to measurements specified except that plants larger than specified may be used if approved by Landscape Architect. Use of such plants shall not increase Contract price. If larger plants are approved, the ball of earth shall be increased in proportion to the size of the plant. Plants shall be measured when branches are in their normal position. Height and spread dimensions specified refer to main body of plant and not branch tip to tip. Caliper measurement shall be taken at a point on tree trunk 6 inches above natural ground line for trees up to 4 inches in caliper and at a point 12 inches above the natural ground line for trees over 4 inches in caliper. If a range of size is given, no plant shall be less than the minimum size specified. The measurements specified are the minimum size acceptable and are the measurements after pruning, where pruning is required.

2.4 WATER SOURCE:

A. Water source shall be provided by Owner. Contractor shall provide transport as required.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS:

A. Inspections by the Landscape Contractor:
1. Prior to all work in this section, verify grades and carefully inspect the installed work of all other trades. Verify that all such work is complete to the point where the installation may properly commence.

2. In the event of discrepancy, immediately notify the Landscape Architect. Do not proceed with this installation in areas of discrepancies until all such discrepancies have been fully resolved.

3. Inspect trees, shrubs and ground cover plants for injury, insect infestations, and proper pruning.

4. Landscape Contractor shall receive site graded to ±0.10 ft. of finish grades shown on the Drawings. Allow for depth of soil amendments and mulch in determining the difference between finished subgrade in groundcover and shrub beds. Verify that subgrades are not compacted. Do not proceed until detrimental conditions are corrected.

3.2 SOIL PREPARATION:

A. The Contractor shall prepare the site for landscaping. In the areas designated for landscaping on the plans, he shall, prior to placing imported material, replacing existing topsoil, or doing any planting, clear the areas of weeds, roots, debris, rocks, and underground obstructions, and construction debris to a depth acceptable for planting. Scarify the subgrade to a 3” minimum depth prior to spreading topsoil.

B. Cultivation and Placement of Amendment:

1. In areas to be planted with shrubs cultivate to a depth of 12”.

2. In groundcover areas, cultivate soil to a depth of 8”. Incorporate 6 cubic yards per 1000 square feet of nitrified fir bark. Prior to planting incorporate to a depth of 6” the following fertilizers, per 1000 square feet:

   25 lbs. 6N-20P-20K

3. Areas within the driplines of existing trees shall be hand cultivated.

C. Soil Mix for Backfill of Shrubs and Trees: The following ingredients shall be tumbled to achieve a homogeneous mix:

   Organic amendment 1 cubic yard
   Native Site Soil 3 cubic yards

3.3 SHRUBS AND TREES:

A. Preparation:
1. Stake out location for plants and outline of planting beds on ground and obtain the approval of Landscape Architect before digging.

2. The Contractor shall protect all utilities, vegetation, and structures during work.

3. Trees shall be located a minimum of 3’ from walls, overheads, walks, headers, and other trees within the project. If conflicts arise between size of areas and plans, Contractor shall contact Landscape Architect for resolution. Failure to make such conflicts known to the Landscape Architect will result in Contractor’s liability to relocate the materials.

B. Excavation:

1. All plant pits shall be dug with vertical walls. The sides and bottoms of all planting pits shall be thoroughly scarified.

2. Holes for one (1) gallon size plants: Twelve (12) inches wider than the can and six (6) inches minimum deeper.

3. Holes for (5) gallon size plants: eighteen (18) inches wider than the can or root ball, and eight (8) inches deeper than can or root ball.

4. Holes for fifteen (15) gallon size plants or larger: Twenty-four (24) inches wider than the can or root ball, and twelve (12) inches deeper than the can or root ball.

C. Plants in Containers:

1. Plants shall be removed carefully from their containers after the containers have been cut on two sides minimum; fifteen-gallon containers shall be opened in three places. In the case of boxed plant specimens, the wood shall be removed at the sides and at the bottom of the box.

2. After removing plant material from its container, stimulate root growth by making four or five vertical cuts 1" deep around the circumference of the root ball.

3. Do not lift or handle plants by the top, stems, or trunk at any time. All plants shall be lifted in such a manner that the root ball is supported from the underside.

4. The Contractor shall check all plants for adequate root systems. If the root system is defective, he shall remove deficient plants from the site and replace them with new ones.

D. Planting:

1. Center plant in pit or trench over tamped mound.

2. Face for best effect.

3. Set plant plumb and hold rigidly in position.
4. All plants shall be set in the ground so that the root ball will be flush with the finish grade. All plants that settle below the finish grade within 30 days of acceptance of the work shall be replanted in the proper position. In case a total section of planting area settles, the Contractor shall lift the plants, import additional soil mix, regrade, and replant, at no additional cost to the Owner.

5. Use soil mix only for backfill. Backfill pit with soil mix in 9" layers and water each layer thoroughly to settle soil. The filled pit shall be flush with surrounding grade when complete.

6. When the plant pit has been approximately one half filled, place planting tablets according to the manufacturer's schedule.

7. Apply post-planting fertilizer.

8. In shrub mass areas, mulch area between plant pits with 2" layer of fir bark for weed control.

9. Planting operation for plants in raised concrete planters is same as above except that finish grade of soil mix shall be 1 1/2" below top of planter walls. Planters may be backfilled with excess topsoil up to the depth specified for plant pits above which backfill shall be soil mix.

10. Planting operations for plants in precast planters is the same as stated in paragraph 9 above. Fill entire planter with soil mix. Place planters as shown on planting plans.

3.4 GROUNDCOVER AREAS:

A. Planting:

1. Space plants equally and uniformly at spacings indicated on the Drawings, which are the maximum and in a triangular pattern.

2. Plant pits shall be sufficiently large so that the root can be freely suspended in the pit. After backfilling the pit, firm the soil so that there will be no air space around the roots.

3. Apply post-planting fertilizer.

4. Mulch all ground cover areas with a 2" layer of fir bark.

3.5 TREE STAKING:

A. Stake trees as indicated on the Drawings.
B. Tying: Find the proper support height by holding the trunk in one hand and pulling the top to one side and releasing it. The lowest height at which the trunk will return to the upright position when the top is released, is the height at which to attach tree ties.

3.6 PRUNING:

A. Tree and Shrub: Pruning shall be performed as required to maintain a natural appearance, promote healthy and vigorous growth, and eliminate diseased or damaged growth.

B. Trees shall be pruned to thin crown and avoid wind damage, eliminate narrow V-shaped branch forks that lack strength, eliminate sucker growth, and maintain a radial branching pattern to avoid crossing branches.

C. Under no circumstances will stripping of lower branches ("raising-up") of young trees be permitted. Lower branches shall be retained in a "tipped back" or pinched condition with as much foliage as possible to promote caliper trunk growth (tapered trunk).

D. Major pruning of trees to compensate for root loss or for aesthetic reasons shall be done only with approval of the Landscape Architect.

E. Shrubs shall not be clipped into balled or boxed forms, unless such is required by the design and directed by the Landscape Architect.

F. All pruning shall be made flush to lateral branches, buds, or trunk. "Stubbing" will not be permitted.

G. Damage: All cuts over 1" resulting from pruning or wind breakage shall be inspected periodically for insect infestation or disease.

3.7 CLEAN UP:

A. Keep all areas of work clean and neat at all times. Upon completion of planting, all cans, boxes, and other debris that is a part of the planting operation shall be removed from the site.

B. All pavements shall be washed off, and site shall be left in an absolutely clean condition. All planting areas shall be cultivated and weed free before final inspection. Clean-up operations shall take place throughout the course of work so that walks and drives are clean at all times.

3.8 INSPECTIONS:

A. Notification: The Contractor shall notify the Landscape Architect a minimum of 72 hours before requiring a visit by the Landscape Architect or his duly appointed representative to the site.

B. Check Points: The following shall be considered check points and the Contractor shall only proceed with the work after the Landscape Architect has visited the site and determined that the work is proceeding satisfactorily.

1. When plant material is placed in the configuration shown on the Drawings before planting.
2. A check visit shall be made to begin the maintenance period. At this time the Contractor shall have completed all phases of the Plans and Specifications. Any discrepancies shall be noted at that time and the Contractor shall make appropriate corrections before the acceptance of the work.

3. A conference including the Owner shall be held at the completion of the work, provided that all deficiencies brought out in the check visit which began the maintenance period have been corrected by this time. The Contractor shall continue to maintain the project at his own expense until all deficiencies have been corrected, at which time the Contractor shall request the Landscape Architect to visit the site and approve the project as complete. The Landscape Architect will accept the landscape project in writing. The date of the acceptance letter shall be the first day of the guarantee period.

C. Should it be determined at the Final Inspection or Final Acceptance visit that any punchlist item is incomplete, any further review of the site will be terminated until all items are guaranteed, in writing, to be complete by the Contractor. The cost of additional site visits by the Landscape Architect to verify completion of work shall be paid for by the Contractor.

3.9 MAINTENANCE:

A. Contractor shall furnish all labor, material, equipment, and services required to maintain the landscape in a healthy and attractive condition for a period of 60 days.

B. Maintenance shall include fertilization, watering, insect and disease control, weed control, weekly trash removal, mulching, restaking trees, tightening of guys, resetting plants to proper grades or upright position, and restoration of watering basins.

C. Maintenance period shall not start until all elements of construction, planting, and irrigation for the entire project are complete. Project will not be segmented into maintenance phases, unless specifically authorized in writing by the Owner's authorized representative.

D. The Contractor shall request an inspection to begin the plant maintenance period after all planting and related work has been completed in accordance with the Contract documents. A prime requirement is that all groundcover and lawn areas be planted. If such criteria is met to the satisfaction of the Architect, a field notification will be issued to the Contractor to establish the effective beginning date of the period.

E. The Contractor's maintenance period will be extended if the provisions required within the plans and specifications are not filled.

F. Watering:

1. All plants shall be kept watered as often as it is necessary to keep them in optimum, vigorous growth. The lawn shall, at no time, show a lack of fresh green color or a loss of resilience due to lack of water. Watering shall be done preferably during the early morning hours.

2. Water shall be controlled so that there will be no excessive run-off, ponding, or overwatering.
3. Root Growth: Periodically the Contractor shall check the progress of the root growth within the back fill area. As the root growth increases beyond the root ball, the frequency of watering shall be reduced so that the roots are encouraged to grow to a lower soil depth. Watering then shall be less frequent, but applications shall be very slow and the Contractor shall assure himself that water does penetrate to the depth of the former plant pit.

G. Spraying:

1. All shrubs and trees shall be inspected at least twice a month during the growing period to determine the need for spraying to control insect damage, fungus development or any other disease that might be attacking the plants. Preventative spraying shall be done only with the approval of the Landscape Architect.

2. Operators of spray equipment shall take all reasonable precautions to protect themselves, other people and buildings from spray. The Contractor shall have all permits and licenses required for such an operation. Where applicable, dormant spray shall be applied to shrubs and trees during the winter period.

3. All equipment shall be properly washed before and after use.

4. No spraying shall take place during windy or gusty days.

H. Staking and Guying: Stakes and guys shall be inspected a minimum of two times a month to assure that the wires and ties are tight and no damage has occurred to the tree trunk or branches.

I. Weed Control:

1. Weeds shall be kept under control, either by hand or by the application of herbicides designed for use on any type of weeds invading the planting areas.

2. Herbicides shall be granular type and broadcast by hand. Spraying of Herbicides is not allowed. Herbicides shall be applied at temperatures recommended by the manufacturers. Herbicides shall not be used during windy or gusty days. All possible precautions shall be taken to protect vegetation which is susceptible to damage from the particular herbicides to be used.

3. The bases of all plants shall be kept completely free of weeds. Periodically, the base of the trees and shrubs shall be cultivated in order to allow better penetration of water, but such cultivation shall be carefully done in order not to destroy surface roots.

J. Fertilization: Top dress all non Calif. Native planting areas at 45 day intervals from time of planting with fertilizer of same composition and at same rate as at time of planting.

K. Litter: The Contractor shall remove promptly after pruning, trimming, and weeding or other work required under the contract, all debris generated by his performance of the work. Immediately after working in the areas of public walks, driveways or paved areas, they shall be vacuumed clean with suitable equipment. All areas covered by this contract shall be kept free
of the following items: bottles, cans, paper cardboard or metallic items. Common debris and litter shall be disposed of in an appropriate manner.

L. Pruning: Prune as necessary to remove injured twigs and branches, dead wood, and suckers.

3.10 GUARANTEE AND REPLACEMENT:

A. Guarantee period shall be extended for a period of one year from the date of written acceptance.

B. All plants shall be guaranteed to be alive and healthy as determined by the Landscape Architect at the end of the guarantee period.

C. The Contractor shall replace, in accordance with the Drawings and Specifications throughout the guarantee period, any plants that die, or in opinion of the Landscape Architect, are in an unhealthy or unsightly condition, and or have lost their natural shape due to dead branches, excessive pruning, inadequate or improper maintenance, or any other causes due to the Contractor's negligence. The Contractor shall not be held responsible for acts of vandalism occurring after the beginning of the guarantee period.

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SECTION 33 05 00
COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping joining materials.
2. Transition fittings.
3. Dielectric fittings.
4. Sleeves.
5. Identification devices.
7. Flowable fill.
8. Piped utility demolition.
9. Piping system common requirements.
10. Equipment installation common requirements.
11. Painting.
12. Concrete bases.
13. Metal supports and anchorages.

1.3 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.


D. CPVC: Chlorinated polyvinyl chloride plastic.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Dielectric fittings.
   2. Identification devices.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
1.8 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

C. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Section 033000 "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8-inch-thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.


G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.

3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

4. PVC to ABS Piping Transition: ASTM D 3138.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 TRANSITION FITTINGS

A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings NPS 1-1/2 and Smaller:
   1. Underground Piping: Manufactured piping coupling or specified piping system fitting.
   2. Aboveground Piping: Specified piping system fitting.

C. AWWA Transition Couplings NPS 2 and Larger:
   1. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

D. Plastic-to-Metal Transition Fittings:
   1. Description: PVC one-piece fitting with manufacturer’s Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint or threaded end.

E. Plastic-to-Metal Transition Unions:
   1. Description: MSS SP-107, PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

F. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:
   1. Description: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.3 DIELECTRIC FITTINGS

A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
B. Dielectric Unions:

1. Description: Factory fabricated, union, NPS 2 (DN 50) and smaller.
   
a. Pressure Rating: 250 psig at 180 deg F.

b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

C. Dielectric Flanges:

1. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) and larger.
   

b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

1. Description: Nonconducting materials for field assembly of companion flanges, NPS 2-1/2 and larger.
   
a. Pressure Rating: 150 psig minimum.

b. Gasket: Neoprene or phenolic.

c. Bolt Sleeves: Phenolic or polyethylene.

d. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 (DN 80) and smaller.
   
a. Pressure Rating: 300 psig at 225 deg F.

b. End Connections: Threaded.

F. Dielectric Nipples:

1. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.
   
a. Pressure Rating: 300 psig at 225 deg F.
b. End Connections: Threaded or grooved.

2.4 SLEEVES

A. Mechanical sleeve seals for pipe penetrations are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.


G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.5 IDENTIFICATION DEVICES

A. General: Products specified are for applications referenced in other utilities Sections. If more than single type is specified for listed applications, selection is Installer's option.

B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
   1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
   2. Location: Accessible and visible.

C. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

D. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive-vinyl type with permanent adhesive.

E. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360 degrees around pipe at each location.

F. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.
G. Lettering: Manufacturer's standard preprinted captions as selected by Architect.

H. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
   1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.

I. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils (0.08 mm) thick.
   1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
   2. Color: Comply with ASME A13.1, unless otherwise indicated.

J. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.
   1. Material: 0.032-inch-thick, polished brass or aluminum.
   2. Material: 0.0375-inch-thick stainless steel.
   5. Size: 1-1/2 inches in diameter, unless otherwise indicated.
   6. Shape: As indicated for each piping system.

K. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.

L. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
   1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
   2. Thickness: 1/16 inch, unless otherwise indicated.
   3. Thickness: 1/16 inch, for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
4. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.

M. Plastic Equipment Markers: Manufacturer’s standard laminated plastic, in the following color codes:

1. Green: Cooling equipment and components.

2. Yellow: Heating equipment and components.


4. Blue: Equipment and components that do not meet criteria above.


6. Terminology: Match schedules as closely as possible. Include the following:
   a. Name and plan number.
   b. Equipment service.
   c. Design capacity.
   d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

7. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

N. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.

1. Size: 3-1/4 by 5-5/8 inches.

2. Fasteners: Brass grommets and wire.

3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

O. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.

1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.
2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   2. Design Mix: 5000-psi, 28-day compressive strength.

2.7 FLOWABLE FILL

A. Description: Low-strength-concrete, flowable-slurry mix.
   3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.
   6. Water: Comply with ASTM C 94/C 94M.
   7. Strength: 100 to 200 psig at 28 days.

PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

A. Refer to Section 024119 "Selective Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.

5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 DIELECTRIC FITTING APPLICATIONS

A. Dry Piping Systems: Connect piping of dissimilar metals with the following:
   1. NPS 2 and Smaller: Dielectric unions.
   2. NPS 2-1/2 to NPS 12: Dielectric flanges or dielectric flange kits.

B. Wet Piping Systems: Connect piping of dissimilar metals with the following:
   1. NPS 2 and Smaller: Dielectric couplings or dielectric nipples.
   2. NPS 2-1/2 to NPS 4: Dielectric nipples.
   3. NPS 2-1/2 to NPS 8: Dielectric nipples or dielectric flange kits.
   4. NPS 10 and NPS 12: Dielectric flange kits.

3.3 PIPING INSTALLATION

A. Install piping according to the following requirements and utilities Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.
G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 2 inches above finished floor level.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
      a. PVC Pipe Sleeves: For pipes smaller than NPS 6.
      b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

J. Verify final equipment locations for roughing-in.

K. Refer to equipment specifications in other Sections for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.


J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.

3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

5. PVC Nonpressure Piping: Join according to ASTM D 2855.

6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End PE Pipe and Fittings: Use butt fusion.

2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.
O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer’s written instructions.

3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Install dielectric fittings at connections of dissimilar metal pipes.

3.6 EQUIPMENT INSTALLATION

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

3.7 PAINTING

A. Painting of piped utility systems, equipment, and components is specified in Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 IDENTIFICATION

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.


2. Locate pipe markers on exposed piping according to the following:

   a. Near each valve and control device.

   b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.

d. At manholes and similar access points that permit view of concealed piping.

e. Near major equipment items and other points of origination and termination.

B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.

1. Lettering Size: Minimum 1/4 inch high for name of unit if viewing distance is less than 24 inches, 1/2 inch high for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.

2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.9 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer’s written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer’s setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Install anchor bolts according to anchor-bolt manufacturer’s written instructions.

7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."
3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section 055000 "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.11 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION
SECTION 33 41 00

STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. California Department of Transportation (Caltrans) Standard Specifications:

1. Section 51: Concrete Structures.

2. Section 52: Reinforcement.

3. Section 55: Steel Structures.

4. Section 66: Corrugated Metal Pipe.

5. Section 70: Miscellaneous Facilities.


7. Section 75: Miscellaneous Metal.

8. Section 90: Portland Cement Concrete.

1.2 SUMMARY

A. Section Includes:

1. Pipe and fittings.

2. Nonpressure transition couplings.

3. Pressure pipe couplings.

4. Expansion joints and deflection fittings.

5. Backwater valves.

6. Cleanouts.

7. Drains.

8. Encasement for piping.
10. Channel drainage systems.
11. Catch basins.
13. Stormwater detention structures.
15. Dry wells.
16. Stormwater disposal systems.

1.3 DEFINITIONS
A. FRP: Fiberglass-reinforced plastic.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings:
   1. Manholes: Include plans, elevations, sections, details, frames, and covers.
   2. Catch basins, stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.
   3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

1.5 INFORMATIONAL SUBMITTALS
A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
B. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet (1:500) and vertical scale of not less than 1 inch equals 5 feet (1:50). Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.
C. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
D. Field quality-control reports.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Municipality no fewer than three days in advance of proposed interruption of service.

2. Do not proceed with interruption of service without Municipality written permission.

PART 2 - PRODUCTS

2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy classes.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI-Trademarked, Shielded Couplings:

1. Description: ASTM C 1277 and CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Shielded Couplings:

1. Description: ASTM C 1277 and ASTM C 1540, with stainless-steel shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
D. Cast-Iron, Shielded Couplings:
   1. Description: ASTM C 1277 and ASTM A 48, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 DUCTILE-IRON, CULVERT PIPE AND FITTINGS

A. Pipe: ASTM A 716, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.4 DUCTILE-IRON, PRESSURE PIPE AND FITTINGS

A. Push-on-Joint Piping:
   1. Pipe: AWWA C151, for push-on joints.
   2. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
   3. Compact Fittings: AWWA C153, for push-on joints.

B. Mechanical-Joint Piping:
   1. Pipe: AWWA C151, with bolt holes in bell.
   2. Standard Fittings: AWWA C110, ductile or gray iron, with bolt holes in bell.
   4. Glands: Cast or ductile iron, with bolt holes and high-strength, cast-iron or high-strength, low-alloy steel bolts and nuts.
   5. Gaskets: AWWA C111, rubber, of shape matching pipe, fittings, and glands.

2.5 STEEL PIPE AND FITTINGS

A. Corrugated-Steel Pipe and Fittings: ASTM A 760, Type I with fittings of similar form and construction as pipe.

   1. Special-Joint Bands: Corrugated steel with O-ring seals.

2.6 ABS PIPE AND FITTINGS

   1. NPS 3 to NPS 6 (DN 80 to DN 150): SDR 35.
   2. NPS 8 to NPS 12 (DN 200 to DN 300): SDR 42.

B. Gaskets: ASTM F 477, elastomeric seals.

2.7 PVC PIPE AND FITTINGS

A. PVC Corrugated Sewer Piping:
   2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.

B. PVC Profile Sewer Piping:
   2. Fittings: ASTM D 3034, PVC with bell ends.

C. PVC Type PSM Sewer Piping:
   1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
   2. Fittings: ASTM D 3034, SDR-26, PVC with bell ends.

D. PVC Gravity Sewer Piping:

E. PVC Pressure Piping:
1. Pipe: AWWA C900, Class 100, Class 150 and Class 200 PVC pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: AWWA C900, Class 100, Class 150 and Class 200 PVC pipe with bell ends

F. PVC Water-Service Piping:
1. Pipe: ASTM D 1785, Schedule 40 PVC, with plain ends for solvent-cemented joints.

G. PVC Pipe Reducer:
2. Fittings: J-M Manufacturing Co. Concentric Increaser (G & G or G & S), or approved equivalent.

2.8 CONCRETE PIPE AND FITTINGS

A. Nonreinforced-Concrete Sewer Pipe and Fittings: ASTM C 14, Class 3, 1350-D, with tongue and groove or bell-and-spigot or flanged ends and gasketed joints with ASTM C 443 rubber gaskets.

B. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76.
1. Bell-and-spigot or flanged ends and gasketed joints with ASTM C 443, rubber gaskets.

2.9 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
1. For Concrete Pipes: ASTM C 443, rubber.
3. For Fiberglass Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
5. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
C. Unshielded, Flexible Couplings:
   1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:
   1. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:
   1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.10 PRESSURE PIPE COUPLINGS

A. Description: AWWA C219, tubular-sleeve coupling, with center sleeve, gaskets, end rings, and bolt fasteners.

B. Metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include 200-psig minimum pressure rating and ends sized to fit adjoining pipes.

C. Center-Sleeve Material: Manufacturer's standard.

D. Gasket Material: Natural or synthetic rubber.

E. Metal Component Finish: Corrosion-resistant coating or material.

2.11 EXPANSION JOINTS AND DEFLECTION FITTINGS

A. Ductile-Iron Flexible Expansion Joints:
   1. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated.

B. Ductile-Iron Expansion Joints:
   1. Description: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron or steel with protective coating, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for expansion indicated.

C. Ductile-Iron Deflection Fittings:
1. Description: Compound-coupling fitting, with ball joint, flexing section, gaskets, and restrained-joint ends, complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for up to 15 degrees of deflection.

2.12 BACKWATER VALVES

A. Cast-Iron Backwater Valves:

1. Description: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.

2. Horizontal type; with swing check valve and hub-and-spigot ends.

3. Combination horizontal and manual gate-valve type; with swing check valve, integral gate valve, and hub-and-spigot ends.

4. Terminal type; with bronze seat, swing check valve, and hub inlet.

B. Plastic Backwater Valves:

1. Description: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

2.13 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

2. Top-Loading Classification(s): Light Duty, Medium Duty, Heavy Duty and Extra-Heavy Duty.

3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. Plastic Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.14 DRAINS

A. Cast-Iron Area Drains:

1. Description: ASME A112.6.3 gray-iron, round body with anchor flange and round grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.
2. Top-Loading Classification(s): Medium and Heavy Duty.

2.15 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: Linear low-density polyethylene film of 0.008-inch minimum thickness.

C. Form: Sheet or tube.

D. Color: Any.

2.16 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints. Shall conform to Section 70-1.02H and 71-1.07 of the Caltrans Standard Specifications.

2. Diameter: 48 inches minimum unless otherwise indicated.

3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.

4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.

5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.

6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.

7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.

9. Steps: Individual FRP steps wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 24 inches.

10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.
B. Designed Precast Concrete Manholes:

1. Description: ASTM C 913; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.

2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.


4. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.

5. Steps: Individual FRP wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 24 inches.

6. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.

7. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER", 2” high.

2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.17 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.


B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.


2. Reinforcing Bars: ASTM A 615, Grade 60 deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.


2. Reinforcing Bars: ASTM A 615, Grade 60 deformed steel.

2.18 POLYMER-CONCRETE, CHANNEL DRAINAGE SYSTEMS

A. General Requirements for Polymer-Concrete, Channel Drainage Systems: Modular system of precast, polymer-concrete channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling. Include quantity of units required to form total lengths indicated.

B. Sloped-Invert, Polymer-Concrete Systems:

1. Channel Sections:
   a. Interlocking-joint, precast, modular units with end caps.
   b. 4-inch inside width and deep, rounded bottom, with built-in invert slope of 0.6 percent and with outlets in quantities, sizes, and locations indicated.
   c. Extension sections necessary for required depth.
   d. Frame: Include gray-iron or steel frame for grate.

2. Grates:
   a. Manufacturer’s designation "Heavy Duty," with slots or perforations that fit recesses in channels.
   b. Material: Galvanized steel.

3. Covers: Solid gray iron if indicated.

4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

C. Narrow-Width, Level-Invert, Polymer-Concrete Systems:
1. **Channel Sections:**
   a. Interlocking-joint, precast, modular units with end caps.
   b. 5-inch inside width and 9-3/4-inch-deep, rounded bottom, with level invert and with NPS 4 outlets in quantities, sizes, and locations indicated.

2. **Grates:**
   a. Slots or perforations that fit recesses in channels.
   b. Material: Galvanized steel.

3. **Covers:** Solid gray iron if indicated.

4. **Locking Mechanism:** Manufacturer's standard device for securing grates to channel sections.

D. **Wide-Width, Level-Invert, Polymer-Concrete Systems:**

1. **Channel Sections:**
   a. Interlocking-joint, precast, modular units with end caps.
   b. 8-inch inside width and 13-3/4-inch-deep, rounded bottom, with level invert and with outlets in quantities, sizes, and locations indicated.

2. **Grates:**
   a. Slots or other openings that fit recesses in channels.
   b. Material: Gray iron.

3. **Covers:** Solid gray iron if indicated.

4. **Locking Mechanism:** Manufacturer's standard device for securing grates to channel sections.

E. **Drainage Specialties:** Precast, polymer-concrete units.

1. **Large Catch Basins:**
   a. 24-by-12-inch polymer-concrete body, with outlets in quantities and sizes indicated.
   b. Gray-iron slotted grate.
   c. Frame: Include gray-iron or steel frame for grate.
2. Small Catch Basins:
   a. 19- to 24-inch by approximately 6-inch polymer-concrete body, with outlets in quantities and sizes indicated.
   b. Gray-iron slotted grate.
   c. Frame: Include gray-iron or steel frame for grate.

F. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.

G. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.19 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.

3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.

4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.

5. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

6. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and grate.

7. Steps: Individual FRP steps wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 24 inches.

8. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
B. Designed Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete; designed according to ASTM C 890 for A-16, heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for joint sealants.

1. Joint Sealants: ASTM C 990, bitumen or butyl rubber.

2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and grate.

3. Steps: Individual FRP steps wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 24 inches.

4. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches minimum unless otherwise indicated.

2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

D. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter flat grate with small square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and cover.

3. Steps: Individual FRP steps wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of structure to finished grade is less than 24 inches.

E. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER", 2" high.
PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.

2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.

3. Install piping with 30-inch minimum cover.


5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."

6. Install ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
7. Install corrugated steel piping according to ASTM A 798.
8. Install corrugated aluminum piping according to ASTM B 788.
9. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
10. Install PE corrugated sewer piping according to ASTM D 2321.
11. Install PVC cellular-core piping according to ASTM D 2321 and ASTM F 1668.
12. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
13. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
14. Install PVC water-service piping according to ASTM D 2321 and ASTM F 1668.
15. Install fiberglass sewer piping according to ASTM D 3839 and ASTM F 1668.
16. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
17. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:


4. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.

5. Join ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.

6. Join corrugated steel sewer piping according to ASTM A 798.

7. Join corrugated aluminum sewer piping according to ASTM B 788.

8. Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.
9. Join corrugated PE piping according to ASTM D 3212 for push-on joints.

10. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.

11. Join PVC corrugated sewer piping according to ASTM D 2321 for elastomeric-seal joints.

12. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.

13. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.

14. Join fiberglass sewer piping according to ASTM D 3839 for elastomeric-seal joints.


17. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.

2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.

3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.


B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.
3.5 DRAIN INSTALLATION

A. Install type of drains in locations indicated.
   1. Use Light-Duty, top-loading classification drains in earth or unpaved foot-traffic areas.
   2. Use Medium-Duty, top-loading classification drains in paved foot-traffic areas.
   3. Use Heavy-Duty, top-loading classification drains in vehicle-traffic service areas.
   4. Use Extra-Heavy-Duty, top-loading classification drains in roadways.

B. Embed drains in 4-inch minimum concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

3.6 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer’s written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.7 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.8 STORMWATER INLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
E. Construct energy dissipaters at outlets, as indicated.

3.9 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.10 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building’s storm building drains specified in Section 221413 "Facility Storm Drainage Piping."

B. Connect force-main piping to building’s storm drainage force mains specified in Section 221413 "Facility Storm Drainage Piping." Terminate piping where indicated.

C. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

D. Connect to sediment interceptors specified in Section 221323 "Sanitary Waste Interceptors."
E. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
   a. Shielded flexible couplings for same or minor difference OD pipes.
   b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
   c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

3.11 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.

2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.

2. Remove top of manhole or structure down to at least 48 inches below final grade. Fill to within 24 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Section 312000 "Earth Moving."

3.12 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.13 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.

2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.

2. Test completed piping systems according to requirements of authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

4. Submit separate report for each test.

5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.

b. Option: Test plastic piping according to ASTM F 1417.

c. Option: Test concrete piping according to ASTM C 924.

6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig.

a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.

b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.14 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION
SECTION 33 46 00

SUBDRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. California Department of Transportation (Caltrans) Standard Specifications:
   1. Section 66: Corrugated Metal Pipe.
   2. Section 70: Miscellaneous Facilities.

1.2 SUMMARY

A. Section Includes:
   1. Perforated-wall pipe and fittings.
   2. Drainage conduits.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Shop Drawings:
      a. Foundation Wall Drainage System: Indicate dimensions, layout of piping, high and low points of pipe inverts, gradient of slope between corners and intersections, and method of connection to site storm sewer systems.
      b. Trench Drain System: Indicate schematic of drainage system listing parts being provided, assembly, relation to adjacent material, methods of leveling and anchorage, method of connection to building storm piping and exact centerline dimensions suitable for installation.
   2. Product Data: Provide data on pipe drainage products, pipe accessories, slot drain system and drain system accessories. Drainage conduits, including rated capacities.
   3. Drainage panels, including rated capacities.

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS


2.2 DRAINAGE CONDUITS

A. Molded-Sheet Drainage Conduits: Prefabricated geocomposite with cusped, molded-plastic drainage core wrapped in geotextile filter fabric.

1. Nominal Size: 12 inches high by approximately 1 inch thick.
   a. Minimum In-Plane Flow: 30 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.

2. Nominal Size: 18 inches high by approximately 1 inch thick.
   a. Minimum In-Plane Flow: 45 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.


4. Fittings: HDPE with combination NPS 4 and NPS 6 (DN 100 and DN 150) outlet connection.

B. Multipipe Drainage Conduits: Prefabricated geocomposite with interconnected, corrugated, perforated-pipe core molded from HDPE complying with ASTM D 1248 and wrapped in geotextile filter fabric.

1. Nominal Size: 6 inches high by approximately 1-1/4 inches thick.
   a. Minimum In-Plane Flow: 15 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.

2. Nominal Size: 12 inches high by approximately 1-1/4 inches thick.
   a. Minimum In-Plane Flow: 30 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.

3. Nominal Size: 18 inches high by approximately 1-1/4 inches thick.
   a. Minimum In-Plane Flow: 45 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.

5. Fittings: HDPE with combination NPS 4 and NPS 6 (DN 100 and DN 150) outlet connection.

6. Couplings: HDPE.


1. Nominal Size: 12 inches high by approximately 1 inch thick.
   a. Minimum In-Plane Flow: 30 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.

2. Nominal Size: 18 inches high by approximately 1 inch thick.
   a. Minimum In-Plane Flow: 45 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.


4. Fittings: HDPE with combination NPS 4 and NPS 6 (DN 100 and DN 150) outlet connection.

5. Couplings: Corrugated HDPE band.

D. Mesh Fabric Drainage Conduits: Prefabricated geocomposite with plastic-filament drainage core wrapped in geotextile filter fabric. Include fittings for bends and connection to drainage piping.

1. Nominal Size: 6 inches high by approximately 0.9 inch thick.
   a. Minimum In-Plane Flow: 2.4 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.

2. Filter Fabric: Nonwoven geotextile made of PP or polyester fibers or combination of both. Flow rates range from 120 to 200 gpm/sq. ft when tested according to ASTM D 4491.

E. Ring Fabric Drainage Conduits: Drainage conduit with HDPE rings-in-grid pattern drainage core, for field-applied geotextile filter fabric. Include fittings for bends and connection to drainage piping.

1. Nominal Size: 18 inches high by 1 inch thick.
a. Minimum In-Plane Flow: 82 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.

2. Nominal Size: 36 inches high by 1 inch thick.
   a. Minimum In-Plane Flow: 164 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.


2.3 TRENCH DRAIN SYSTEM

A. Manufacturers:
   1. ACO Polymer Products, Inc.: Brickslot and K100S Trench Drain System, or approved equivalent.

   2. Manufacturer Offering Acceptable Equivalent Product: Elkington Gatic or approved equivalent.


B. Components:
   1. Grate System: Galvanized steel grate with 0.47-inch-wide flared drainage slot along 1 side and recessed solid color; configured to fit directly into drainage channel and be secured with manufacturer's standard boltless locking system; ADA compliant; engineered to withstand DIN 19580 Load Class C; 4.84-inch overall width; 3.50 inches high; Brickslot Grate System with QuickLok Locking Bar System or approved equivalent.

   2. Drain Channels: Manufactured from polyester polymer concrete; engineered to withstand DIN 19580 Load Class C; neutral invert; full radius trench bottom; male-to-female interconnecting end profile; horizontal cast in anchors on outside wall; minimum 1/8-inch-thick stainless steel edge rail integrally cast into drain body; preformed 4-inch diameter drill-outs on bottom for connection with piping; supplied with closing caps; KlassikDrain K1000S, or approved equivalent.

   a. Channel Dimensions:

      1) Nominal Clear Opening: 4.00 inches.

      2) Overall Width: 5.10 inches.

      3) Overall Depth: As indicated on Drawings.

      4) Minimum Wall Thickness: 0.50-inch minimum wall thickness.
5) Polymer Concrete Properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Result</th>
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</thead>
<tbody>
<tr>
<td>Compressive Strength</td>
<td>ASTM C579</td>
<td>14,000 psi</td>
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<tr>
<td>Flexural Strength</td>
<td>ASTM C580</td>
<td>4,000 psi</td>
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<tr>
<td>Water Absorption</td>
<td>ASTM C97</td>
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<tr>
<td>Freeze-Thaw</td>
<td>ASTM C666</td>
<td>Maintains 95.1% modulus of elasticity after 300 cycles</td>
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<tr>
<td>Coefficient of Expansion/Contraction</td>
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<td>$11.0 \times 10^{-6}$/degree Farhenheit</td>
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<tr>
<td>Flame Spread</td>
<td>ASTM E84</td>
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<td>Smoke Density</td>
<td>ASTM E84</td>
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</tr>
<tr>
<td>Weathering</td>
<td>ASTM G153</td>
<td>No change after 2,000 hr exposure</td>
</tr>
</tbody>
</table>

3. Accessories:
   a. Access Unit: 2-piece galvanized steel assembly consisting of sleeve attached to drain channel with removable cover having drainage slot along 1 side and recess to receive matching paving; configured to provide access to drainage channel after grate system is covered with paving; 7.00 inches wide x 19.69 inches long x 3.30 inches deep overall; Brickslot Access Unit or approved equivalent.
   b. Access Unit Removal Tool: QuickLok/PowerLok Grate Removal Tool or approved equivalent.

2.4 SOIL MATERIALS

A. Soil materials are specified in Section 312000 "Earth Moving."

2.5 WATERPROOFING FELTS

A. Material: Comply with ASTM D 226, Type I, asphalt or ASTM D 227, coal-tar-saturated organic felt.

2.6 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.

B. Structure Type: Nonwoven, needle-punched continuous filament.

   1. Survivability: AASHTO M 288 Class 2
2. Styles: Flat and sock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.

B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and

C. Verify that drainage panels installed as part of foundation wall waterproofing is properly positioned to drain into subdrainage system.

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

3.2 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.3 FOUNDATION DRAINAGE INSTALLATION

A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches deep and 12 inches wide.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.

E. Install drainage piping as indicated in Section 330500 “Common Work Results for Utilities” for foundation subdrainage.

F. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.

G. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.

H. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
I. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

J. Install drainage panels on foundation walls as follows:
   1. Coordinate placement with other drainage materials.
   2. Lay perforated drainage pipe at base of footing. Install as indicated in Section 330500 “Common Work Results for Utilities.”
   4. Attach panels to wall beginning at subdrainage pipe. Place and secure molded-sheet drainage panels, with geotextile facing away from wall.

K. Place backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.4 LANDSCAPING DRAINAGE INSTALLATION

A. Provide trench width to allow installation of drainage conduit. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

D. Install drainage conduits as indicated in Section 330500 “Common Work Results for Utilities” for landscaping subdrainage with horizontal distance of at least 6 inches between conduit and trench walls. Wrap drainage conduits without integral geotextile filter fabric with flat-style geotextile filter fabric before installation. Connect fabric sections with adhesive or tape.

E. Add drainage course to top of drainage conduits.

F. After satisfactory testing, cover drainage conduit to within 12 inches of finish grade.

G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

I. Fill to Grade: Place satisfactory soil fill material over drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.
3.5 TRENCH DRAIN SYSTEM INSTALLATION

A. Install slot drain system in accordance with final reviewed shop drawings and manufacturer's instructions and recommendations.

1. Lay drain channels starting from outlet point interlocking ends; cap ends of runs. Level and support with sheet metal shims.

2. Connect drainage channels to rain water leader piping.

3. Place slot grates and access units in drain channels; adjust to final position and engage locking bolts.

4. Coordinate installation of adjacent deck insulation, compressible filler and top ping slabs.

5. Remove protective wrapping from slot drains.

6. Remove access units and remove debris from drain channel. Flush channels to check for blockages; unblock if necessary and reinstall access units.

7. Deliver access unit removal toli to Owner; obtain receipt.

3.6 PIPING INSTALLATION

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer’s written instructions and other requirements indicated.

1. Foundation Subdrainage: Install piping level and with a minimum cover of 30 inches unless otherwise indicated.

2. Underslab Subdrainage: Install piping level.

3. Plaza Deck Subdrainage: Install piping level.

4. Retaining-Wall Subdrainage: When water discharges at end of wall into stormwater piping system, install piping level and with a minimum cover of 30 inches unless otherwise indicated.

5. Landscaping Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 30 inches unless otherwise indicated.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

C. Install thermoplastic piping according to ASTM D 2321.

3.7 PIPE JOINT CONSTRUCTION

A. Join perforated PE pipe and fittings with couplings according to ASTM D 3212 with loose banded, coupled, or push-on joints.

B. Join perforated PVC sewer pipe and fittings according to ASTM D 3212 with loose bell-and-spigot, push-on joints.

C. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.8 BACKWATER VALVE INSTALLATION

A. Comply with requirements for backwater valves specified in Section 334100 "Storm Utility Drainage Piping."

B. Install horizontal backwater valves in header piping downstream from perforated subdrainage piping.

3.9 CLEANOUT INSTALLATION

A. Comply with requirements for cleanouts specified in Section 334100 "Storm Utility Drainage Piping."

B. Cleanouts for Landscaping Subdrainage:

1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.

2. In vehicular-traffic areas, use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches deep. Set top of cleanout flush with grade.

3. In non-vehicular-traffic areas, use NPS 4 (DN 100) PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches deep. Set top of cleanout 1 inch above grade.
4. Comply with requirements for concrete specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."

C. Cleanouts for Underslab Subdrainage:

1. Install cleanouts and riser extensions from piping to top of slab. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.

2. Use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout flush with top of slab.

3.10 CONNECTIONS

A. Comply with requirements for piping specified in Section 334100 "Storm Utility Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect low elevations of subdrainage system to solid-wall-piping storm drainage system.

3.11 IDENTIFICATION

A. Arrange for installation of green warning tapes directly over piping. Comply with requirements for underground warning tapes specified in specified in Section 312000 "Earth Moving."

1. Install PE warning tape or detectable warning tape over ferrous piping.

2. Install detectable warning tape over nonferrous piping and over edges of underground structures.

3.12 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.

2. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

B. Drain piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.
3.13 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION